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WHAT YOU CAN'T MEASURE - YOU CAN'T IMPROVE

The role of maturity models to improve data governance

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WHAT YOU CAN'T MEASURE - YOU CAN'T IMPROVE

- *The role of maturity models to improve data governance*

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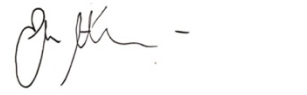

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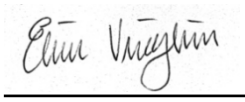

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Abstract

Background and purpose: As a consequence of the growing power of data, there is a need for companies to maximise the value derived from it. However, to maximise the value derived from data, it needs to be available, secure, relevant, and of high quality, which can be assured by data governance. In addition, data governance has become crucial for companies to meet legal requirements and to be competitive. The increasing need for data governance puts pressure on organisations to control how they work with data and thus a need to improve. To understand how an organisation works today and what can be improved, a maturity model can be used. However, available data governance maturity models do not only miss out on aspects within data governance but also on how to use the model. Thus, the purpose of this study is to explore how a maturity model can support organisations in improving data governance. The model is practically contributing as a tool for companies to assess their current level of maturity and to identify potential improvements.

Methodology: A qualitative research strategy has been used throughout this study. After investigating existing literature, workshops with data governance experts were conducted. Based on the findings from literature and workshops, aspects important when creating the model could be identified and the TMT Data Governance Maturity model was created. To test the validity of the model and to determine what to take into consideration when using the model, it was applied to a case company where semi-structured interviews with employees were conducted. The findings from the interviews were analysed by comparing the answers to the levels in the model, using a thematic approach. The levels of maturity were then determined based on the average of all respondents' answers. By comparing the assigned levels with the higher levels, actions for how to improve were identified and relevant improvement areas could thereafter be defined.

Main Findings: Based on the theoretical framework and workshops 13 elements were identified as crucial for data governance maturity models: *Strategy & Approach, Leadership, Structure, Progress Measure, Knowledge & Change Management, Rules, Data Quality, Data Security & Privacy, Data Lifecycle Management, Metadata Management, Master Data Management, Business Intelligence,* and *Adherence*. The research also showed that an important aspect of maturity models is interview questions reflecting the elements and some sort of measurement, which resulted in five levels being defined: *Unaware, Ad Hoc, Proactive, Managed,* and *Optimised*. When testing the model, one finding was that the model always needs to be adapted to each specific organisation before use to be of value, since all companies are unique. If adapting the model to be in line with the characteristics of the organisation, the current maturity level could be determined and thereby also what is needed to reach the higher levels by identification of the gap. However, the result from using the maturity model only works as guidance for what could be improved since the reality usually is more complex than assigning an organisation a level on a scale.

Key Words: *data governance, maturity model, maturity assessment, maturity levels, improvement areas*

List of Definitions

Data Governance is the use of rules, shared decision making (planning, monitoring, implementation), and accountabilities of people and information systems as they execute data-related processes.

Data Governance Program refers to an organisation's ongoing process of and work with data governance.

Dimensions refer to the three categories of elements included in the created model. The first dimension is *People*, the second dimension is *Policies,* and the final dimension is *Capabilities*. Each dimension includes different elements.

Elements refer to the 13 aspects of data governance included in the created model. These are sub-dimensions to the three main dimensions.

Level refers to the five different stages of maturity included in the created model. These are *Unaware*, *Ad Hoc*, *Proactive*, *Managed,* and *Optimised*.

Data Quality is the extent to which data satisfies the requirements of its intended purpose.

Lifecycle Management is the extent to which the data lifecycle is defined. Hence, how the data should be created, used, retained, and archived.

Leaders refer to management working in a leading position. Meaning that both top management and middle management is included in the concept, depending on the context.

Master Data Management (MDM) consists of the core business objects that are being used in the different applications across an organisation, along with their associated metadata, definitions, and roles.

Metadata can be defined as "data about data" or "data that describes other data". Hence, metadata is all information that can help users to understand what data is recorded, where the data is recorded, and who owns it.

TMT Data Governance Maturity Model is the model that has been created in this study. The model includes three dimensions, 13 elements including questions, and five levels.

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1. Introduction

This chapter initiates with a background and problem discussion of the topic to be investigated. Thereafter, the purpose and research question followed by the delimitations of the study are presented. The chapter ends with a visualisation of the disposition of the study to provide the reader with an overview of the chapters.

1.1 Background

"*Data is the new oil*", was initially expressed by Clive Humby in 2006 and has since been widely quoted (Bridle, 2018). Whether or not oil is the best parable to describe the role of data, it certainly sheds light on the importance of it as a corporate asset. The convergence of information technology has resulted in an explosion in the volume of data being created, which opens for new business possibilities (Yao Li & Xiaoying Liu, 2017). Hence, the increasing power of data has made executives in every industry realise the value of it (Petzold, Roggendorf, Rowshankish & Sporleder, 2020). According to Sobers, Petras, and Westbrook (2020), data should be considered a key differentiator in maintaining and creating a competitive advantage since it influences both strategic and operational decisions. Therefore, data is a crucial asset for companies and will be even more crucial in the future (Permana & Suroso, 2018; Alhassan, Damon & Daly, 2016).

To treat data as a crucial asset, organisations need to have several functions in place, such as planning, monitoring, and controlling the data (Permana & Suroso, 2018). However, to maximise the value derived from data, it needs to be available, secure, relevant and of high quality (Petzold et al., 2020). These conditions can be assured by data governance which ensures that the data is useful (Permana & Suroso, 2018; Arbanas, Dejong, Aga & Sutter, 2019). Data governance could be explained as the creation and definition of the standards, procedures, and processes for how to manage data and who is owning it (Newby, 2020; Everett, 2019). In this study, data governance will be defined as *"the exercise of authority and control (planning, monitoring, and enforcement) over the management of data assets"* (Mosley, 2010, p.28). However, data governance is not a project with a defined start and end, it is an ongoing process (Ladley, 2012). Therefore, companies that have implemented data governance are described to have an ongoing data governance program (ibid).

Data governance is crucial for companies, not only to be competitive but also from a legal perspective. The impact of regulatory requirements regarding privacy concerns of data, such as the General Data Protection Regulation (GDPR), puts pressure on companies to have knowledge about the usage and storage of data (Petzold et al., 2020). Additionally, Arbanas et al. (2019) explain that, by understanding where data is located and how it is being used, organisations could identify potential threats and changes in the environment at an early stage. Data governance is therefore empowering business decisions by enabling more explicit predictions of future customer needs and by identifying new opportunities (Abraham,

Schneider & Vom Brocke, 2019; Baltassis, Gourévitch, & Quarta, 2019). Thus, to stay competitive, or alive, companies need to understand how to govern and find value in large amounts of data to take advantage of the opportunities it brings (Permana & Suroso, 2018).

1.1.1 Case Company

One sector that possesses massive amounts of data is the Technology, Media, and Telecommunications (TMT) sector (Arbanas et al., 2019). The success of TMT companies is to a large extent dependent on their ability to use data in decision-making (ibid). However, to continue making data-based decisions, TMT companies are seeing the need to work with data governance (ibid). As data becomes more crucial and available, new risks and changes in the regulatory landscape appear. To manage these changes, TMT companies must develop a strong and strategic data governance program.

The case company in this study is operating in the TMT sector and offers a product within technology. Since the case company wishes to be fully anonymous in this report due to strategic reasons, it will henceforth be referred to as "Tech-X". Today, Tech-X has approximately 500 employees with its headquarters in Sweden. They have an existing data governance program that was implemented during autumn 2020. As a company, they strive for data-drivenness to stay competitive in the future. Tech-X wants to get an understanding of their current strengths and weaknesses of their data governance program to identify how to improve it further.

1.2 Problem Discussion

A successful data governance program requires all dimensions of an organisation to be aligned, such as the people, processes, and technologies (Arbanas et al., 2019). However, achieving a successful data governance program seems to be a complex process, since the majority of the data governance programs in organisations today are considered ineffective or underdeveloped (Petzold et al., 2020; Baltassis, Gourévitch, and Quarta, 2019). Ghosh, Deshpanade, and Lundia (2019) further explain that poor data governance typically results in organisations being unable to derive value from data. Making it important to implement a well-functioning data governance program from the start or to improve the existing one (ibid). This has resulted in an increasing interest in improving data governance among companies (Newby, 2020), with the TMT sector and Tech-X as no exception (Arbanas et al., 2019).

To improve data governance, companies need an understanding of where they are now and where they visionise to be in the future. One widely used method for assessing the current status is by applying a maturity model (Kurniawan et al., 2019; Arbanas et al., 2019; Newby, 2020). Some maturity models related to data governance exist, for instance, IBM Data Governance Maturity Model and Stanford University's Data Governance Maturity Model (Kurniawan et al., 2019; Olaitan, Herselman & Wayi, 2019). However, when the researchers investigated available models it was discovered that these do not cover all aspects of data governance. "Aspects" refer to general features of data governance maturity models in this study, for instance dimensions, elements, levels and interview questions. The aspects not

covered in available models are aspects that are mentioned repetitively in the literature as well as considered a crucial part of a data governance program according to Tech-X. Examples of elements that could not be identified in available maturity models were strategy, leadership, knowledge, change management, and business intelligence. In addition, available data governance maturity models do not cover *how* to assess and determine an organisation's current level of maturity. Meaning, in available models, no clear instructions on how to use the model, for instance regarding how to determine the levels, are available which makes them difficult to apply. Hence, there is a gap in existing research in terms of maturity models including all aspects of data governance and that explain how the assessment should be made to gain insights on what to improve.

1.3 Purpose and Research Question

The purpose of this study is to explore how a maturity model can help organisations to improve their data governance. Available data governance maturity models, for instance, IBM Data Governance Maturity Model and Stanford University's Data Governance Maturity Model (Kurniawan et al., 2019; Olaitan, Herselman & Wayi, 2019), do not include all aspects of data governance, as discussed earlier. Therefore, a data governance maturity model has been created in this study. Hence, the practical contribution of this study aims at providing a maturity model that includes the important aspects of data governance, such as elements, stages of maturity and interview questions. The model is created to be applied to companies in the TMT sector, but it can be adapted and applied by companies in other industries. In addition, how to assess and determine an organisation's current level of data governance maturity, which is necessary to understand what to improve, is not available in the existing literature. Therefore, the created model has been tested to gain an understanding of how to assess the current level and how it can be used to improve data governance. Hence, the theoretical contribution aims at providing insights on how a maturity model can support organisations in improving their data governance. In accordance with the background and problem discussion, the following research question has been formulated:

How can a maturity model support organisations in improving data governance?

To answer the research question, key aspects within data governance will be investigated and integrated in the model. The feasibility of the model will be tested on Tech-X to evaluate how it can help an organisation improve its data governance. Thereby, this study will also contribute to providing recommendations for what Tech-X can improve to reach a higher level of data governance maturity.

1.4 Delimitations

Since the concept of data governance is broad, five delimitations have been stated. Firstly, since the model has been created and tested with a company in the TMT sector, this study has to some extent been based upon what aspects of data governance are important for organisations in the TMT sector. Hence, this study has not investigated what aspects organisations in other industries want to include in the model. Secondly, since the study is focused on what Tech-X can improve as a company, there will be no focus on external stakeholders' attitudes and views of data governance. Meaning that this report does not investigate how to include external stakeholders work with data governance when creating the model or how this can affect the use of it.

Furthermore, this study only aims to investigate how a maturity model supports organisations in improving data governance by gaining an understanding of their current status of data governance. Therefore, a third delimitation is that it will not explore how the maturity model can be used by an organisation to improve its data governance over time. Meaning that, it has not explored how the result retrieved from the assessment can be implemented in the organisation and whether this will result in a higher level of data governance or not. The fourth delimitation is that the model does not incorporate new emerging data concepts, such as cloud computing and big data, which can impact data governance. A fifth and final delimitation is that this study has used interviews with employees to determine Tech-X's level of data governance maturity, hence this study has not investigated whether the model could be used for self-assessment or not.

1.5 Disposition of the Report

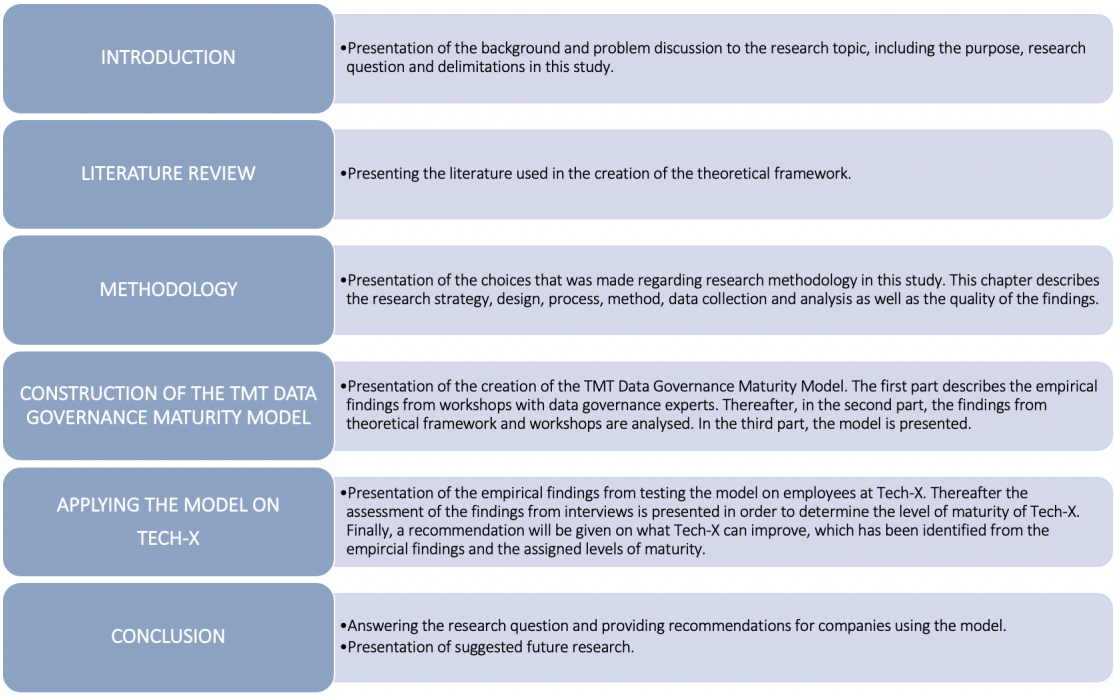

Figure 1: Disposition of the report.

2. Literature Review

This chapter introduces the literature on concepts and aspects within data governance that are used in this study. Firstly, an introduction to data governance is presented, followed by literature regarding data governance maturity models. Thereafter, the key aspects within data governance are presented. Finally, key success factors and challenges with data governance are discussed and a theoretical framework is created based upon the literature review.

2.1 Data Governance

To derive the highest value from data, the data needs to be of high quality, accurate, and available (Ladley, 2012), which data governance aims to secure. Data governance can be defined as *"the exercise of authority and control (planning, monitoring, and enforcement) over the management of data assets"* (Mosley, 2010, p. 28). Data governance includes several different activities, such as the definition and creation of standards, rules, and processes for how to manage data, as well as who holds the decision rights and accountability of the data (Mosley, 2010; Alhassan, Sammon & Daly, 2017; Balakrishnan, Das, Chattopadhyay, 2020). Likewise, Bhansali (2014) describes that data governance ensures that there is a common standard in an organisation regarding how data is created, defined, owned, and enforced. According to Loshin (2009), data governance should ensure that the data in the organisation meets the expectations of the business purposes concerning compliance, security, and privacy.

Both Ladley (2012) and Bhansali (2014) states that data governance is not a project with a defined start and end, it is an ongoing process of monitoring, evaluating, and assessing the data and its users. Therefore, it should be managed as an ongoing program and a continuous improvement process (Mosley, 2010; Bhansali, 2014). To manage data efficiently, it is required to work across organizational and system boundaries. Data governance makes it possible to cross these boundaries by enabling shared decision-making and supporting an integrated view of data (Bhansali, 2014). Hence, as explained by Balakrishnan, Das, and Chattopadhyay (2020), data governance could be seen as a mechanism that converts data, from being considered a liability, into a reliable strategic asset.

2.2 Maturity Models

Olaitan, Herselman and Wayi (2019) describe that a maturity model is a structured collection of elements that describes the criteria of different stages of a program within an organisation. Likewise, Kurniawan et al. (2019) explain that a data governance maturity model is a tool used to build, improve and evaluate a data governance program. Correspondingly, a maturity model gives an understanding of the current level of a program, while also describing what is needed to get from the current to the desired maturity level (Kurniawan et al., 2019; Olaitan, Herselman & Wayi, 2019). The current status of data governance maturity describes to what extent an organisation has developed and established the processes and standards necessary for the optimisation of the collection, storing, usage, and distribution of data (Marchildon et al., 2018).

Organisations can be on different levels of maturity, while some are in the implementation phase, others already have a well-functioning program that is being improved continuously (Kurniawan et al., 2019). Meaning that a maturity model can be used during the whole development progress of a data governance program (ibid). However, for an organisation to achieve an effective data governance program, identification of an organisation's current situation is not enough (Bhansali, 2014). An understanding must also be given on an organisation's long-term vision of data governance, to grasp what an organisation should focus its improvement efforts on to reach a higher level of data governance maturity (ibid).

2.2.1 Levels

One aspect of data governance maturity models, mentioned by Saputra, Handika, and Ruldeviyani (2018) and Kurniawan et al. (2019), is the benefit of using five levels. This is also stated by Olaitan, Herselman, and Wayi (2019), who explains that a common maturity model to take inspiration from when creating levels is the Capability Maturity Model (CMM), which measures an organisation's maturity with regards to capabilities in five levels. In the CMM the first level is "*Initial*", this level indicates that processes are unpredictable and not in control of the organisation (Saputra, Handika, and Ruldeviyani, 2018). The second level is "*Managed*", which means that the organisation is managing and has defined processes for some projects. The third level is "*Defined*", meaning that an organisation has characterised processes for the whole organisation and that the organisation is acting proactively towards changes. The fourth level is "*Quantitatively Managed*", which indicates that the processes are quantitatively measured and controlled throughout the organisation. Finally, the fifth level is called "*Optimising*", organisations at this level typically focus on continuous improvement of the processes (Saputra, Handika, and Ruldeviyani, 2018).

Ladley (2012) presents the levels of the Information Management Maturity (IMM) model which are relatively similar to the CMM with its five levels but connected to data and information. The first level in the IMM model is called "*Initial*" which means that the individuals in the organisation have the authority over data and that no rules exist. "*Repeatable*" is the second level, which describes that there is some focus on data at a team level. The third level, "*Defined*" means that the organisation has started to consider an enterprise-wide focus on data while level four "*Managed*", means that the organisation has implemented an enterprise focus on data and the most processes are in place (Ladley, 2012). Finally, the last level "*Optimised*" indicates that the organisation manages data and information effectively while being aligned with the overall business (ibid).

2.2.2 Dimensions & Elements

DeStefano, Tao, and Gai (2016) highlight that the aspects of data governance can also be divided into different focus areas. Similarly, Kurniawan et al. (2019) describe that a data governance maturity model can be divided into different dimensions to which the elements important for data governance can be assigned to. For instance, the Stanford Data Governance Maturity Model is divided into three main dimensions (Saputra, & and Ruldeviyani, 2018;

Kurniawan et al., 2019). The first dimension is called "*People*", which includes elements related to roles and organisational structures. The second dimension is called "*Policies*", which concerns elements regarding rules. The third dimension is called "*Capabilities*", which includes elements such as technologies and techniques related to data governance (Saputra, & and Ruldeviyani, 2018; Kurniawan et al., 2019).

Based upon the literature review made in this study, 13 elements within data governance have been identified as key elements of the data governance framework. These 13 elements were chosen to take into consideration as they are frequently mentioned by scholars in literature and seen as important for Tech-X's organisation and industry according to experts. These elements have been divided into three dimensions; *People*, *Policies,* and *Capabilities* in accordance with Saputra, Handika, and Ruldeviyani (2018) as well as Kurniawan et al. (2019). Table 1 shows the three dimensions and their belonging elements.

ELEMENTS	AUTHORS
PEOPLE	
Strategy	Ladley (2019), Korhonen et al. (2013), Balakrishnan, et al. (2020), Cheong & Chang (2007).
Leadership	Bhansali (2014), Ladley (2012), Foley & Gulliemette (2010).
Ownership Structure • Hierarchical Roles & Responsibilities	Ladley (2012), Bhansali (2014), Barker (2016), Newman & Logan (2009), Mosley (2010), Soares, (2014), Cheon & Chang (2007).
Awareness & Communication	Ladley (2012), Mosley (2010), Bhansali (2014), Sarsfield (2009), Kurniawan et al (2019), Cheong & Chang, 2007.
Performance Management	Ladley (2012), Bhansali (2014), Cheong & Chang, (2007).
Knowledge & Change Management	Ladley (2012), Bhansali (2014).
POLICIES	
Rules • Compliance & Regulations	Ladley (2012), Bhansali (2014), Soares (2014) Abraham et al. (2019), Cheon & Chang (2007).
Data Quality	Ghosh (2019), Bhansali (2014), Ladley (2012), Mosley (2010), Weber et al. (2009) Salido (2010), Otto (2011), Keith (2013), Soares (2014), Cheon & Chang (2007).
Data Security & Privacy	Henning (2018). Soares (2014). Keith (2013), Bhansali (2014), Balakrishnan et al. (2020).
Data Lifecycle Management	Khatri & Brown (2010), Bhansali (2014), Ladley (2012), Alhassan et al. (2016), Khatri & Bown (2010).
CAPABILITIES	
Metadata Management	Keith (2013), Khatri & Brown (2010). Bhansali (2014), Kurniawan et al. (2019), Soares (2014).
Master Data Management	Barker (2016), Keith (2013), Soares (2014), Loshin (2009), Riikka & Pekkola (2017), Ladley (2012).
Business Intelligence	Keith (2013), Ladley (2012), Mosley (2010), Foley & Guillemette (2010).

Table 1. The elements within data governance mentioned most frequently in the literature.

2.3 People

The *People* dimension includes the elements, *Strategy*, *Leadership*, *Roles & Responsibilities*, *Awareness & Communication*, *Performance Management* as well as *Knowledge & Change Management*.

2.3.1 Strategy

The strategic part of data governance is used as a direction to achieve the desired future state. The data governance strategy determines what activities are needed to ensure that the data governance program will be of value and meet the business needs (Ladley, 2019; Cheon & Chang, 2007). Thus, the strategy creates the foundation of a data governance program and influences all other aspects of data governance, hence it is a crucial part of a data governance program (ibid). The strategy supports the suggested value proposition and should work as an alignment between the data governance program and the strategic requirements (Ladley, 2012). Meaning, all efforts made within data governance should support the organisational goals and objectives (Ladley, 2012; Korhonen et al., 2013; Marchildon et al., 2018).

For the acceptance of data governance in an organisation, it is important to involve employees in strategy-making (Ladley, 2012). Cross-functional involvement is also mentioned as another crucial success factor by Cheon & Chang (2007) and Bhansali (2014). It is described that all teams and levels of an organisation need to be involved and participate in the data governance work for it to be of value (Cheon & Chang, 2007; Mosley, 2010; Bhansali, 2014). Ladley (2012) argues that involving the employees in the strategy-making will make them more positive towards the data governance program while also ensuring alignment to business needs. Without alignment to business needs, employees could find it difficult to recognize the value of working with data governance. Thus, involving employees in the process can diminish the risk of resistance (ibid).

2.3.2 Leadership

A successful data governance program requires the management unit to be engaged, committed, and involved (Bhansali, 2014; Ladley, 2012). Bhansali (2014) mentions four tasks considered important for the management unit. Firstly, they need to assign someone responsible for the data governance program. Secondly, they should ensure that the organisation has a data governance strategy, which balances the perspective between stakeholders, users, and IT. Thirdly, they should make sure that the roles and responsibilities of internal stakeholders have been developed and modified. Finally, they should ensure that IT activities conform to rules, procedures, and regulations (ibid). In addition, using data as a part of the decision-making process can help an organisation to make better decisions (Foley & Gulliemette, 2010). Hence, the management should lead by example, and thus follow the data rules and work towards reaching the goals (Ladley, 2012). Meaning, management should strive for incorporating data in the decision-making processes for the rest of the organisation to follow (ibid).

2.3.3 Ownership Structure

Bhansali (2014), argues that one of the cornerstones for making a data governance program successful is having a clear ownership structure. Ladley (2012) explains that the designation of accountability and responsibilities are crucial for data governance to be of value. Similarly, Cheon and Chang (2007) state that clearly defined roles and responsibilities are a critical success factor of an organisation's data governance program. Therefore, data governance includes the establishment of who has the decision rights and who is accountable for the data assets (Bhansali, 2014). However, organisations should remember that data governance is not one single IT project, rather it is a joint ownership and responsibility between the business function and the IT department. If only the IT department would be the owner of the effort, the business function could experience that the data governance program does not contribute to their work (ibid).

2.3.3.2 Hierarchical Roles & Responsibilities

Ladley (2012) explains that organisations also need to have hierarchical roles and responsibilities within their data governance program to enable issue resolution, monitoring as well as direction setting.

On the lower part of the hierarchical structure, there are data stewardship teams who operate in each functional area, these provide guidance to individual data stewards (Bhansali, 2014). Newman and Logan (2009) explain that data stewards take part in data governance by implementing activities such as daily operational procedures. Data stewards are responsible for data quality, correcting errors, and creating rules that are enforced automatically (Bhansali, 2014). Hence, data stewardship ensures that there is an effective control and use of the data assets (ibid).

On the upper part of the hierarchical structure, the data governance council can be found. According to Mosley (2010) and Bhansali (2014), the data governance council is the highest and primary authority for data governance, which consists of a cross-functional group of representatives from all business units that makes policy decisions. The data governance council also ensures that there is a strategic alignment between business and IT initiatives (Cheon & Chang, 2007). Further, Barker (2016) explains that the data governance council needs to coordinate and direct the data governance activities across the organisation, assign roles, authority, and accountability of the data governance efforts as well as to ensure that the data governance strategy supports the organisation's objectives. In addition, Ladley (2012) and Cheon & Chang (2007) states that the data governance council is responsible for the monitoring, communication, information sharing, and cross-functional issue resolution of data governance.

2.3.4 Awareness & Communication

Data governance is an effort that requires the whole organisation's attention and engagement (Ladley, 2012). Kurniawan et al. (2019) and Bhansali (2014) describe that awareness of data

rules, roles and technologies is a cornerstone for a well-functioning data governance program. All employees need to be aware of and understand the strategy, data rules, standards, and regulations, according to Mosley (2010). Mosley (2010) also highlights the importance of understanding the organisation's commitment to data protection, data quality, and data security. Bhansali (2014) and Sarsfield (2009) describe that the key component to strong data governance is coordination, communication, and involvement of all employees. Cheon and Chang (2007) also highlighted that communication, and training is the key to a successful data governance program. Similarly, Mosley (2010) argues that one of the most important activities to derive value from data governance is to continually communicate to and educate employees at all levels. Mosley (2010) describes several approaches that can be used to communicate data governance activities. For instance, by maintaining an intranet website for a data governance program, publishing newsletters via email or by making short information and promotion announcements at department meetings (ibid).

2.3.5 Performance Management

To make people engaged in the data governance program it is vital to develop realistic metrics to measure the effectiveness of it (Bhansali, 2014). Similarly, Ladley (2012, p. 30) states that "*You cannot manage what you do not measure*" to emphasise the importance of using metrics as a means to monitor the progress of the data governance program. Likewise, Cheon and Chang (2007) described that it is favourable to have metrics to measure the progress. Metrics help to create a feeling of responsibility (Bhansali, 2014). Examples of metrics are data quality, data governance stewardship progress or effectiveness as well as business value (Ladley, 2012).

2.3.6 Knowledge & Change Management

Change management is the process and structure to ensure that change is implemented smoothly (Bhansali, 2014). An implementation of a data governance program often creates a need for change since employees need to treat and manage data in new ways (Ladley, 2012). Thus, when implementing a data governance program, it is common that resistance will arise. Therefore, it is important to educate the employees in data governance to make them realise the value of it (ibid).

Furthermore, when changes happen in the organisation it can affect the data governance program in different ways (Bhansali, 2014). For instance, employees changing roles or leaving the organisation can result in changes due to knowledge loss. Therefore, ensuring that existing employees document their work to make the transition easier is of high importance. It is important to be prepared for the unexpected to ensure that the data governance program will not be harmed by changes in the organisation (ibid).

2.4 Policies

The *Policies* dimension includes the elements *Rules*, *Data Quality*, *Data Security & Privacy* as well as *Data Lifecycle Management.*

2.4.1 Rules

Definition of rules is a crucial aspect of data governance according to Ladley (2012) and Cheon and Chang (2007). This is because rules create the foundation for how data governance should be enforced and executed, while also ensuring compliance to regulations and alignment to the organisation (Ladley, 2012; Bhansali, 2014). Rules are declarations of how people should behave in a certain situation (Soares, 2014). The rules should be adapted to the objective of the organisation and the needs of the different teams or departments (Bhansali, 2014). Abraham, Schneider, and Vom Brocke (2019) describe that organisations use data rules to communicate roles, responsibilities as well as key objectives. An effective data governance program requires rules to be cross-functional and not decided by individual business units (Bhansali, 2014).

Data governance usually covers rules regarding quality, security, lifecycle as well as legal and corporate compliance (Bhansali, 2014). Bhansali (2014) explains that effective standards help to accomplish adherence to, for instance, privacy standards, information security, and regulatory compliance. Likewise, Cheon and Chang (2007) state that compliance monitoring to ensure that rules are followed is a critical success factor for a data governance program. To ensure that the rules are available throughout the organisation, and to minimise the risk for misinterpretations, it is important to have a common repository that compiles key terms, common rules and definitions regarding data (Soares, 2014).

2.4.1.2 Compliance and Regulations

The increased usage of data results in that external regulations are being created to ensure people's privacy, therefore, one of the drivers for the need of data governance is external regulations (Bhansali, 2014). Meaning that enforcement of regulatory compliance requires a well-developed data governance structure and technical solutions. Thereby, well-developed standards, procedures and rules are also required to ensure that an organisation has the ability to conform to new regulations and compliance requirements (Bhansali, 2014). Data governance helps an organisation to comply with regulations and compliance requirements by the definition and enforcement of standards and procedures (ibid).

2.4.2 Data Quality

Data quality is the extent to which data satisfies the requirements of its intended purpose (Mosley, 2010). Data should be accurate, complete, timely, consistent as well as relevant to be of high quality (Mosley, 2010; Bhansali, 2014). According to Salido (2010), employees should collectively be responsible for data quality, for instance by defining standards and rules for management, use, and protection of data (Salido, 2010).

Ghosh (2019) highlights that data quality and data governance often are used interchangeably in practice and theory. However, data governance should be seen as a structure for managing data quality. This is because data governance helps to improve and maintain the quality of data in several ways (Bhansali, 2014; Ladley, 2012). Firstly, data governance ensures that the standards and rules for data quality are defined and integrated into day-to-day operations (Bhansali, 2014). Secondly, data governance ensures ongoing evaluation and monitoring of data quality. Meaning, that data governance programs implement metrics to execute quality checks, resulting in potential problems with poor quality that can be identified at an early stage and that the potential harm can be reduced (Ladley, 2012; Bhansali, 2014).

According to Cheon and Chang (2007), another success factor is quality controls, which need to be in place to determine where and when data should be evaluated and addressed to ensure that the quality of the data is high. Finally, data governance helps to identify, manage and resolve data issues (Mosley, 2010) and ensures that tools exist so the users can document, assign, track and report on data issues (Soares, 2014).

2.4.3 Data Security & Privacy

The stored data must be protected to secure the privacy of information regarding customers, employees, and financials (Henning, 2018; Soares, 2014). Data security is the protection of databases from unauthorized users (Keith, 2013), hence ensuring that only eligible people have access to the data. Therefore, organisations should have a security policy in place since it defines the access restrictions in the organisation (Keith, 2013). Likewise, Bhansali (2014) explains that security and privacy standards require well-functioning policies. The policies should specify rules, routines, and which people are eligible for each category of data. (Keith, 2013; Soares, 2014).

Furthermore, data security also ensures that potential audit trails are in place so that in the case of a breach in security it is possible to track who did what (Keith, 2013). To prevent unauthorized users from getting hold of the data, an organisation could use firewall controls, access controls as well as detection and mitigation controls (Bhansali, 2014). To support and recover from data failures organisations could implement data replication, i.e., backups (Balakrishnan, Das, Chattopadhyay, 2020). The objective of replication systems is to keep data loss at a minimum level to achieve high data quality.

2.4.4 Data Lifecycle Management

Khatri and Brown (2010) describe that one central aspect in data governance is to understand that data moves through different stages. Bhansali (2014) and Ladley (2012) explain that data governance creates rules for how to manage data during its whole lifecycle. Hence, how the data should be created, used, retained, and archived (Ladley, 2012; Alhassan, Sammon & Daly, 2016). Examples of data lifecycle rules could, for instance, be how long the data should be accessible and when the data should be archived (Bhansali, 2014). Khatri and Brown (2010)

further describe that by setting rules of the usage of data and deciding upon the lifetime of it, organisations can gain knowledge on the optimal storage size and thereby minimise costs.

2.5 Capabilities

The *Capabilities* dimension includes the elements, *Metadata Management*, *Master Data Management* as well as *Business Intelligence*.

2.5.1 Metadata Management

According to Keith (2013), metadata can be defined as *"data about data"* or *"data that describes other data"* (p.87). Hence, metadata is all information that can help users to understand what data is recorded, where the data is recorded and who owns it (Keith, 2013). Additionally, Soares (2014) exemplifies that metadata can describe characteristics of a data object, such as its name, location, quality, value to the enterprise, or relationship to other data objects in the organisation. Bhsansali (2014) states that it is important that the metadata is both easily accessible and available to the eligible users as well as searchable.

Bhsansali (2014) further describes that metadata can be divided into four categories. The first category is business metadata, which describes the business meaning of data, including business definitions of metrics, hierarchies, and business rules. The second category is technical metadata, which describes data structures and formats. The third category is process metadata, which describes the data input process such as integration and validation rules. Finally, the last category is operational metadata which is information about who has accessed what data and when (ibid).

2.5.2 Master Data Management

An efficient data governance program requires the organisation to work with master data management (MDM) and have control of master data (Barker, 2016). MDM aims to guarantee that an organisation only uses one version of its "master data" for all of its operations (Keith, 2013; Soares, 2014). According to Loshin (2009), master data consist of the core business objects that are being used in the different applications across an organisation, along with their associated metadata, definitions, and roles. Hence, master data consists of the key things that are logged, measured, and analysed in an organisation's system. This can for instance be customers, employees, suppliers, products, and locations (Loshin, 2009; Soares, 2014). Additionally, MDM minimises the risk that different versions of one data will be used and thus that silos between departments can be avoided (Riikka & Pekkola, 2017)

2.5.3 Business Intelligence

Business Intelligence (BI) refers to the set of techniques that transforms raw data into information that can be used in the decision-making process (Keith, 2013; Ladley, 2012). Mosley (2010) describes that BI is a query, analysing, and reporting activity that helps an

organisation to monitor its financial and operational health. This by enabling decision-makers to take historical, current as well as predictive views of the business (Keith, 2013). According to Foley and Guillemette (2010), BI helps managers to make better decisions which can result in improved processes and help create a competitive advantage.

Many of the BI-related efforts never reach their full potential, as the insights obtained from such efforts are not coordinated with business activities (Ladley, 2012). However, data governance ensures that BI activities are aligned with business activities (ibid). In addition, data governance helps to ensure that the data quality is both defined as well as supportive of BI. Thus, making sure that the data in the organisation actually can be used in BI activities and that the data is trustworthy. Hence, data governance enhances the value of BI (ibid).

2.6 Pros and Cons of Maturity Models

Kurniawan et al. (2019) describe that a benefit with maturity models is that it enables the identification of the strengths and weaknesses of an organisation, while also allowing for internal benchmarking (ibid). Similarly, Olaitan, Herselman, and Wayi (2019) as well as Gers (2014), describe that a maturity model helps to identify what has been achieved and not. Bhansali (2014) and Ladley (2012) further describes that, by identifying the current status, a maturity model can help to provide insights into what challenges and opportunities an organisation has regarding data governance. Thereby, a maturity model helps to increase the understanding of how to take the data governance program to the next step (Olaitan, Herselman & Wayi, 2019; Gers, 2014). In addition, Bhansali (2014) explains that an assessment of an organisation's current level of data governance not only helps to provide an understanding of the issues with a data governance program but also of the processes and technologies employed as well as the interactions and collaborations among people and different departments.

However, Kurniawan et al. (2019) mention that it is important to remember that all maturity models have different emphasis and focus areas. Therefore, they might not be directly applicable to all organisations. Meaning that a disadvantage with maturity models is that they might not reflect the organisation it is being applied to and thus the result can be deceptive. Hence, before using a maturity model it can be beneficial to adopt it to the organisation and the purpose of the assessment (ibid). Additionally, a critique mentioned by King (2003) is that, even though an organisation is assigned a level in the maturity model, it does not guarantee that the level is accurate. Likewise, Velden et al. (1996) emphasises that organisations are too complex to be assigned a level on a scale from one to five and that organisations should not blindly trust the result.

2.7 Theoretical Framework

Based on the literature review presented above, a theoretical data governance framework was created. The theoretical data governance framework consists of five levels: initial, repeatable, defined, quantitatively managed and optimised. In addition, the theoretical framework consists

of 13 elements which are divided into three dimensions: people, policies and capabilities. The elements have been created based upon the data governance concepts and aspects that are mentioned repeatedly in the literature. The five levels and all 13 elements with their key takeaways are briefly summarised in table 2 below. Note that the theoretical framework is used as the basis in creation of the model. The theoretical framework will later be analysed with findings from workshops with data governance experts. After adapting the theoretical framework to the findings in workshops, the final model was created and can be found in chapter 4.2.

LEVELS				
Level 1: *Initial*	Level 2: *Repeatable*	Level 3: *Defined*	Level 4: *Quantitatively Managed*	Level 5: *Optimised*
Data governance processes are non-existing and the organisation is acting reactively towards changes related to data governance (Ladley, 2012; Saputra, Handika and Ruldeviyani, 2018).	Some data governance processes are defined for some projects at team level (Ladley, 2012; Saputra, Handika and Ruldeviyani, 2018).	Some data governance processes are defined on company level and the organisation is acting proactive towards changes related to data governance (Ladley, 2012; Saputra, Handika and Ruldeviyani, 2018).	Data governance processes are defined, measured and controlled throughout the organisation (Ladley, 2012; Saputra, Handika and Ruldeviyani, 2018).	Data governance processes are defined, measured, controlled as well as continuously improved and effectively managed throughout the organisation (Ladley, 2012; Saputra, Handika and Ruldeviyani, 2018).

ELEMENTS	KEY TAKEAWAYS
PEOPLE	
Strategy	• The data governance strategy determines what activities are needed to ensure that the data governance program meets business needs (Ladley, 2019). • Involving employees in data governance is important for alignment and understanding of data governance (Ladley, 2012; Cheon & Chang, 2007; Bhansali, 2014).
Leadership	• Involvement and commitment of top management in the data governance strategy and program (Bhansali, 2014; Ladley, 2012). • Lead by example (Ladley, 2012). • Promote data-based decisions (Foley & Gulliemette, 2010; Ladley, 2012).
Ownership Structure	• The designation of accountability and responsibilities to strengthen the data governance program (Ladley, 2012). • Joint ownership between the business function and the IT department (Bhansali, 2014). • Data stewards ensure effective control and use of data assets by implementing daily operational procedures (Newman & Logan, 2009; Bhansali, 2014). • Data governance council coordinates, monitors and communicates data governance activities across the organisation (Barker, 2016; Ladley, 2012; Cheon & Chang, 2007).
Awareness & Communication	• All employees need to be aware of and understand data rules, standards and regulations (Mosley, 2010). • It is vital to continually communicate and educate employees in data governance (Mosley, 2010; Cheon & Chang, 2007).
Performance Management	• Realistic metrics to monitor the progress of the data governance program (Ladley, 2012; Bhansali, 2014).
Knowledge & Change Management	• The process and structure to ensure that change is implemented smoothly (Bhansali, 2014). • When implementing a data governance program, it is common that resistance among employees will arise which hence increases the need for training (Ladley, 2012). • It is important to ensure that existing employees document their work to make the transition easier Bhansali (2014). • It is important to be prepared for unexpected situations to ensure that the data governance program can be adapted accordingly (Bhansali, 2014).

POLICIES	
Rules	• The creation and enforcement of rules regarding data creates the foundation for data governance (Ladley, 2012; Bhansali, 2014). • The rules should be adapted to the objective of the organisation and the needs of the different teams (Bhansali, 2014). • Rules should be cross-functional (Bhansali, 2014). • Organisations should use data rules to communicate roles, responsibilities as well as key objectives (Abraham, Schneider and Vom Brocke, 2019). • Compliance monitoring to ensure that rules are followed is a critical success factor for a data governance program (Cheon and Chang, 2007). • Organisations should have a common repository that gathers key terms, common rules and definitions regarding data (Soares, 2014). • Data governance helps an organisation to comply with external regulations (Bhansali, 2014).
Data Quality	• Controlling that the data meets the requirements of its intended purpose, thus ensuring that the data is accurate, complete, timely, consistent and relevant (Mosley, 2010; Bhansali, 2014) • Employees should collectively be responsible for data quality (Salido, 2010). • Data quality and data governance often are used interchangeably in practice and theory (Ghosh, 2019). Data governance should be seen as a structure for managing data quality (ibid). • Data governance is important in identifying, managing and resolving data issues (Mosley, 2010; Ladley 2012).
Data Security & Privacy	• Efforts taken to protect the data from unauthorized users, to secure privacy of critical information (Keith, 2013; Soares, 2014; Henning, 2018). • Security and privacy standards should specify rules, routines and the access of data. (Keith, 2013; Soares, 2014) • Firewall controls, access controls as well as detection and mitigation controls should be used to prevent unauthorized users from getting access to the data (Bhansali, 2014). • To support and recover from data failures organisations could implement data replication, i.e backups (Balakrishnan, Das, Chattopadhyay., 2020).
Data Lifecycle Management	• Rules for how the data should be created, used, retained and archived or purged (Ladley, 2012; Alhassan, Sammon & Daly; 2016). • By defining rules of the usage and lifetime of data, organisations can gain knowledge on the optimal storage size and thereby minimise costs Khatri and Brown (2010).

CAPABILITIES	
Meta Data Management	• Metadata is data about the data, to ease the understanding, usage and management of data (Khatri & Brown, 2010; Keith, 2013). • The metadata should be easily accessible and available to the eligible users as well as searchable (Bhansali, 2014). • Metadata can be divided into four categories; business, technical, process and operational (Bhansali, 2014).
Master Data Management	• MDM guarantees that an organisation only uses one version of its “master data” for all of its operations (Keith, 2013; Soares, 2014).
Business Intelligence	• The set of techniques that transforms raw data into information that can be used in the decision-making process (Ladley, 2012; Keith, 2013). • Enabling decision-makers to take historical, current as well as predictive views of the business (Keith, 2013). • BI-related efforts should be coordinated with business activities (Ladley, 2012).

Table 2: The theoretical data governance framework.

3. Methodology

In this chapter, the chosen research strategy, approach, design, and process are presented. Thereafter, the secondary and primary data collection, consisting of workshops and semi-structured interviews, are described. This is followed by a description of the analysis methods used for the primary data collection. Finally, an elaboration of the quality of the study is given and chosen quality measurements are explained.

3.1 Research Strategy

To be able to create a data governance maturity model, a qualitative research strategy was chosen. A qualitative research strategy was also seen as important to gain an understanding of how a maturity model supports organisation in improving data governance. This is because a qualitative strategy emphasises words rather than numbers in the collection and analysis of data (Bell, Bryman & Harley, 2019. Additionally, one approach of qualitative research is collaborative research (Hammond & Wellington, 2012; Bell et al., 2019). A collaborative approach means that the researchers and the people being studied are working together to achieve a pre-decided goal. This provides opportunities for knowledge sharing and consciousness-raising (Hammond & Wellington, 2012). This was seen as beneficial since the subjective opinions of experts were needed to ensure the model's feasibility and validity in a social and operational context. Also, a qualitative strategy focuses on the perspective of those being studied, hence what they see as important and significant (Bell et al., 2019), which further strengthens the choice of a qualitative study. Furthermore, a qualitative research strategy provides flexibility and adaptability, allowing for the emergence of new information (ibid). This was seen as another advantage since this study is exploratory. Meaning that a qualitative strategy is further argued to be suitable since it reduces the risk of missing out on important aspects within data governance.

This study has used a combination of the inductive and deductive approaches, which is called an abductive approach (Saunders et al., 2012). Initially, this study used a deductive approach by gathering existing literature within data governance to create a theoretical framework, which was later discussed during workshops. The findings from literature and workshops resulted in the creation of the data governance maturity model. Thereafter, the created model was tested and applied on the case company and an inductive approach was used. This since the information retrieved from interviews was combined with the theoretical findings to understand how the model can be used to improve data governance. Meaning, since this study does not move directly from data to theory, an abductive approach was more appropriate. In addition, an abductive approach allows for the identification of explanations of patterns which helps to generate new or modify existing theories within a specific topic (ibid). Hence, as this study is an exploratory case study that investigates an unexplored field of research, the choice of the abductive approach is further strengthened.

3.2 Research Design

The chosen research design of this study is an exploratory case study approach. An exploratory approach was considered suitable since existing research within the topic is sparse (Bell et al., 2019), due to that available models do not cover all aspects of data governance or instructions for applying it. To answer the research question, it was considered essential to test the created model's feasibility on a company. Hence, by applying the model to a case company, knowledge could be gained of how a maturity model can support organisations in improving data governance. It was considered advantageous to collaborate with a company to get business perspectives in the creation of the model and also to test the model to understand how it can help an organisation to improve. This enabled the researchers to receive feedback from the end-user during the creation process while also testing the feasibility of it. According to Bell et al., (2019), a case study aims at analysing a single case, for instance, an organisation, where the researcher aspires to gain a clear and in-depth understanding of the organisation. What makes a case study design different from other research designs is the focus on a bounded system, in this case, Tech-X, which is used to examine the setting (Hammond & Wellington, 2012; Bell et al., 2019).

3.3 Research Process

To answer the research question, a data governance maturity model needed to be created, since the available models miss out on several important aspects within data governance, as well as being tested. Therefore, the created model was applied to Tech-X. Figure 2 below describes the steps that the researchers have taken to answer the research question.

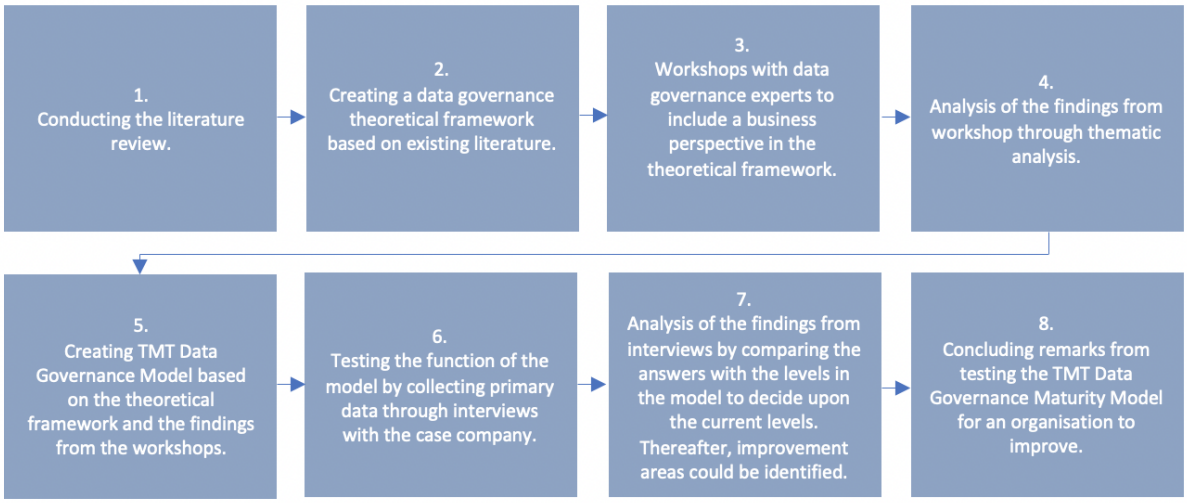

Figure 2: The research process.

1. To investigate the aspects within data governance, a literature review was conducted.
2. Based upon the literature review, a theoretical framework could be created (section 2.8).
3. To ensure the model's feasibility and to minimise the risk of missing out on important aspects when creating a data governance maturity model, workshops with data governance experts were held (section 4.1).
4. The inputs from the workshops were analysed and contrasted with the literature.
5. The findings from the literature and workshop eventually resulted in the creation of the "*TMT Data Governance Maturity Mode*l" (section 4.2 and 4.3).
6. To understand how to use the model it was applied to Tech-X. Hence, to determine Tech-X's level of data governance maturity, interviews with questions from the model were held with 20 employees to gain an understanding of their current status (section 5.1 and 5.2).
7. By comparing the answers from interviews with the maturity levels in the model, the current level, actions for how to reach higher levels, and improvement areas could be identified (section 5.3).
8. Finally, concluding remarks of important aspects when creating a maturity model and how a maturity model can support organisations in improving data governance could be drawn and the research question could be answered (chapter 6).

3.4 Research Method

Both primary and secondary data have been collected to answer the research question. Primary data have been collected through interviews and workshops by the researchers, while secondary data have been collected from existing literature on the topic.

3.4.1 Secondary Data Collection

In this study, secondary data has been collected from previous research. According to Bell et al. (2019), the literature review justifies the chosen research questions and explains the choice of the research design. Furthermore, the literature review provides the basis for a study, helping the researcher to collect the primary data and to analyse it correctly (Kothari, 2004; Bell et al. (2019). In this study, the literature review has not only provided a theoretical background to the topic but has also been used as a foundation when creating the model. Additionally, the literature review has helped the researchers to generate and develop recommendations on how Tech-X can improve their data governance.

3.4.1.1 Literature Review

A systematic literature review was conducted in this study. This approach was chosen since it aims at minimising bias by using an exhaustive literature search of existing articles on the topic by setting specific exclusion and inclusion criteria (Hammond & Wellington, 2012; Bell et al., 2019). As a first step, an initial review of the literature was conducted to understand what should be included in a data governance maturity model. Thereafter, key search words and

inclusion and exclusion criteria were decided based upon the research questions and delimitations of this study. Finally, a more extensive systematic literature review was conducted by using key search words for browsing in different databases.

The literature review is based on academic articles considered relevant for the research question and that are related to the topic of data governance. The secondary data have been collected from the Gothenburg University's and Chalmers University of Technology's digital library sources. To find the relevant literature, the keywords presented in appendix 1 have been used.

3.4.1.2 Inclusion and Exclusion

The collected literature was chosen in regard to certain inclusion and exclusion criteria. The first inclusion criterion is that literature regarding the design, implementation, and development of an ongoing data governance program were all included. Meaning that theory regarding how to create and establish a data governance program as well as how to develop an existing one was included. A second inclusion criterion is literature regarding maturity models, key success factors, and key challenges of data governance. The final inclusion criteria were that all literature should be peer-reviewed to ensure the quality of the study.

The first exclusion criterion is connected to the relevance of the study. Hence literature within the topic of data governance published before 2005 was excluded since data technology is rapidly changing which reduces the validity of older literature. The second exclusion criteria were to exclude literature only concerning how big data and cloud data influence data governance. The third exclusion criterion is connected to the concept of data management. Meaning that literature regarding data management, which data governance is a part of, was excluded to avoid misinterpretations and confusion. The final exclusion criteria were to exclude all literature published in other languages than English.

3.4.2 Primary Data Collection

Primary data have been collected to ensure the created model's validity and to test its feasibility while also helping the researchers to answer the research question. Two methods have been used to collect primary data: workshops and semi-structured interviews. The workshops were conducted to get opinions from experts on the theoretical framework. One expert is working internally at Tech-X and the other expert is working as an external consultant for Tech-X. Based on the workshops, the theoretical framework was adjusted, and the data governance maturity model was created. Hence, the workshops were crucial for the creation of the model.

Thereafter, the model was tested by conducting semi-structured interviews with employees at Tech-X to determine the maturity level and improvement areas. In addition, to gain knowledge of what to consider when using the model. Meaning that the interviews were used to understand how to use the model. Hence, this section for *Primary Data Collection* is divided into two parts: workshops and semi-structured interviews.

3.4.2.1 Workshops

One way to apply the collaborative approach of qualitative research is by using workshops, which is an arrangement of people that discuss a specific topic by acquiring knowledge and creative problem solving (Ørngreen & Levinsen, 2017). A workshop aims to fulfil a predefined unpredictable purpose. Hence, workshops enable the identification of new factors of relevance for the topic, which neither the researchers nor the participants might have thought of (ibid). The use of workshops as a method to collect primary data was considered crucial to gain a business and data governance expert view on the model to ensure its validity. The participants in the workshops are in this report considered "data governance experts" since they have several years of work experience within the field.

To ensure that all aspects of data governance were covered, an interview guide was used during the workshops (appendix 2). An interview guide supports the interviewer and the respondent through the interview, in this case the workshops, while allowing the respondent to share its opinions on the topic (Bell et al., 2019). The interview guide consisted of questions about the theoretical data governance framework (see section 4.1), to discuss what aspects are relevant and what parts are needed to be adapted to be in line with organisations today. The interview guide consisted of four questions, asking for the participants' thoughts regarding the elements and levels. The questions enabled the researchers to guide the discussion but also allowed for the participants' reflections. The interview guide and the theoretical framework were shared with the experts before the workshops, allowing them to prepare and think of the framework to enhance the discussions.

3.4.2.1.1 Sampling and Selection of Participants

For qualitative studies, it is common to use a non-probability approach that entails purposive sampling. This means that the respondents are selected based upon the researcher's judgment of the respondents' relevance in relation to the research question, rather than randomly selected (Walliman, 2010; Bell et al., 2019). For the workshops, a non-probability purposive sampling was used since the selected participants needed to have both experience of data governance and insights in Tech-X. Hence, one inclusion criterion for the participants was that they should work daily with data governance. To get an accurate result when determining Tech-X's level of maturity and identifying improvement areas, the model needed to be applicable and relevant for Tech-X's business. Therefore, a second inclusion criterion was that the experts should have insights in Tech-X as a company.

Henceforth, the workshop participants will be referred to as the "*experts"* in the study. Two experts fulfilled the criteria and participated in the workshop sessions (table 3). Expert 1 contributed with knowledge of data governance from Tech-X's perspective. She is currently Head of Data Governance at Tech-X and is working actively with the program. Expert 2 has been working as a consultant within data governance for 33 years, currently for Tech-X, and contributed with a broad and external perspective of data governance. The researchers contributed with a business perspective to the theoretical perspectives on data governance. It could have been beneficial to bring in more perspectives from data governance experts, not

working at Tech-X, to ensure that all relevant aspects were covered in the model. However, due to the time and other resource limitations of this study, workshops with more participants were not feasible.

PARTICIPANTS	POSITION
Expert 1	Head of Data Governance
Expert 2	Consultant within Data Governance

Table 3. List of experts participating in workshops.

3.4.2.1.2 Conducting the Workshops

The workshops were executed virtually due to geographic distance and Covid-19. According to Hammond and Wellington (2012), virtual workshops allow for face-to-face contact and thus helps to observe the participant's body language and behaviour. Three workshops were executed, and each workshop lasted for four hours. All workshops were conducted in English.

Ørngreen and Levinsen (2017) describe that the data obtained from workshops typically are different from data obtained from interviews. This is because it is difficult to document a workshop session since there is no clear beginning and end of the sessions. Both researchers were present in all sessions and involved in the discussions. However, one researcher focused on taking notes and the other on being the moderator and leading the discussion, which is favourable according to Ørngreen and Levinsen (2017). This allowed the researchers to guide the discussion and follow up on interesting aspects while relevant topics and opinions could be documented right away. The researchers have chosen not to fully transcribe the workshop sessions, not only because it is difficult and time-consuming due to the number of speakers involved (Ørngreen & Levinsen, 2017), but also since detailed notes were taken. Additionally, the workshops were recorded to avoid misinterpretations and information loss (Bell et al., 2019; Ørngreen and Levinsen, 2017). The recordings also enabled the researchers to go back and listen to the discussions which ensured that no relevant thoughts were missed.

3.4.2.2 Interviews

Interviews were held to test the feasibility of the created model and also to answer the research question. Meaning, the information collected from the interviews was used to determine Tech-X's levels of data governance maturity, to identify improvement areas, and thus to understand how a maturity model can support an organisation in improving data governance.

This study has used semi-structured interviews by using an interview guide (Bell et al., 2019), which can be found in appendix 3. The structure of semi-structured interviews was considered crucial to ensure that all interview questions and elements within the data governance maturity model were covered in each interview (Bell et al., 2019). In addition, semi-structured interviews also ensured comparability between the answers which was needed in the determination of Tech-X's level of maturity (ibid). In addition, semi-structured interviews are flexible as an interviewer can adjust the order of the questions if needed (Walliman, 2010), which was considered essential to ensure that each respondent's perceptions of Tech-X's data governance program were captured.

The interview guide consists of definitions of relevant concepts and 33 open-ended questions that are assigned into different elements. Some questions are used to test the knowledge and understanding of the employees, while other questions are used to investigate the usage and implementation of data governance in the organisation. The interview guide was not shared with respondents before the interviews to mitigate the risk that respondents searched for answers, which could have influenced the accuracy of the assessment.

3.4.2.2.1 Sampling and Selection of Respondents

A non-probability approach that entails purposive sampling was used for the interviews. The reason for a purposive sample was that employees with different positions and from different teams needed to be involved in the research to get a wide spread of the sample. This to gain a transparent view of the whole organisation's data governance maturity. Hence, the selection of respondents was not randomly selected (Bell et al., 2019). The sample of respondents in the interviews were selected based upon two criteria; each respondent must have worked for Tech-X for at least one year and the sample should represent different teams and positions in the organisation. The respondents were chosen in collaboration with Tech-X to ensure that there was a widespread presence in the sample. Tech-X shared a list of potential respondents with the researchers, since it was considered difficult to attract employees from several different departments to participate in the study without internal help. However, the final respondents were chosen by the researchers.

The researchers are aware of the potential bias with choosing respondents based on the judgment from someone working for the company. Despite that, the potential bias was not considered crucial to reach an accurate answer to the research question. In addition, it was assumed that Tech-X wanted to obtain a fair result, to ensure that the determined maturity level reflects their organisation. To ensure that all questions in the model could be answered, Expert 1 was also chosen as a respondent. Expert 1 only contributed with additional information needed to assess the levels. However, she is not considered a respondent in the selected sample since she only answered the questions that could not be answered by the other respondents. The reason being that, since the expert has been involved in the creation of the data governance program at Tech-X, it could harm the accuracy of the outcome of the study.

3.4.2.2.2 Conducting the Interviews

An email was sent to the respondents before the interviews including a brief overview of the project to ensure that respondents felt comfortable before the interviews. However, the respondents were asked to *not* prepare anything before the interviews since it could negatively affect the accuracy of the study. All interviews were held virtually due to physical distance and the restrictions of Covid-19. If interviews cannot be held face-to-face, virtual interviews are preferred as it to some extent compensates for the loss in face-to-face interaction (Bell et al., 2019). The interviews were held in the language preferred by the respondents to create a relaxed atmosphere. Resulting in five interviews being conducted in English and 15 interviews in Swedish. Moreover, all interviews were recorded, allowing for a more detailed examination of what had been said and minimising accusations of bias (Bell et al., 2019). Due to ethical

reasons, all respondents were asked for permission before being recorded where all of the respondents accepted. See table 4 for information on the interviews and the respondents.

During the interviews, both researchers were present and asked questions. After the interviews had been conducted the relevant parts were transcribed by the researchers. This to ease the analysis process, to avoid missing out on vital points and to capture the respondents' own words and expressions, which could enhance the comparison of the answers (Bell et al., 2019). The interviews that were conducted in Swedish were also transcribed in Swedish. Meaning that some information from interviews that is presented in this study have been translated to English. The researchers translated these interviews together to ensure that the answers still reflected the viewpoint of the respondents. Since Tech-X wishes to be anonymous, the names of the respondents are not published.

RESPONDENTS	POSITION	DATE	DURATION (min)	LANGUAGE
R1	Team Member	210309/10	140	Swedish
R2	Quality Expert	210310	45	Swedish
R3	Team Member	210310	45	Swedish
R4	Team Member	210311	60	Swedish
R5	Product Owner	210316	50	English
R6	Team Leader	210316	55	English
R7	Team Member	210317	55	Swedish
R8	Product Owner	210317	55	English
R9	Product Owner	210317	50	Swedish
R10	Head of Security	210318	65	Swedish
R11	Team Member	210318	35	English
R12	Team Member	210318	50	Swedish
R13	Team Member	210318	30	Swedish
R14	Team Member	210323	35	Swedish
R15	Technical Expert	210323	50	Swedish
R16	Team Member	210323	40	Swedish
R17	Team Member	210323	45	English
R18	Consultant	210324	40	Swedish
R19	Product Owner	210324	40	Swedish
R20	Engineering Manager	210326	40	Swedish

Table 4. List of respondents for the interviews

3.5 Data Analysis

The data collected from workshops and semi-structured interviews have been analysed by using a thematic approach. The thematic analysis focuses on identifying patterns and the main themes that have been found in the collected data (Bell et al., 2019). In addition, the thematic analysis provides flexibility (ibid), which was beneficial due to the limited time scope of this project. The thematic analysis enables comparison of information retrieved from literature with insights obtained from workshops and interviews.

A first analysis was made when creating the model. After creating the theoretical framework and workshops with experts, the main findings regarding dimensions, elements, levels,

interview questions and criteria for each level per element were summarised. The summaries enabled colour coding which eased the comparison between the perspectives from literature and the experts. Hence similarities and differences between workshops and literature could be identified. In the first part of creating the model, the five general levels were identified by analysing and comparing the aspects mentioned in literature and during workshops. See appendix 4 for example of the process.

In the next step of the creation of the model, 13 elements were identified in a similar way by using colour coding. In accordance with literature, the elements were divided into three dimensions. Thereafter, the questions in the model were defined based upon the information retrieved from literature and workshops regarding each element. Examples of how the elements and interview questions were identified can be found in appendix 5.

As a next step, the general levels were compared with the questions in the model to define the criterion for each of the five levels per each question within an element. The criteria for the levels in each question was also based upon findings from literature and workshops. The researchers started defining the reference criteria for level 1 and 5. Thereafter, the criteria for level 2, 3 and 4 could be defined. This step of the analysis was done jointly with the data governance consultancy (E2) to ensure that the criteria reflected reality. Each criterion was colour coded to ensure that it also reflected the general level, as well as answered the questions. An example of how the analysis process for the level's criteria for each question within an element were made are presented in appendix 6. The final output from the analysis of the literature and workshops, after deciding upon the definitions for dimensions, elements, general levels, interview questions and criteria for each level per question, created the *TMT Data Governance Maturity Model.*

A second analysis was made when testing the validity and use of the model by applying it on the case company. The interviews with employees at Tech-X were transcribed and used as a basis when colour coding the findings. As recommended by Bell et al. (2019), the coding process was made continually during the interviews and was based on commonly mentioned topics in the interviews. Thereafter, each interview was assigned a level for each interview question in the model by comparing the individual answer with the levels in the model. Thenceforth, the levels for each question were determined by taking the average levels received from the respondents or by considering the expert's opinion. The ground rule was to take the average level of all respondents' assigned level to determine the final levels. Nevertheless, in some cases, when the average did not reflect the actual status in the organisation, another level was chosen based upon the judgement of experts. To determine the levels for each element, the average of the assigned levels for each question was calculated and rounded to the nearest integer. Likewise, the levels for each dimension were determined by taking the average of the assigned levels for all elements within each dimension. A presentation of the method used for determining the levels is presented in appendix 7.

When the final levels for dimensions and elements had been identified, the model was used to identify improvement areas. By comparing the criteria for the assigned level with the criteria for higher levels for each question, a gap could be identified and thus actions for how to reach

higher levels could be defined for each element. By applying a thematic analysis and colour coding, the most commonly mentioned actions to reach higher levels were categorised into themes. These themes thereafter resulted in three improvement areas identified. The three improvement areas were analysed in conjunction with literature and henceforth presented for Tech-X. The improvement areas were discussed with experts and compared to the findings from literature to ensure its relevance. An example of how to identify improvement areas, based on the comparison between the assigned and actions to reach higher levels, can be found in appendix 8.

3.6 Quality of the Findings

The quality of the findings of this study could be evaluated through three criteria: replicability, reliability and validity, according to Bell et al., (2019). However, some authors argue that other criteria are more important when evaluating qualitative studies. Lincoln and Guba (1985) propose two criteria: authenticity and trustworthiness. As this study is qualitative, the criteria suggested by Lincoln and Guba can be seen as more appropriate to use. Trustworthiness includes four subcategories, which are credibility, transferability, dependability and confirmability. These will be discussed in the following section.

3.6.1 Authenticity

Authenticity refers to whether the researcher manages to represent the different viewpoints of the respondents in a fair way (Bell et al., 2019). Similarly, Connelly (2016) explains that authenticity is the extent that a researcher manages to fairly convey the messages of the respondents. In this study it was important to present the correct viewpoint of the respondents in the workshops, to create a useful model, and in the interviews, to test the model, while being able to provide Tech-X with a fair result. The openness of the workshops as well as the semi-structured approach in the interviews is argued to enable the participants and the respondents to elaborate on their perspective on data governance and Tech-X's data governance program.

When translating the interviews from Swedish to English, there is a risk for misinterpretations and that the views and opinions might not reflect those of the respondents (Bell et al., 2019). To mitigate this issue, the researchers recorded the interviews and jointly translated the transcriptions. Therefore, the researchers argue the findings are fairly presenting the respondent's viewpoints which is increasing the authenticity of the study.

3.6.2 Credibility

Credibility can be compared to the quantitative criteria of internal validity (Bell et al., 2019). It is corresponding to an elaborative description of the research process, ensuring the findings to be trustworthy (Lincoln and Guba, 1994; Connelly, 2016). Trustworthiness could be reached by using practices that are commonly used in qualitative studies (Bell et al., 2019). Therefore, commonly used methods in qualitative studies have been used, for instance, interview guides and transcriptions of interviews.

Another method that ensures credibility, mentioned by Saunders et al., (2012), is providing participants with relevant information before the interviews. Before the workshop sessions, the experts were provided all relevant information that had been found in the literature and the interview guide. However, the same procedure could not be done for the interviewees as it could have affected Tech-X assigned maturity level if the interviewees prepared.

3.6.3 Transferability

Transferability is referred to external validity in quantitative research, which is the extent findings of a study can apply to other contexts (Bell et al., 2019). Qualitative research tends to be connected to the uniqueness of a specific social context. Therefore, transferability in qualitative research cannot be ensured similarly as external validity is done in quantitative research (Guba and Lincoln, 1985). Transferability in this study has been ensured by extensively describing all parts of the collected data from workshops and interviews (Geertz, 1973). Additionally, a comprehensive description of the collection of primary data and the process for analysis has been given.

However, due to time and resource limitations, only two experts participated in the workshop sessions. This can negatively impact the transferability since only the opinions of the two experts have been taken into consideration. The researchers tried to increase the transferability by including experts having both an internal and external perspective of data governance to ensure that the different perspectives were covered. This is also aimed to mitigate the potential subjectiveness. Additionally, since the model was created based on both findings from literature and experts, and as the model can be adapted if needed, it is argued to be applicable to other companies as well. Although, the identified improvement areas are specific for Tech-X and should only be seen as guidance for other companies. However, aspects identified as important when creating and using a maturity model to improve data governance are argued to be relevant for other companies since these are commonly mentioned in literature. In addition, the findings regarding how a maturity model can support organisations in improving data governance are argued to not be specific to the case of Tech-X, and hence this result can to a wider extent be generalised.

3.6.4 Dependability

In qualitative research, dependability is corresponding to the quantitative criteria of reliability (Connelly, 2016; Bell et al., 2019). According to Connely (2016) dependability refers to whether the data can be seen as consistent over time and under different conditions. However, Saunders et al. (2012) describe that it can be difficult to ensure that the same result and conclusions of a study would be reached if the study was executed again since the social settings of cases are under constant change. Regarding this study, it is difficult to determine the lifespan of the created model since the development of data governance and data-related innovations are difficult to predict. The dependability of this research is therefore difficult to guarantee. However, the experts in this research estimated that the model will be valid for a

long time, which increases the likelihood that the research can be validly executed again and thus that the same aspects could be identified. The dependability for the practical recommendations to Tech-X can neither be guaranteed since the sample and organisational settings are likely to change. Although, the dependability of how a maturity model can support organisations in improving data governance is argued to be consistent over time and under different conditions since this is not solely dependent upon the context it is applied to.

The researchers have been transparent during the process by clearly describing and motivating the decisions made regarding research methods, strengthening the dependability by increasing the likelihood that others understand the research process and findings. Thereby, facilitating the replication of the study. In addition, appendixes of the interview guides are attached which strengthens the dependability of the study (Bell et al., 2019).

3.6.5 Confirmability

Confirmability is the contrast to the quantitative criteria objectivity, which refers to whether the researcher has managed to exclude personal values and opinions in the research (Connely, 2016; Bell et al., 2019). The researchers are aware that personal values and opinions could have influenced the study. However, the objectivity of the findings has still been strived for throughout the research process by gathering information from both an internal expert that works at Tech-X and an external expert, and literature when creating the model. However, when testing the model to determine how a maturity model can support organisations in improving data governance, the identified findings are to some extent based upon the researchers' personal opinions. Although, the findings have been analysed in conjunction with literature to lower the subjectiveness of the study.

4. The Creation of the Data Governance Maturity Model

This chapter presents the TMT Data Governance Maturity Model and the creation of it. First, the inputs from the workshop sessions with experts are presented. Thereafter, the findings from workshops are analysed and compared to the theoretical framework and the levels, dimensions, elements, and questions in the model are defined. At the end of the chapter, an overview of the TMT Data Governance Maturity Model, with included instructions for how to use it, will be presented.

4.1 Inputs from Workshops

The following section presents the inputs on the model retrieved from the workshops, i.e., the expert's view of what aspects are important regarding data governance. Thus, providing a business point of view on what to include in a data governance maturity model. The section is divided into levels and dimensions & elements.

4.1.1 Levels

The experts that participated in the workshop were convinced that the method used to understand a company's data governance needed to include some sort of measurement, such as maturity levels. This is because maturity levels enable an assessment of the current status, but also the possibility to remake the assessment to see if Tech-X has advanced in the future. E1 highlighted the famous quote from Peter Drucker "*what you can't measure, you can't improve*". Thus, it was agreed upon to create a data governance maturity model that included levels.

Five maturity levels were suggested by E2. The expert, who has been working with data governance as a consultant for many companies, explained that five levels cover most of the different stages that organisations can be in, both organisations that have recently started to work with data and companies that are fully data driven. There was a dialogue on how the levels in the models should be defined. It was discussed that organisations at the first level typically are not aware of data governance or the importance of it, thereby they are performing their day-to-day businesses without any data governance activities. E1 explained that "*some organisations are not interested in data and do therefore not see the value of data governance*". Organisations at the second level are aware that data is important, but they are not managing or governing their data on a day-to-day basis and therefore there is no structure for the communication of the program and the awareness is low. Meaning that they are only managing or governing it as new problems arise, such as regulations. Hence, organisations at this level are working reactively. Organisations at the third level usually have some sort of plan and strategy for how to work with data, but only short-term and not long-term, according to E2. Hence, E1 suggested that this level could be called proactive. These organisations usually have no control to see if the data governance activities are being followed. Additionally, only a few people are aware of the data governance program since it has not been communicated. At level

four an organisation has a direction and a well-defined vision for how to work with data governance. However, if something unexpected comes up, the organisation acts upon that and lets it disturb their plan. As E1 explained "*the organisations at level four are at the forefront when it comes to data, but they usually struggle in adapting their data governance program to changes in the external environment*". Although even though it has been communicated throughout the organisation everyone is not yet aware of it. Finally, the experts agreed upon that organisations at level five have such a good structure of their data governance program that, when changes in the environment happen, the organisation can easily adapt and change their data governance program accordingly. They also described that in organisations at this level, everyone is aware of the program since it is continuously communicated.

4.1.2 Dimensions & Elements

All elements in the theoretical framework were considered crucial to include in the model, according to both experts. However, the elements and the belonging questions needed to be further adapted to reflect the current business environment and Tech-X. However, E1 and E2 agreed upon that *People*, *Processes,* and *Capabilities* described the dimensions of data governance properly. Although, E1 explained that Tech-X commonly divides data governance into three main dimensions; *Ownership, Rules, and Execute.* Nevertheless, both experts agreed to divide the elements into the dimensions: *People, Processes,* and *Capabilities*, with the thought that it is easier for people from other companies to understand.

4.1.2.1 People

The experts concluded that the theory-based elements *Strategy, Leadership, Ownership Structure, Awareness & Communication, Performance Management* as well as *Knowledge & Change Management* should be categorised under the people dimension, in accordance with the theoretical framework. The reason being that all of the elements are referring to the organisational part of a data governance program.

According to the experts, the first element; *Strategy*, covers all of the other elements since all aspects of the data governance program should be integrated into it. Due to the importance of the strategy element, the experts suggested that it should include more questions. E2 explained that "*it is crucial that the data governance strategy is aligned with the business strategy, if not, an organisation will have a lower level of maturity*". In addition, it was discussed that organisations having clearly defined activities for how to execute the strategy and thus reaching the vision, is of high importance to be mature. It was further discussed that to determine an organisation's level of maturity for the strategy element, it is necessary to investigate who has been participating in data governance strategy making. E1 described that "*a formal cross-functional team which creates and periodically reviews the strategy usually is more likely to have a successful data governance program, as it facilitates the alignment to business needs and goals*". If only a few key stakeholders have created the strategy, the organisation should be assigned a level in the middle of the scale. The other expert agreed and added that it is also essential to communicate the strategy to all employees, not only when it is created but also

when it has been revised. Furthermore, E2 explained that "*an organisation with employees that are aware of, have access to and know where to find the strategy is more likely to have a high level of maturity*". Thus, if only a few people have access to it as well as awareness of it, the organisation should be at level two. However, according to the experts, this element does also test the organisation's approach to data governance and therefore they suggest that it should be called "Strategy & Approach".

The next element, *Leadership*, is vital since leaders guide the organisation towards data-drivenness, according to both experts. E2 mentioned that an important question to ask is *"Do the leaders understand the value of data?",* whereas E1 added, *"and what is the rest of the organisation's view of leadership in data governance?".* It was discussed that if the leaders recognise data governance as a crucial asset to gain competitive advantage, they should be assigned a high maturity level. Additionally, E2 described that "*a leader which is committed to data governance typically is very involved in the data governance strategy making and in the execution of it*". Other organisations where leaders only view data governance as an IT-project should be assigned a low maturity level. If leaders for instance are only involved to ensure compliance with external regulations a lower level of maturity should be assigned since this indicates that they do not fully understand the value of data governance. Another point being emphasised was decision-making and that leaders need to encourage the organisation to make decisions based upon data. It was discussed that organisations where data is well-incorporated into the decision-making process, are at a high level. While organisations that rely more on gut feeling and previous experience should be assigned a lower level.

All aspects of the theoretical element *Ownership Structure* are vital for today's businesses, according to the experts. It was stated that, if there is no clear ownership structure nor defined roles and responsibilities, no one will take care of the data. E1 explained that "*having a clear ownership structure also makes it easier for people to know whom to contact if having questions with some data*". Something that was highlighted in the workshops but not mentioned in the literature was that it is important to distinguish between who owns the data and who manages the data. In some organisations data is owned or managed by one or several persons while in other organisations by separate teams. The experts agreed that organisations that are struggling with this, typically have not defined an ownership structure and should therefore be assigned a low maturity level. In contrast, organisations with a formal and clear ownership structure should be assigned a high maturity level. Organisations with an informal ownership structure are in the middle of the scale. In addition, the experts explained that some data assets can have multiple owners, and, in those cases, it is important to decide upon who is the main owner. Therefore, the experts thought it was interesting to investigate the attitudes towards multiple ownership since this can indicate the level of maturity.

Regarding the next element, *Awareness & Communication,* the experts thought that it is one of the most crucial aspects within data governance. As E2 described "*If the employees are not aware of data governance and its included concepts, you have not communicated it enough*". Therefore, the experts thought it would be better to incorporate the communication aspect into all other elements. This since a data governance maturity model should investigate if the

employees are aware of the other elements within data governance and thus if they have been communicated.

Regarding the next element, *Performance Management*, the experts agreed that it is beneficial to use metrics to measure the data governance progress to create an engagement among employees. However, it was discussed that a more suitable name for the element in the model might be "*Progress Measure*" since it is mainly about measuring the progress rather than ensuring that an organisation is performing in a single moment. The participants explained that, even though an organisation has well-defined performance metrics, they will not derive any value from them if not tracking the progress. The progress also needs to be properly communicated to the employees, according to both experts. E1 emphasised that "*It is important that the progress is shown on a common dashboard so that all employees can see the progress as this creates engagement and a feeling of responsibility*". It was further discussed that organisations at the lowest levels are not using metrics at all to track the progress. In contrast, organisations that have a few metrics defined that are monitored typically are somewhere in the middle of the scale. Only a few people are usually aware of the progress in these organisations. Additionally, E2 described that, if the metrics are providing a strategic direction, an organisation should be assigned the highest level.

Regarding the element *Knowledge & Change Management*, it was discussed that training for new and existing employees within data and data governance can help to mitigate potential resistance. Thus, organisations should have training for newly hired employees, enabling them to understand the data governance program from the beginning. In addition, they should also have continuous training for existing employees, to ensure that everyone keeps track of the program. E2 explained that for organisations to be on level five, they should have a structured program that includes mandatory training activities. Additionally, each employee would be measured individually. E2 further explained that many organisations have training sessions in place, but they struggle in getting the employees to attend the sessions. These organisations should be assigned a level in the middle of the scale, according to E2. Another aspect within change management is the mitigation of losing valuable information and knowledge when employees leave the company. *"It is very important that all processes that an employee executes are well documented and uploaded on a common space",* as stated by E1. E2 further explained that "*otherwise the company always needs to start the process over again, which is a waste of time and money*". If an organisation does not have any routines to prevent knowledge loss, it was agreed that they should be on level one.

4.1.2.2 Policies

The experts agreed, according to the theoretical framework, that the elements *Rules, Data Quality, Privacy and Data Privacy & Security* and *Data Lifecycle Management* belong to the dimension called rules. Reason being that these elements set criteria for the data itself and how to work with data.

The first element, *Rules*, refers to the processes and rules within data governance. One issue in organisations today is that rules are developed in silos which often makes them inapplicable for the whole organisation, as stated by E2. The experts agreed upon that in the ideal scenario the rules should be defined in collaboration with the data and business units, ensuring that they are changed in accordance with changes in the business. The rules should also be applicable throughout the organisation and be revised regularly as the business environment changes. One idea to ensure that this is enabled, suggested by E1, is to have a business glossary that captures all the rules.

Within the *Rules* element in the theoretical framework, it was stated that it is important to ensure that the rules are also being followed to comply with external regulations. The experts thought that this was more about whether there is an adherence to the created rules and thus not about the actual creation of the rules. Hence, it was suggested that the question and element should be placed under the dimension; *Capabilities* and as a separate element called "*Adherence*" since it is of high importance. E1 described that "*If the rules are integrated into systems and processes as well as continuously adapted to changes in the environment, people have no choice but to follow the rules*". Meaning, organisations that have controls in place to ensure that people follow the rules should be assessed a high level of maturity. However, if only having controls in place for some systems, a level on the middle of the scale should be assigned. For external regulations, it is instead important to assign someone responsible to ensure adherence and adopting these to the organisation. An organisation which has a centralised team responsible for adherence to external regulations and which translates these for the business to adopt is at level 5 on the maturity scale.

The next element is *Data Quality*, which the experts explained needed to be controlled. One way of controlling data quality is by having clear responsibilities to resolve issues within a certain time limit, according to respondents. In organisations where data quality is a joint responsibility of the entire company, the level of maturity is high. In contrast, organisations where a few people or teams are responsible for the quality should be assigned a lower level, while organisations that have clearly defined roles and responsibilities for data stewards are at level four. E1 described that "*it is important to have some means in place to reduce the number of data quality issues*". Organisations which are managing defects as they occur are typically assigned a lower level while those organisations that are continuously monitoring the quality should be assigned a higher level. It was mentioned by E2 that to have full control over the quality of data, there should be a central quality department. E2 mentions the importance of "*to measure and monitor the quality of data, and to continuously follow up the metrics*". E1 explained further that *"the measurement should be integrated into the different processes"*. If the data quality is not aligned with the current way of working, or if it is not a mandatory task in every activity, the organisation should be assigned the third level. This also requires that the routines for data quality are widely communicated throughout the organisation.

The experts described *Privacy & Security* as an increasingly important aspect of data governance that is crucial to monitor unusual patterns. E1 explained that only the people that need access to certain data assets should be granted access. To enable this, all privacy-, and

security standards should be communicated throughout the organisation. If there are no company-wide routines for communicating the standards, the organisation should be assigned a lower maturity level. Privacy and security are also important because it controls compliance to external regulations, for instance regarding data storage, as mentioned by the experts. It was further discussed that this requires all employees to be trained and aware of their responsibilities within data security. Moreover, it was agreed that it is important to investigate if and how an organisation is working to prevent data breaches. Examples of security systems could be access control, firewalls, regular monitoring etcetera. In addition, it was agreed upon that organisations should be prepared if a critical system goes down. Hence, the experts stated that organisations that execute regular tests and that have backups of systems to prevent data loss should be assigned the highest level of maturity.

The experts agreed upon the value of having a defined lifecycle for existing data, which strengthened the relevance of the *Data Lifecycle Management* element. The experts described that the number of lifecycle stages being defined determines the level of maturity for the organisation. The experts explained that it is important to be responsible for the creation and use of data as it is a crucial and expensive asset to have. E2 mentioned that, for organisations to be on level five, all data lifecycles should be defined. The expert further explained that most of the stages should be automated to mitigate the risk of human error. Another reason for having an automated lifecycle process was to work efficiently with the storage space. Meaning, if data only is deleted when needed due to lack of storage, an organisation should be assigned a lower level. In contrast, if data is deleted according to its lifecycle a higher level should be assigned. In addition, having automation of the archiving process is also beneficial to comply with external regulations, according to the experts. However, it was also elaborated on the importance of being extra careful with the critical data. All data should hence be classified, and the critical data should follow the most stringent standards.

4.1.2.3 Capabilities

For the *Capabilities* dimension, the experts agreed that the elements in the theoretical framework *Metadata Management, Master Data Management,* and *Business Intelligence* belong under the dimension since these elements are the execution and the result of the rules. In addition, as mentioned earlier, the experts thought that another element called *Adherence* should be included in this element.

Regarding the first element, *Metadata Management*, the experts discussed that the metadata should be easily accessible for all employees for the organisation to receive a high level. However, the value an organisation can derive from their metadata is not only dependent upon the accessibility of it, but also on the extent of coverage. As mentioned by E1, "*is the metadata organisation-wide, department-wide, system-wide? What metadata exists? Technical, business and/or operational*?". Hence, according to the experts, there are three types of metadata at Tech-X: technical, operational, and business. The experts further explained that an organisation which typically only has technical metadata for a few databases and applications is on a lower level of maturity. While organisations having both technical and operational metadata is in the

middle and organisations having all three types of metadata is at the highest level. Additionally, it was discussed that it is also important to have routines for reviewing and updating the metadata to ensure that it is useful. Regarding the process for updating metadata, E2 mentioned that "*an organisation which has an automated routine for updating metadata and a defined approval process, should be assigned the highest level of maturity*". Metadata that is only updated upon request should instead be assigned a lower level of maturity, according to the experts.

For *Master Data Management*, the experts discussed the importance of identifying a main system where changes happen. These changes should then be communicated to all other systems with the same master data. E2 described this as "*organisations have to decide which system is the master, then all the other systems will follow everything that happens in the master system*". Organisations that are planning to create a central repository for critical data such as customers and products are in the middle of the maturity scale. Other organisations with a central data repository where the changes happen for all their key data are at a high level of maturity.

For the *Business Intelligence* element, the experts mentioned that BI activities such as reporting, and analytics should be taken into consideration. The experts explained that if a lot of manual work is required to get hold of the correct data, an organisation should be assigned a lower level of maturity. In contrast, if the data is fully optimised, reported automatically and can be used for prescriptive and predictive analytics, the organisation should be assigned a high level. Another important aspect to investigate is whether the employees trust the data or not. "*If they do not trust the data, they will not use the data when making decisions*", as explained by E1. Additionally, the experts agreed that, if the data is controlled before being used, employees are more likely to use it for decision-making. Furthermore, the participants discussed how the level of automation of processes indicates the level of maturity. If integration of new data and controlling of existing data is automated, the level of maturity should be high. Nevertheless, if only the key data is automatically integrated and needs to be manually complemented with other data, the maturity level is somewhere in the middle of the scale. Additionally, it was discussed that to derive the highest value when it comes to business intelligence, there needs to be tools and techniques in place for moving data from one system to another in a structured way. Both experts explained that if an organisation randomly moves the data from one system to another the organisation should be assessed with a lower level of maturity. In contrast, organisations that move data with established rules and guidelines should be assigned a higher level.

4.1.3 Interviews & Assessment

The experts agreed upon that interviews with employees should be conducted and used to assess the maturity levels, according to both experts. This is because it is important to get their view on how an organisation is working with data governance and what is functioning and not. E2 highlighted that the interview sample should be decided based on the size of the organisation. For this study, 20 employees were considered a suitable sample. Another

important aspect mentioned to take into consideration is to ensure that the sample consists of employees from different departments and positions to ensure a widespread, according to both experts.

The experts also mentioned the importance of adapting the interviews and model to the specific needs of the organisation, since every organisation is unique. As described by E2 "*when using a data governance model, the organisation should always ensure that all parts are relevant for the organisational needs*". Hence, the elements and interview questions can be adapted, for instance by ignoring the parts that are not of relevance for the organisation or weighing the different elements. If the organisation feels that the levels cannot be determined by using the provided interview guide, it can be complemented by follow-up questions. In addition, expert 1 highlighted that, if needed, the interviews could be complemented with internal information, for instance by searching on the intranet.

4.2 Development of the TMT Data Governance Maturity Model

This section presents the data governance maturity model created in this study, the *TMT Data Governance Maturity Model*. The model has been created by comparing the findings from the theoretical framework with findings from the workshops, which has resulted in the model created in this study. First, the levels in the models are presented. Thereafter, the dimensions and elements, including questions and criteria for the levels in each element, are described. Finally, the model is visualised and instructions on how to use the model are presented.

4.2.1 Levels

The experts participating in the workshop stated that maturity levels are a crucial part of a maturity model. This is not only because levels make it easy to understand the current maturity level and what can be improved, but also as a maturity model makes it easy to track the progress. Meaning that using levels enable the user to identify if an organisation has advanced over time. Similarly, Kurniawan et al. (2019) and Olaitan, Herselman, and Wayi (2019) explain that a data governance maturity model can help an organisation to improve its data governance program by gaining an understanding of the organisation's current level and comparing that to the higher levels. In the existing literature, most maturity models consist of five maturity levels (Olaitan, Herselman, and Wayi, 2019). The experts also agreed that five levels of maturity are appropriate since it covers most of the different stages' organisations are in today. Therefore, in line with previous literature on maturity models and with the experts' opinions, it was decided that the model created in this study should include five levels.

Ladley (2012) and Saputra, Handika, and Ruldeviyani (2018) described that organisations at the first level are not having processes related to data governance in place and are working reactively. Organisations at level two have some processes in place for certain projects at a department level (ibid). Likewise, the experts discussed that organisations at level one is not aware of the importance of data governance while those at level two are seeing some need for

data governance and thus are starting some implementation effort, but the awareness is low since there is no structure for the communication of it.

Regarding level three, the experts explained that organisations typically have implemented a data governance program and have some plan for it but are only working with it short-term and it is only communicated to a few people. Therefore, they suggested that level three could be called proactive. Similarly, Ladley (2012) and Saptura, Handika, and Ruldeviyani (2018) stated that organisations that are at level three are working proactively with data governance.

Furthermore, at level four organisations have defined all processes and those are being controlled throughout the organisation (Ladley, 2012; Saptura, Handika & Ruldeviyani, 2018). Likewise, the experts described that organisations at level four know how to work with data governance and that these have a well-defined vision for how to derive value from it. However, they are having some difficulties adapting to changes. In addition, not everyone is aware of the program even though it has been communicated throughout the organisation.

Regarding the highest level of maturity, level five, Ladley (2012) and Saptura, Handika, and Ruldeviyani (2018) explained that organisations are managing data governance so effectively that they can work on continuous improvement of it. Correspondingly, the experts described that organisations at level five have such a good data governance program that they can adapt it to changes in the environment while everyone in the organisation is fully aware of it.

Based on the information obtained from the theoretical framework and the workshops, the five levels shown in figure 3 have been defined for the maturity model created in this study. The five levels will be used as the basis to define levels for each question and element in the model. The criteria for each level within each element and each question will be discussed in the next section “Dimensions & Elements”.

Figure 3: Descriptions of the levels of a data governance maturity model.

4.2.2 Dimensions & Elements

A finding retrieved both from literature and workshops was that the elements within data governance can be divided into three main dimensions. Saputra, Handika, and Ruldeviyani (2018) and Kurniawan et al. (2019) described that these could be *People, Policies,* and *Capabilities*. In contrast, E1 described that Tech-X commonly is using *“Ownership, Rules, and*

Execute" as dimensions of data governance. However, the experts agreed that the theoretical dimensions were more appropriate to use in the model to increase its adaptability to different organisations. Therefore, the created model is divided into the dimensions *People*, *Policies,* and *Capabilities*. Another finding emphasised by experts as well as Olaitan, Herselman, and Wayi (2019) is that the model needs to cover the different elements seen as important to evaluate an organisation's data governance program. In accordance with the experts' opinions, the awareness and communication aspect of data governance has been incorporated into other elements, and the adherence part of the *Rules* element has gained its own element called *Adherence*. Resulting in that the model consists of 13 elements that have been decided based upon the theoretical framework and the experts' opinion. Each element consists of one to five questions which are presented below.

4.2.2.1 People

In this section the elements within the dimension *People* (figure 4) will be analysed and presented.

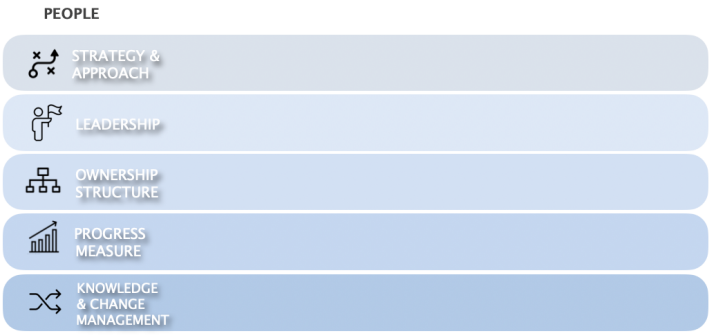

Figure 4: The elements within the People dimension.

4.2.2.1.1 Strategy & Approach

The element in the theoretical framework called Strategy, was suggested by the experts to be called "Strategy & Approach" to also include an organisation's approach to data governance. Accordingly, the name of the element was changed to *Strategy & Approach*. According to the experts, the data governance strategy determines and describes how an organisation should work to derive value from the data governance program. Connecting the data governance strategy to the business needs and goals was emphasized as crucial by Ladley (2012) and Korhonen et al. (2013) as well as by the experts. If not being connected to the business objectives, employees will not recognize the value of the data governance program (Ladley, 2012). Additionally, Ladley (2012), Cheon & Chang (2007) and Bhansali (2014) as well as the experts stated that it is important to involve employees in the data governance program. Also, as mentioned by the experts, a cross-functional team increases the likelihood that the strategy will be connected to the business objectives. However, even if the strategy is aligned with the corporate needs and goals, it will not create any value if the employees are not aware of it, being emphasized by Mosley (2010) and during the workshops. Additionally, the experts described that short and long-term activities on how to execute the strategy are vital to define. This because it both ensures that the data governance strategy is aligned with business needs

and goals and also because it makes it easy for the employees to understand what needs to be done.

Based upon the information retrieved from literature and workshops, in conjunction with the defined levels, the questions and levels in table 5 were defined for the *Strategy & Approach* element.

QUESTIONS 1. Is there a data governance program and strategy in the organisation? 2. Who has been part of shaping the data governance program and strategy? 3. Is the data governance strategy aligned with the corporate needs and goals? 4. How is the data governance strategy executed in the organisation? 5. Has the data governance program and strategy been communicated?				
LEVEL 1: UNAWARE Q1, Q2, Q3, Q4 & Q5. No program or strategy exists.	**LEVEL 2: AD HOC** Q1. A data governance program and strategy has been formulated but has not been implemented. Q2. The program and strategy have been formulated by one or two people. Q3. The program and strategy are not aligned with corporate needs and goals. Q4. Activities are executed in an ad hoc manner. Q5. The program and strategy have not been communicated. Only the people who have created the program and strategy are aware of it.	**LEVEL 3: PROACTIVE** Q1. A short-term program and strategy exists. Q2. The program and strategy have been created by a few key stakeholders. Q3. The program and strategy are to some extent aligned with corporate needs and goals. Q4. Some short-term activities are executed. Q5. The program and strategy have been communicated to some people. Some people in the organisation are aware of the program and strategy.	**LEVEL 4: MANAGED** Q1. A program and strategy, with some long-term activities, exist. Q2. The program and strategy have been created by an informal cross-functional team. Q3. The strategy and program are aligned with corporate objectives when created but not when updated. Q4. Some long-term prioritised activities are executed but these priorities are changing. Q5. The program and strategy have been communicated when created across the organisation. A majority are aware of these.	**LEVEL 5: OPTIMISED** Q1. A well-defined program and strategy with long-term activities exist. Q2. The program and strategy have been created by the data governance council. Q3. The program and strategy are aligned with corporate needs and goals. Q4.There is a clear roadmap on short- and long-term activities. Activities are re-prioritises as needed. Q5. The program and strategy are communicated and published for everyone, both when created and updated. Everyone is aware of these.

Table 5: Descriptions of the questions and levels within the Strategy & Approach element.

4.2.2.1.2 Leadership

To have leaders that are committed to the data governance program were emphasised as crucial by Bhansali (2014) and Ladley (2012) as well as by the experts. Therefore, it is seen as necessary to understand and investigate why leaders want to work with data to see if they understand the value of it. The leaders are also responsible for ensuring that there is a data governance strategy (Bhansali, 2014) and should therefore also participate in the strategy making. However, the experts' stated that a leader that is very committed is not only involved in the strategy-making but also in the execution of it. As discussed during workshops, the level of involvement indicates how they value data governance. In addition, Ladley (2012) described that it is very important that managers are following the rules related to data governance as this creates an encouragement among other employees to do the same. Similarly, during the workshops, it was expressed that it is interesting to investigate how employees describe the value of data to leaders as this might differ from the leaders' view. Foley and Gulliemette

(2010) also stated that management should work towards making data a part of the decision-making process. If organisations work with data-driven decision making, they should be assigned one of the higher levels of maturity, according to the experts.

Based upon the information retrieved from literature and workshops in conjunction with the defined levels, the questions and levels in table 6 were defined for the *Leadership* element.

QUESTIONS				
1. What is the value of data to leaders? 2. How would you describe leaders' involvement in the execution of the data governance strategy? 3. How does the organisation make decisions?				
LEVEL 1: UNAWARE	**LEVEL 2: AD HOC**	**LEVEL 3: PROACTIVE**	**LEVEL 4: MANAGED**	**LEVEL 5: OPTIMISED**
Q1. Leaders see data solely as an IT asset Q2. Leaders are never involved in data-related initiatives. Q3. Decisions are based on experience and gut-feeling.	Q1. Leaders see data as necessary to comply with external regulations. Q2. Leaders have some insights in the strategy making, but they are not involved. Q3. Decisions are mostly based upon experience but some data is used.	Q1. Leaders see data as important for the operational work. Q2. Leaders participate in roadmap-setting of the strategy. Q3. Decisions are based upon data in conjunction with experience.	Q1. Leaders see data as important to drive business growth. Q2. Leaders are continuously participating in strategy-making and to some extent in the execution of it. Q3. Most decisions are based upon data.	Q1. Leaders see data as a crucial asset that is significant to gain competitive advantage. Q2. Leaders are committed and involved in the execution of the strategy. Q3. Data is the back-bone of every decision.

Table 6: Descriptions of the questions and levels within the Leadership element.

4.2.2.1.3 Ownership Structure

One of the most important aspects regarding data governance is having an ownership structure with clearly defined roles and responsibilities (Ladley, 2012; Bhansali, 2014). Likewise, the experts explained that if there is no clear ownership structure no one will take care of the data. However, being emphasised during workshops, it is important to also ensure that the ownership structure has been communicated to the organisation and make it available to ensure that employees know whom to contact if having any issues. Communication is described as a key component to strong data governance by Bhansali (2014) and Sarsfield (2009). During the workshops it was also discussed that there can be different people who own the data and who manage it. In addition, the experts mentioned that some data assets might have multiple owners, and, in such cases, it is very important to decide upon a main owner who takes the main responsibility. Making it interesting to investigate the attitudes towards this in the organisation.

Based upon the information retrieved from literature and workshops in conjunction with the defined levels, the questions and levels in table 7 were defined for the *Ownership Structure* element.

QUESTIONS 1. Who owns the data assets in the organisation? 2. Who manages the data assets in your organisation? 3. How should data assets that have multiple owners be handled?				
LEVEL 1: UNAWARE Q1 & Q3. No clear ownership structure exists. Q2. No one manages the data.	**LEVEL 2: AD HOC** Q1. Some ownership is assigned on a system level. Q2. Data is managed in silos. Q3. No structure for managing multiple owners.	**LEVEL 3: PROACTIVE** Q1. There is an informal network of stakeholders who take responsibility for some data assets. Q2. The informal network of stakeholders manage some data assets. Q3. Multiple ownership should be allowed for certain assets.	**LEVEL 4: MANAGED** Q1. An ownership structure is defined for the majority of data assets with clearly defined roles and responsibilities. Q2. There is a central team responsible for managing data assets. Q3. A framework for managing multiple ownership exists.	**LEVEL 5: OPTIMISED** Q1. There is a clearly defined ownership structure. All employees know who to contact if having questions regarding data. Q2. All data assets are managed. Regular meetings are held to revise the ownership. Q3. A main owner is decided jointly for data assets with multiple owners.

Table 7: Descriptions of the questions and levels within the Ownership element.

4.2.2.1.4 Progress Measure

In the theoretical framework, the element called "Performance Management" was suggested by the experts to be called "Progress Measure" since it focuses on metrics to measure the progress rather than ensuring that the organisation is performing. Therefore, the element is called *Progress Measure* in the model created in this study. According to the experts, one benefit of using metrics is that it creates engagement among employees. Likewise, Bhansali (2014) explained that metrics create a feeling of responsibility, and Ladley (2012) explained that metrics are needed to measure the effectiveness of a data governance program. However, as discussed during the workshops and indicated by Ladley (2012), it is not enough to only have metrics in place, they also need to be monitored. According to experts, monitoring of metrics can provide organisations with a strategic direction. Additionally, to derive value from the metrics is vital to ensure that the metrics, as well as the progress, are being shown in a commonplace or communicated throughout the organisation.

Based upon the information retrieved from literature and workshops in conjunction with the defined levels, the questions and levels in table 8 were defined for the *Progress Measure* element.

QUESTIONS 1. To what extent are metrics defined to measure the progress of the data governance program? 2. How are these metrics monitored? 3. How is the progress communicated?				
LEVEL 1: UNAWARE Q1, Q2 & Q3. No data governance program exists.	**LEVEL 2: AD HOC** Q1: A data governance program exists but no performance metrics are defined. Q2: Since metrics do not exists no monitoring exists Q3: Since metrics do not exist no communication exists.	**LEVEL 3: PROACTIVE** Q1. A few performance metrics have been defined but more are required. Q2. The metrics are to some extent monitored. Q3. Only a few people are aware of the progress.	**LEVEL 4: MANAGED** Q1. A majority of the performance metrics have been defined. Q2. The metrics are monitored, but no focus on the progress on a strategic level. Q3. Only the main stakeholders are aware of the progress.	**LEVEL 5: OPTIMISED** Q1. All performance metrics have been defined. Q2. The metrics are monitored and provide a strategic direction. Q3. The progress is published openly on dashboards.

Table 8: Descriptions of the questions and levels within the Progress Measure element.

4.2.2.1.5 Knowledge & Change Management

Ladley (2012) emphasised that the likelihood of resistance towards data governance programs among employees is high at the beginning of a program. Therefore, it is important to investigate the attitudes among employees to understand how to decrease potential resistance. Additionally, Ladley (2012) described that to mitigate resistance it is important to educate the employees in data governance. Likewise, during workshops, it was discussed that not only new employees should be informed and trained regarding data and data governance. Instead, an organisation should have recurring training sessions for all employees to ensure that everyone keeps track and has the knowledge required. Preferably, these training sessions should be mandatory. Further on, mitigating the risk of losing important knowledge when employees leave the company is important for all activities within an organisation, according to the experts and Bhansali (2014). Therefore, Bhansali (2014) described that it is important to ensure that documentation is being kept, which reduces the risk that knowledge and important information get lost. Similarly, during the workshops, it was agreed that it is important to have well-defined routines for mitigating knowledge loss related to data. The documentations, routines, and other necessary information should be able to be found in a commonplace. Hence, it is important to have well-defined on- and off-boarding processes.

Based upon the information retrieved from literature and workshops in conjunction with the defined levels, the questions and levels in table 9 were defined for the *Knowledge & Change Management* element.

QUESTIONS 1. How would you describe the understanding and the value of data governance in the organisation? 2. Does your organisation have a data training program? 3. How do you mitigate the risk that knowledge and routines related to data get lost when an employee changes position or leaves the company?				
LEVEL 1: UNAWARE	**LEVEL 2: AD HOC**	**LEVEL 3: PROACTIVE**	**LEVEL 4: MANAGED**	**LEVEL 5: OPTIMISED**
Q1. No data governance program exists. Q2. No data training program exists. Q3. There are no routines to prevent knowledge loss.	Q1. The organisation understands the value of data governance, but has not implemented it since employees are reluctant to change. Q2. Data training programs exist but employees are not aware of it. Q3. Some individuals are documenting their work.	Q1. The organisation has implemented data governance, but most employees are reluctant to change. Q2. Data training sessions happen on individual interest. Q3. Some individuals are documenting their work and share these in a commonplace.	Q1. The organisation has implemented a data governance program which most employees are working according to. Q2. Non-mandatory data training programs exist and are offered to everyone. Q3. There are central routines for preventing knowledge loss.	Q1. The organisation has a fully implemented data governance program which all employees embrace. Q2. Mandatory data training programs exist, measuring each individual's progress. Q3. Well-defined central on-boarding and off-boarding routines, documents commonly shared.

Table 9: Descriptions of the questions and levels within the Knowledge & Change Management element.

4.2.2.2 Policies

In this section the elements within the dimension *Policies* (figure 5) will be analysed and presented.

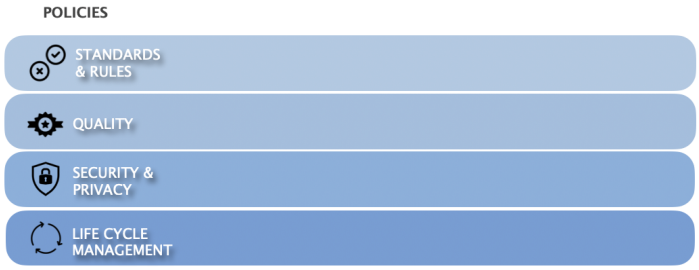

Figure 5: The elements within the Policies dimension.

4.2.2.2.1 Rules

During the workshops it was agreed that one common issue related to rules is that internal rules are developed in silos, meaning that each team develops its own data rules. According to experts, in the ideal scenario, the rules should be developed in collaboration between the data- and business units. Similarly, Bhansali (2014) described that rules should be cross-functional and applied across the organisation, therefore they should not be developed by individual departments. However, they should still be aligned with the needs of different departments and with the objective of the organisation to be of value (Bhansali, 2014). In addition, as the business environment changes, it is also vital to adapt and revise the internal rules regularly, according to experts. One way to increase the understanding of the rules, as mentioned by the

experts as well as Soares (2014), is to use a commonplace where rules and definitions related to data are described. This should be accessible and communicated to all employees to ensure that employees are aware of them (Kurniawan et al. 2019; Bhansali, 2014).

Based upon the information retrieved from literature and workshops in conjunction with the defined levels, the questions and levels in table 10 were defined for the *Rules* element.

QUESTIONS				
1. How are data related rules developed? 2. Are data rules applicable to the whole organisation or do each department have their own? 3. What is the frequency for revising data rules? 4. Is there a commonplace where data rules and definitions are captured? How are the rules communicated?				
LEVEL 1: UNAWARE	**LEVEL 2: AD HOC**	**LEVEL 3: PROACTIVE**	**LEVEL 4: MANAGED**	**LEVEL 5: OPTIMISED**
Q1, Q2, Q3, & Q4. No data governance program exists, hence no data rules exist.	Q1. Each department develops their own rules. Q2. Each department applies their own rules. Q3. No routine for revisement. Q4. No commonplace for capturing data rules and definitions exists.	Q1. The rules are developed by a few stakeholders. Q2. A few rules are applied across the organisation. Q3. Revisement sessions are only held when needed. Q4. Data rules and definitions are captured in a commonplace but employees do not know that they exist.	Q1. The rules are developed based upon needs from departments. Q2. The majority of the rules are applied across the organisation. Q3. There are some planned sessions held for revisement. Q4. A commonplace exists for some rules and definitions. Some employees are aware of it.	Q1. These are developed in collaboration with business units and adopted to changes. Q2. All rules are applied across the organisation. Q3. There are calendar based sessions held for revisement. Q4. All data rules and definitions are captured and defined in a commonplace which everyone is aware of.

Table 10: Descriptions of the questions and levels within the Rules element.

4.2.2.2.2 Data Quality

According to Salido (2012), all employees should together be responsible for data quality. This was also emphasised by experts who agreed that organisations recognising data quality as a joint responsibility of the entire company or have assigned the responsibility on data owners or stewards are more mature. During the workshops, it was also discussed that there is a need to investigate how a company is working to reduce the risk of data issues. It was agreed upon that continuous monitoring of the data quality and using metrics to keep track of the progress is a good way to ensure that the quality is high. Likewise, Ladley (2012) described that having an ongoing evaluation of data quality helps organisations to identify poor data quality at an early stage. However, as mentioned during workshops, it is beneficial to have a central quality department that can manage all data issues. Furthermore, the awareness and communication of routines related to data quality are crucial, being mentioned by both the experts and by Mosley (2010).

Based upon the information retrieved from literature and workshops in conjunction with the defined levels, the questions and levels in table 11 were defined for the *Data Quality* element.

QUESTIONS 1. Who/which department is responsible/accountable for the data quality? 2. What processes are in place for monitoring data quality? 3. What steps are taken to reduce data quality issues? 4. Are routines for data quality communicated?				
LEVEL 1: UNAWARE	**LEVEL 2: AD HOC**	**LEVEL 3: PROACTIVE**	**LEVEL 4: MANAGED**	**LEVEL 5: OPTIMISED**
Q1 & Q2. Nobody is responsible for the data quality. Q3. No steps taken to reduce data quality issues. Q4. Data quality is not measured.	Q1. No formal data quality responsibilities exist. Q 2. Data quality is not a focus in the operational work therefore rarely measured. Q3. Data quality issues are handled when key system crashes or customers complain. Q4. No structure for communication of data quality routines.	Q1. A quality department is established. Q2. Some data quality metrics and routines are defined and monitored. Q3. Some data analysis and correction activities exist, but issues are mainly managed as they appear. Q4. A few people are aware of the routines and know where to find them.	Q1. A data quality department and data stewards are identified. Q2. Metrics are defined and monitored on a regular basis. Q3. Data analysis and correction activities exist to protect critical data. Q4. The majority are aware of the routines and know where to find them	Q1. A data quality department and data stewards exist, but data quality is seen as a joint responsibility of the entire company. Q2. Metrics are defined and continuously monitored. Q3. Data analysis and correction activities exist to protect all data. Q4. Routines are communicated and available for the entire organisation. Everyone is aware of their responsibilities.

Table 11: Descriptions of the questions and levels within the data quality element.

4.2.2.2.3 Data Security & Privacy

According to both Keith (2013) and the experts, organisations need to ensure that only eligible people have access to the data. This can, for instance, be made by creating security and privacy standards that state who should have access to what data (Keith, 2013; Bhansali, 2014). As mentioned during the workshops and by Mosley (2010), these standards should be communicated to ensure that people are aware of their responsibility. During the workshops, it was further discussed that it is important that organisations have processes in place to manage and prevent data breaches. In line with this, Bhansali (2014) described that organisations can use methods to manage this, such as firewalls, access controls, and detection and mitigation controls to increase the safety level. Additionally, the experts agreed that it would be interesting to investigate how an organisation acts if or when a critical system is down, to understand whether they are prepared or not. Meaning that regular tests and backups of systems should preferably be executed to reduce the risk of data loss, which was also emphasised by Balakrishnan, Das, and Chattopadhyay (2020).

Based upon the information retrieved from literature and workshops in conjunction with the defined levels, the questions and levels in table 12 were defined for the *Data Security & Privacy* element.

QUESTIONS 1. Are there any data privacy/security standards, such as access, in place? 2. How are the data privacy and security standards being communicated? 3. What is the process for preventing or managing data breaches? 4. If a critical system goes down, what is the process for data disaster recovery?				
LEVEL 1: UNAWARE Q1, Q2, Q3 & Q4. No privacy or security standards exist.	**LEVEL 2: AD HOC** Q1. Standards have been developed but not implemented. Standards for granting access are therefore neither implemented. Q2. Since the standards have not been implemented they have not been communicated. Q3. Data breaches are managed as they appear. Q4. Most data losses are never recovered.	**LEVEL 3: PROACTIVE** Q1. Standards are being implemented and rolled out to some business units. External access restrictions exist, but not internal. Q2. Standards are communicated but there is no formal routine for it. Q3. Vague processes exist for how to manage data breaches. Q4. Each system failure is managed and recovered in its own way.	**LEVEL 4: MANAGED** Q1. All standards are implemented for all critical data assets but not regularly monitored. External and internal standards exist for how data access is granted. Q2. Standards are published in a commonplace and regularly communicated. Q3. Well-defined processes exist for how to manage data breaches. Q4. There is a roadmap in place to manage data loss.	**LEVEL 5: OPTIMISED** Q1. All standards are implemented and all critical data assets are monitored regularly. Only the people that need access are granted access internally. Q2. All standards are communicated and easily accessible. Employees are trained and aware of their responsibilities. Q3. Data breaches are prevented through access controls, firewalls etc. Q4. There are regular back ups and tests to ensure recovery of critical systems.

Table 12: Descriptions of the questions and levels within the Data Security & Privacy element.

4.2.2.2.4 Data Lifecycle Management

Data governance creates rules for how to manage data during its whole lifecycle, i.e., how the data should be created, used, retained, and archived (Ladley, 2012; Bhansali, 2014; Alhassan, Sammon & Daly, 2016). Data lifecycle management is, for instance, important for organisations to work efficiently with their costs (Khatri & Brown, 2010). Hence, making it interesting to investigate to what extent an organisation has defined the lifecycle for its data. In line with this, the experts highlighted that it is beneficial if the process for archiving is automated. An automated process increases the likelihood that the data actually will be deleted and that it conforms to external regulations while mitigating the risk of human error, according to the experts. In addition, it was discussed that defining the lifecycle is even more important for critical data. Thus, it is important that the critical data is identified, and that data is classified with regard to its criticality. Furthermore, the experts mentioned that it is beneficial if a company succeeds with creating an awareness of the data lifecycle throughout the organisation.

Based upon the information retrieved from literature and workshops in conjunction with the defined levels, the questions and levels in table 13 were defined for the *Data Lifecycle Management* element.

QUESTIONS 1. To what extent do your data assets have a defined lifecycle? 2. Are there any established processes for data archiving? 3. Have the critical data been identified or is all data treated equally?				
LEVEL 1: UNAWARE	**LEVEL 2: AD HOC**	**LEVEL 3: PROACTIVE**	**LEVEL 4: MANAGED**	**LEVEL 5: OPTIMISED**
Q1, Q2 & Q3. There is no data lifecycle management.	Q1. Some data have the creation stage defined but not other stages. Q2. Data is archived when there is a lack of storage. Q3. Critical data has not been identified.	Q1. Some data have several stages of their lifecycle defined. Q2. Unused data is archived yearly. Q3. Some critical data has been identified.	Q1. The majority and/or critical data has the whole lifecycle defined. Q2. Critical data is archived according to the lifecycle. Q3. A majority of the critical data has been identified.	Q1. All data has the whole lifecycle defined. Q2. All data is archived automatically and according to the lifecycle. Q3. All critical data has been identified.

Table 13: Descriptions of the questions and levels within the Data Lifecycle Management element.

4.2.2.3 Capabilities

In this section the elements within the dimension *Capabilities* (figure 6) will be analysed and presented.

Figure 6: The elements within the Capabilities dimension.

4.2.2.3.1 Metadata Management

Metadata is information about other data (Keith, 2013). Bhansali (2014) stated that the metadata needs to be easily accessible as well as available to the people who need it, which was also highlighted by the experts. Four categories of metadata were mentioned in literature: business, technical, process, and operational metadata (Bhansali, 2014). However, during the workshops, the experts discussed that three types of metadata exist at Tech-X, namely technical, business, and operational metadata. Thus, since the model created has been adopted to Tech-X's business, it will not include process data. However, this can be adjusted by other organisations if needed. The experts highlighted that it is interesting to investigate the extent of coverage of the types of metadata throughout an organisation. Furthermore, the experts discussed that it is also important for an organisation to have routines for reviewing and updating the metadata. The routines should preferably be automated.

Based upon the information retrieved from literature and workshops in conjunction with the defined levels, the questions and levels in table 14 were defined for the *Metadata Management* element.

QUESTIONS				
1. How accessible is the metadata? 2. What is the extent of coverage of metadata? 3. What is the process for updating and reviewing metadata?				
LEVEL 1: UNAWARE	**LEVEL 2: AD HOC**	**LEVEL 3: PROACTIVE**	**LEVEL 4: MANAGED**	**LEVEL 5: OPTIMISED**
Q1, Q2 & Q3. No metadata management exists.	Q1. Access is provided on request. Q2. Some technical metadata exists on system level. Q3. Metadata is manually updated when necessary.	Q1. Access is provided to a few users through a specialised tool. Q2. Technical metadata exists for most data and operational metadata exists for some metadata. Q3. There are some manual processes for updating metadata.	Q1. Access is provided to several users through a specialised tool. Q2. Technical and operational exist for most data. Some business metadata exists. Q3. There are well-defined processes for updating metadata with periodic reviews, some being automatic.	Q1 Access is provided to all users through a user friendly tool. Q2. Technical, operational and business metadata exist for all data assets. Q3. Metadata is updated and reviewed automatically.

Table 14: Descriptions of the questions and levels within the metadata management element.

4.2.2.3.2 Master Data Management

As mentioned by Keith (2013) and Soares (2014), MDM guarantees that an organisation only uses one version of its master data. Similarly, during the workshops, it was discussed that organisations must decide upon a main system or repository where all changes to a data asset happen. The changes should thereafter be connected and changed accordingly in the other systems with the same master data, according to the experts. This reduces the risk that different versions of one data will be used and thus potential silos between different departments could be overpassed (Riikka & Pekkola, 2017). Additionally, the experts described that an organisation ensuring that there is only one version of its master data is vital to understand their level of maturity.

Based upon the information retrieved from literature and workshops in conjunction with the defined levels, the question and levels in table 15 were defined for the *Master Data Management* element.

QUESTIONS				
1. How is it ensured that only one version of the data exists?				
LEVEL 1: UNAWARE	**LEVEL 2: AD HOC**	**LEVEL 3: PROACTIVE**	**LEVEL 4: MANAGED**	**LEVEL 5: OPTIMISED**
Q1. No master data management exists.	Q1. A central repository does not exist, but MDM is to a small extent manually managed.	Q1. A central repository is planned to be implemented for key data assets.	Q1. A central repository exists, but only for key data assets.	Q1. A central repository exists for all data assets.

Table 15: Descriptions of the questions and levels within the master data management element.

4.2.2.3.3 Business Intelligence

According to Keith (2013) and Ladley (2012), BI refers to techniques that transform raw data into valuable information that are analysed and used in decision making. During the workshops, it was described that initially, it is important to investigate if the data in an organisation can be used for BI activities, such as analytics and reporting. Furthermore, Ladley (2012) stated that data governance helps to make sure that the data used in BI activities are trustworthy. Similarly, the experts discussed that there is a need to investigate if the employees of an organisation trust the data to understand if they are willing to use it for decision making. As explained further by the experts, if the data is being controlled before use, it is a higher possibility that the organisation will trust the data. Additionally, the experts mentioned that another interesting aspect to investigate is to what extent the process of integration of new data and controlling of existing data is automatic. It was also discussed that data sometimes needs to be moved from one system to another to be able to analyse it. Making it interesting to understand whether or not tools and techniques for moving data are available.

Based upon the information retrieved from literature and workshops in conjunction with the defined levels, the questions and levels in table 16 were defined for the *Business Intelligence* element.

QUESTIONS				
1. To what extent are requirements for BI activities fulfilled? 2. Is the data controlled before use? 3. What is the level of automation for integrating new data and controlling existing data? 4. Are there standards in place for moving data in a structured way?				
LEVEL 1: UNAWARE	**LEVEL 2: AD HOC**	**LEVEL 3: PROACTIVE**	**LEVEL 4: MANAGED**	**LEVEL 5: OPTIMISED**
Q1. No BI activities are executed. Q2. No data is controlled before use. Q3. No automation in the integration of data. Q4. No standards for moving data exist.	Q1. BI activities are executed, but solely manually. Q2. A minority of the data is controlled before use but the sources are not reliable. Q3. The data is manually integrated and controlled. Q4. No standards for moving data exist, hence data is moved when necessary.	Q1. BI activities are executed, mostly manually, but automatic to some extent. Q2. Some data is controlled before use, some data sources are reliable . Q3. A small part of the data is integrated and controlled automatically. Q4. Some standards for moving data exist, but not all data is moved accordingly	Q1. A roadmap for BI activities exists. Q2. Only critical data is controlled before use and a majority of the data sources are reliable. Q3. All critical data is controlled and integrated automatically. Q4. Standards exist for moving data, most data is moved accordingly.	Q1. Data is optimised to meet the analytical needs for BI activities. Q2. All data is controlled before use and all data sources are reliable. Q3. All data is controlled and integrated automatically. Q4. Well-defined standards exist for moving data, all data is moved accordingly. .

Table 16: Descriptions of the questions and levels within the business intelligence element.

4.2.2.3.4 Adherence

Both Bhansali (2014), Cheon & Chang (2007) and the experts described that an organisation needs to ensure that rules are being followed. However, the experts expressed that compliance to internal rules and external regulations is more about adherence rather than the actual creation of rules. In addition, they thought that adherence is a crucial part of data governance and should

therefore have its own element. Therefore, these questions have been placed under the dimension *Capabilities* and under the element called *Adherence*, instead of under the *Rules* element as in the theoretical framework. The experts discussed that organisations should have control practices in place and integrated in systems for adherence to internal rules. However, for external data regulations it is important to investigate if the organisation has assigned someone as responsible for meeting those.

Based upon the information retrieved from literature and workshops in conjunction with the defined levels, the questions and levels in table 17 were defined for the *Adherence* element.

QUESTIONS 1. Are there any controls in place to ensure adherence to internal data rules and standards? 2. Who is responsible for adherence to external data regulations?				
LEVEL 1: UNAWARE Q1. No data governance practice exists. Q2. Nobody is responsible for adherence to external data regulations.	**LEVEL 2: AD HOC** Q1. Controls for rules and standards do not exist. Q2. A few people are specialised in external regulations, these are not widely accessible.	**LEVEL 3: PROACTIVE** Q1. Controls for rules and standards related are implemented as needed. Q2. There is an informal network of people responsible for adherence to external regulations.	**LEVEL 4: MANAGED** Q1. Controls for rules and standards related to critical data are implemented. Q2. A formal centralised team is responsible for adherence to external regulations.	**LEVEL 5: OPTIMISED** Q1. Controls for all rules and standards are implemented for all data. Q2. A formal centralised team is responsible for adherence to external regulations and which translates these for the business to adopt.

Table 17: Descriptions of the questions and levels within the adherence element.

4.2.3 Overview of the TMT Data Governance Maturity Model

An overview of the TMT Data Governance Maturity Model is presented in figure 7 below. In addition, recommendations on how the interviews could be conducted are presented.

The TMT Data Governance Maturity Model consists of five levels, three dimensions, and 13 elements (figure 7). These have been chosen based on the theoretical framework (see 2.7) and the workshops with data governance experts (see 4.1). The criteria for each level have been defined both on a general level (figure 3), for each element and question (see 4.2.2). Each element consists of one to five interview questions that should be asked to employees. The answers from the interviews will later be used to assess the maturity levels. A compilation of all questions can be found in appendix 9 and an example of the process for defining the questions can be found in appendix 5. Note that, before applying the maturity model, it is important to adapt it to the individual organisation, according to Kurniawan et al (2019) and the experts.

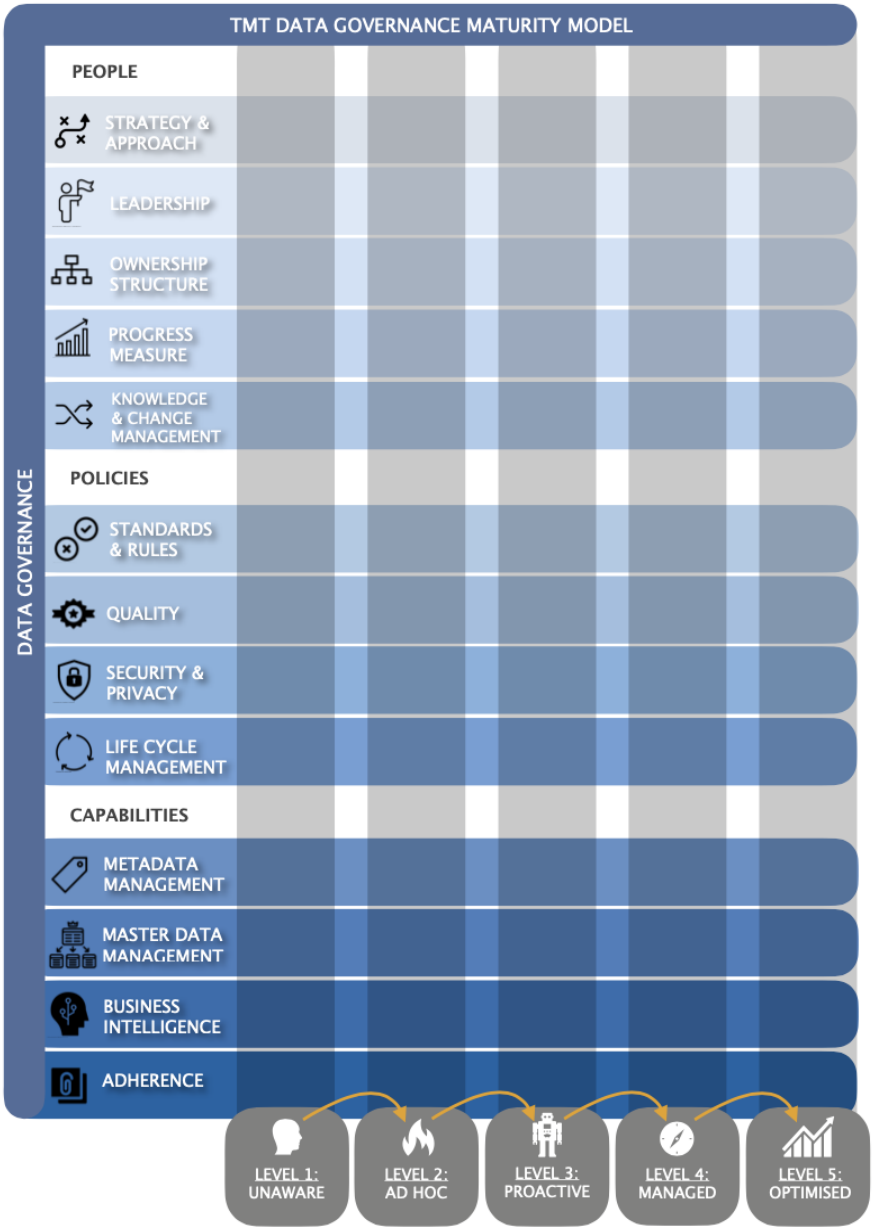

Figure 7: The created model; the TMT Data Governance Maturity Model.

Interviews

To use the model, and assess the levels of maturity, interviews with employees should be conducted. During workshops, the experts highlighted the importance of interviewing employees in different positions and departments of the organisation to get a comprehensive view of the current status of the data governance program. The number of interviews should be decided based on the size of the organisation, according to E2. To use as reference, 20 interviews were conducted on the case company, with approximately 500 employees, in this study. An interview guide, with the questions included in the model can be found in appendix 9. The interview questions could be complemented with follow up questions during interviews. Expert 1 highlighted, if needed to accurately assess the levels, the interviews could be complemented with internal information, for instance by searching on the intranet. Based on the findings from interviews, levels can be assigned for all elements. Insights from testing the model will be presented in 5.4. In appendix 10, instructions for using the model can be found.

5. Testing the TMT Data Governance Maturity Model

The purpose of this chapter is to apply the TMT Data Governance Maturity Model to Tech-X to test the model's feasibility and to understand how it supports organisations in improving data governance. First, the findings from interviews with employees at Tech-X will be presented. Thereafter, the information retrieved from interviews will be discussed in relation to the TMT Data Governance Maturity Model and Tech-X's levels of data governance will be determined. This is followed by an identification and analysis of improvement areas for Tech-X. Finally, insights from testing the model are analysed and presented.

5.1 Findings from Interviews with Employees

In this section, the information retrieved from the interviews with employees at Tech-X are presented. The section is structured according to elements in the created *TMT Data Governance Maturity Model* (see section 4.2).

5.1.1 Strategy & Approach

E1 and R1 described that Tech-X has a data strategy that data governance is a part of. The data governance strategy was created approximately six months ago. It was created through workshops with around 20 people who were representing different parts of the organisation. However, R1 explained that the data governance strategy is not publicly available and states that this is a problem. This can be shown as 11/20 respondents were not aware of the data governance strategy and only a few of the other nine knew what it was about.

R4 stated that "*A data governance strategy exists but you cannot use it, it is not relevant*". R15 and R18 described accordingly that the strategy is too visionary and not adaptable to the real working tasks of the employees. As explained by R18, *"It is difficult to apply the strategy to the job that is performed on lower levels in the organisation"*. The respondent suggested that it needs to be further broken down to the actual activities in the organisation. E1 also stated that the data governance strategy is not aligned with the business goals and needs. Likewise, E1 described that short- and long-term activities of the strategy have not been identified and thus the strategy cannot be executed.

According to E1, R1, and R4 a data governance program with a revision cycle exists. This is also accessible for all employees. However, R1 explained that the awareness of it is quite low, since "*It does not add any value to their employees' practical tasks*". However, 14/20 respondents answered that they did not know if a data governance program exists. R2 explained that "*I am not aware of the data governance strategy or data governance program so I do not think that it can have been communicated. In general, I do not think that there is so much talk about data governance as it should be*". R13 described that "*If this is important, it needs to be communicated more*". Many respondents also explained that you need to have a data

governance strategy and data governance program which actually are of value to people and which can make their daily work easier, otherwise people will not follow it.

5.1.2 Leadership

The respondents agreed that data governance is important for leaders at Tech-X. In addition, the top management team have also been involved in the creation of the data governance strategy. R1 for instance highlighted that the Vice President and the Head of Strategy participated. Additionally, Tech-X has hired a Chief Digital Officer which is responsible for topics such as data governance. E1 described that leaders were involved in the creation of the strategy, however, they could commit more time and effort regarding the execution of it. When the respondents were asked why leaders at Tech-X want to work with data governance, several of the respondents (9/20) answered that it is crucial for their product. Other reasons mentioned by the respondents were to meet external regulations, to decrease costs or to be seen as a data-driven company.

R7 and R10 described that leaders prefer decisions to be based upon data, but it is up to each decision-maker. However, how a decision is being made in the organisation seems to differ among teams. R4 described that a majority of the teams make decisions based upon both data and experience. Similarly, R15 described that its team does not have all the data needed to only make decisions based upon data, therefore they need to combine it with experience. Contrary, R6 described that the respondent and its team make the majority of the decisions based upon data. However, most of the respondents stated that all decisions in practice cannot be based upon data, and therefore experience is used to a wider extent than data.

5.1.3 Ownership Structure

One of the main issues of the data governance strategy and program, mentioned most frequently by the respondents, was the ownership structure. E1 described that data ownership is assigned and documented on a system level but not on a content level. However, only 5/20 were aware that documented information on data ownership exists. Meaning that the majority of the respondents (15/20) were not aware of the ownership structure. The ones who were aware of it considered it to be unclear. R4 explained that "*I know that there exists documentation for the ownership framework, but the issue is that it is not adapted to the operational tasks at Tech-X"*. The respondent also explained that, in some cases, an owner has been decided but the owner itself does not recognize it as the owner of the data. R1 further explained that "*The ownership framework is in general unclear and needs further improvement, it is difficult to know who is responsible for what data"*. Similarly, R10 indicated that the formal ownership structure might not reflect the organisation.

Regarding the question, who manages the data, the majority of the respondents did not see how it differed from who was owning it. Other respondents thought that the team using the data also is responsible for managing it. R9 argued that the ownership and management of certain data should be questioned; "*Is it the owner or the user who actually uses the data in the daily*

work?". R9 and R11 stated that it is important to decide upon whether it is the owner who should determine if data can be deleted or not. In that case, the owner needs to collaborate with the employees who are using the data to know when it can be deleted.

Furthermore, regarding multiple owners, some respondents mentioned that they in general thought that problems could arise if having several owners of a data asset and thus that it is beneficial to assign a main owner. In contrast, R14 stated that sometimes it can be favourable to have multiple owners, especially if there are multiple teams who use the data. The respondent further explained that even if one team thinks that the data can be deleted another team using the same data might still need it.

5.1.4 Progress Measure

According to E1, some metrics related to data governance on an organisation level exist at Tech-X. However, 14/20 respondents were not aware that metrics existed. Some respondents indicated that metrics probably exist, but they did not know which or where those could be found. R4 described that "*We probably have some metrics. But since I do not think that the data governance strategy or program is reflecting the organisation, I am unsure if these are relevant*". Furthermore, since the knowledge regarding metrics related to data governance was low among the respondents, no one of the respondents knew how these metrics were monitored or tracked. In contrast, E1 described that the metrics are tracked and monitored but only the people working closely with data governance are aware of the progress. Even though the majority of the respondents were not aware that central data governance metrics existed, some respondents answered that their teams had their own metrics. These teams typically also show and communicate the progress openly on dashboards.

5.1.5 Knowledge & Change Management

Regarding resistance toward data governance in the organisation, R10 explained that "*The data governance strategy and program is a new thing and there is some resistance from employees. I mean some people just do not like change or that others tell them how to perform their work*". The respondent meant that it can be difficult to get people to follow the strategy and incorporate it into their work since it is new, and employees might not see the value of it. Several respondents mentioned that they think that there might be some resistance as the data governance strategy and program is not applicable on the operational work. R2 indicated that it might be an indirect resistance toward data governance as the understanding of the importance of it varies in the organisation. The respondent explained *"Many of the employees are coming from larger and more established organisations where data governance just works. So, these people have not needed to reflect over data governance as they need to do here at Tech-X, which can result in some resistance*". R14 explained that the way that Tech-X is working with data has become their culture. Meaning that the employees together have created their internal way of working.

When the respondents were asked if they had executed any training within data or data governance, the answers were widely spread. A few respondents mentioned mandatory courses in GDPR and IP as examples of training in place. Although, according to E1, no pure data governance training exists, only training for data security. The teams at Tech-X have different routines to prevent knowledge from getting lost when employees leave the company. R4 stated that "*It is important to ensure that the documentation of knowledge is a team responsibility and not an individual responsibility*". Some teams do not seem to have any processes for this. Other teams ensure to document as much as possible of necessary information or have implemented offboarding meetings to ensure that the process goes smoothly. However, several respondents explained that there is no central routine or process for the organisation on how to manage off-boarding in regard to mitigating data knowledge loss. However, R20 described that a map of the employees' knowledge is being made to know how to reduce the risk of losing it.

5.1.6 Rules

No organisation-wide rules related to data governance exist at Tech-X, according to E1. Instead, 9/20 respondents answered that their teams had defined their own rules. R4 described "*My team has created rules that apply for us, but we have not used the data governance program to develop these*". Although, the teams which have created their own rules do not typically have a commonplace where those can be found. The rest of the respondents were not aware if their teams had defined any rules related to data. R2 expressed that "*The team responsible for the data governance program needs to work a lot more with clarifying what applies when it comes to rules*". Furthermore, since there are no rules applicable for the whole organisation, R1 describes that it is difficult to know who is responsible for updating the rules. The respondent described it as "*The one who takes the responsibility for something is the one who gets it, which is consistent throughout Tech*-X". Additionally, E1 described that a business glossary is in the creation process, where the rules and definitions should be captured. However, none of the respondents were aware that this is in the creation process.

5.1.7 Data Quality

Regarding the question if the respondents knew who was responsible for the data quality, different answers were given. A majority of the respondents answered that they did not know who was responsible. Many of these respondents suggested different people or teams that they thought could have the responsibility. Anyhow, R1, R4, R12, R13 and R18 thought that the team using certain data is also responsible for the quality of it. Likewise, R17 described "*I do not think that there is a single person or team responsible for it, it is more case to case or team to team*". Similarly, E1 stated that the responsibility of the data quality is on a user level. However, R1 described that no formal responsibility of the data quality has been communicated. R19 highlighted that there are many initiatives regarding data quality, but no strategy for it exists. R4 further argued that the ambiguity regarding responsibilities, for instance regarding data quality, is a consequence of the poor ownership structure.

R18 described that the employees using a certain data asset are responsible for reporting poor quality. Likewise, R15 described that each team must have its own processes for data quality since it depends on the type of data that the team is collecting. A few respondents mentioned that some requirements on minimum quality standards exist and that tests are performed regularly to ensure that the requirements are met. For instance, R20 described that there is a system in place that controls that the data is of a certain quality. A few other respondents, as well as E1, mentioned that all teams are working with quality to comply with the requirements of different standards. Although, none of the respondents knew for sure how Tech-X in general and on a central level is working to reduce data issues. Accordingly, E1 explained that there are no central initiatives in place for how to work with data quality.

Furthermore, the monitoring and tracking of the data quality also differ among teams. Several respondents mentioned that their teams have defined their own metrics related to data quality. Although, according to 18/20 of the respondents, topics regarding data quality are not widely communicated in the organisation. Only R5 and R12 described that their teams had a process for communicating the metrics. Both of the teams have an established dashboard where different data quality metrics are presented. However, these dashboards are not yet accessible for the whole organisation but both respondents thought that dashboards are a great tool for communication. R5 stated, "*I think that it would be valuable for other teams to work with dashboards just as we do".*

5.1.8 Data Security & Privacy

Data security and privacy standards exist at Tech-X, according to R10. These standards are located on the intranet. Information and mandatory training of these standards exist as a part of the onboarding process and for existing employees continuously every year.

A few of the respondents described that the IT department solely is responsible for the security and privacy of data. However, when it comes to accessibility of the data, there is a common principle at Tech-X that all employees should have access to all data, according to the majority of the respondents. R4 stated that "*We have a principle that as many as possible should have access to all data because you never know who can bring insights to what*". Although, several of the respondents mentioned that a consequence of this is the increased risk of deletion or leakage of important data. However, R10, who is Head of Security, explained that Tech-X is not satisfied with how they are granting access right now. The respondent stated that "*The transparent culture and processes for granting access needs to change for the company to comply with external regulations in the future*". Accordingly, E1 described that it is not sustainable in the long run that all employees have access to everything. However, a potential challenge of data access, mentioned by R2, is the ambiguous ownership structure. The respondent explained that "*It is difficult to know who should have access to what data when you do not know who owns the data and who needs it in their daily work*".

Nevertheless, there are established processes in place to control the privacy and security of data, as mentioned by some of the respondents. To prevent the occurrence of data breaches,

Tech-X uses access controls, regular monitoring, firewalls as well as automatic alerts. Furthermore, if a critical system is down, it seems to be the highest priority to fix it. R5, R9, R10, R12, R19 and R20 described that Tech-X is working proactively by making regular testing and back-ups of systems to reduce the risk of data loss and potential crashes. This to ensure that the recovery is optimised and to manage the data disaster recovery quickly.

5.1.9 Data Lifecycle Management

R20 described that to what extent the data lifecycle is defined differs between the data assets. For instance, R5 explained that its team had the process defined from creation to archiving while R13 described that its team only defined the creation stage. In contrast, other respondents stated that they do not know if the data lifecycle is defined for their team's data, while a few respondents answered that they know that the lifecycle has not been defined. The answers also differed when the respondents were asked about data archiving. Some respondents stated that their teams have automated processes to archive data, while other respondents explain that archiving is done manually. Other respondents answered that they do not even know if their team has a defined process for archiving. R14 described that its team is not archiving the data at all and probably will not do it in the future either since all data is valuable for them.

However, several respondents stated that they think that Tech-X keeps too much data and that they struggle with a lack of space. R1 explained that the company strives to delete the data every month, "*all data that has been collected should be deleted after one month if it is not used frequently*". However, the respondent further explained that this is not followed in practice. According to R16, people at Tech-X are not aware of the limited space for data. The respondent explained that "*Many teams are collecting large amounts of data and assume that there is storage space available*". The respondent, therefore, thinks that there needs to be a clearer structure for the data lifecycle. Accordingly, E1 described that on an organisational level, data is only deleted when there is a lack of storage.

Regarding the classification of data assets some respondents answered that they did not know if the data had been classified. These respondents thought that all data was treated similarly. Other respondents explained that Tech-X is working with classification to understand what data is more critical than others. Although, these respondents explained that the classification exists for some data but not for others. However, E1 explained that there are standards regarding the classification of data. Nevertheless, the expert stated, "*We have the standards in place, but when it comes to the reality of implementing it, we are far behind*".

5.1.10 Metadata Management

Most of the respondents explained that they know what metadata is. However, only a few of the respondents have heard of different types of metadata: business, operational and technical data. After the researchers had explained the definitions of the concepts, it became clearer to most respondents how Tech-X is working with metadata. Most respondents knew that technical metadata existed in the organisation, and some mentioned operational metadata. No respondent

knew for sure that business metadata existed and according to E1, business metadata does not exist yet.

All respondents seem to think that the metadata to some extent is easy access. R5 described that "*We have special systems to make sure that all metadata is easily accessible*". However, R20 stated that metadata is not available for all data. Similarly, E1 described that, as of today, operational and technical metadata are not in place for all data assets. When the respondents were asked if there are any processes for updating the metadata, some respondents (6/20) answered that there are manual processes in place for updating some metadata. Other respondents (5/20) answered that the process for updating metadata is done automatically, while others (9/20) explained that they do not know if or how the metadata is being updated. According to E1, metadata tends to be manually updated when needed.

5.1.11 Master Data Management

Tech-X is working with master data management to some extent, according to most of the respondents. 9/20 respondents expressed that they are working with MDM for some data, but not for all data. R18 described that there is a system that has been identified as the main system for some master data. Today, some of the teams at Tech-X are using this system to update the master data and the plan is that more teams will use the system in the future. R2 explained that its team is working with MDM for critical data. However, R19 and E1 described that Tech-X is not working with MDM in a structured and central way and that this is an area for improvement. However, R1 outlined that the plan is to decrease the number of systems that are expected to enhance the MDM. R20 further described that it is an ongoing discussion of which system should be identified as the master. The respondent highlighted that everyone has agreed upon that a master system is beneficial to identify.

5.1.12 Business Intelligence

Several of the respondents answered that the existing data at Tech-X generally fulfil the requirements for being used for business intelligence activities such as reporting and analytics. R7 expressed "*You can for sure make some decisions upon the data, but you cannot make the final decisions upon it. It gives you direction, but you need to take other aspects into consideration as well*". However, R19 stated that the data can be improved to better meet the requirements for analytics and reporting. Some manual interventions are still needed, according to the respondent. In general, the majority of the respondents describe that they trust the data. A few respondents answered that their teams have quality checks and that a tool or system exists for controlling the data. However, R14 explained that the quality control of data differs among teams. E1 further explained that Tech-X has data coming from both reliable and not reliable sources.

According to several respondents, Tech-X strives to increase automatic solutions regarding integration and controlling of data, but today some processes must be run manually. As

expressed by R7, "*Tech-X are working towards becoming as automated as possible. But today there is some level of manual work within analytics and decision-making processes*".

Furthermore, 8/20 respondents answered that they think or assume that Tech-X has the tools and techniques in place for moving data from one system to another in a smooth way, while the other respondents could not answer the question. However, R9 described "*for some systems we have the tools and techniques in place but not for others*". R19 instead explained that Tech-X has the tools in place for moving data internally, but not externally.

5.1.13 Adherence

When the respondents were asked if there are any controls to ensure that internal data rules are being followed, the majority answered that they did not know. R4 described "*I think the people who create the rules rarely ensure that these are being followed and there are no consequences if they are not being followed*". R10 further described that it is fairly easy for employees to make mistakes when working with data, and therefore it can be assumed that controls are not incorporated into systems to a wider extent. R19 and E1 stated that controls for adherence do not yet exist but that Tech-X is planning to implement it in the future.

On the question regarding who is responsible for adherence to external data regulations, 9/20 of the respondents answered that it is the legal department. However, R1 described that no one actually is responsible. Although, even if it is not clear who is responsible for external regulations among the respondents, all respondents agreed that Tech-X always ensures that they are complying with external regulations. E1 described that each team, with guidance from the legal department, is responsible for adherence to external data regulations.

5.1.14 Desired Future Level

Since it was described by Bhansali (2014) that it is beneficial to know what an organisation strives for before trying to understand how to improve its data governance, Expert 1 at Tech-X were asked about Tech-X's desired future level of maturity. Expert 1 explained that Tech-X strives to reach level 4 for all elements, except for the *Data Security & Privacy* element in Tech-X strives for level 5 since they already have a majority of the parts within this element in place. Companies on level 4 in general have a clear direction and defined vision, goal and roadmap for the data governance program, according to E1. Data governance activities are implemented across the organisation, but the main challenge for companies in this stage is to keep track of and manage the data governance program regardless if unexpected things happen.

5.2 Determination of Tech-X's Levels of Data Governance Maturity and Identification of Actions to Improve

In this section, the findings from interviews are compared to the levels in the TMT Data Governance Maturity Model. This to determine Tech-X's data governance maturity level for each question, element, dimension and overall as well as to identify actions for Tech-X to reach

their desired maturity level of 4, respectively 5 for the *Data Security & Privacy* element. A summary of the result will also be given.

5.2.1 People

Tech-X is assigned level 2 for the *People* dimension, which is based on the average levels of the elements *Strategy & Approach*, *Leadership*, *Ownership Structure*, *Progress Measure,* and *Knowledge & Change Management*. The determination and actions needed for Tech-X to reach the desired maturity level of 4 within each element are described below.

5.2.1.1 Strategy & Approach

KEY FINDINGS FROM INTERVIEWS	CURRENT STATUS	ACTIONS TO REACH LEVEL 4
• Low awareness of the data governance program and strategy. • The program and strategy are not aligned to the daily work. • Low awareness of the data governance program and strategy. • No short- or long-term activities for how to execute the strategy have been identified.	Q1. A short-term program and strategy exist *(level 3)*. Q2. The program and strategy have been created by a cross-functional team *(level 4)*. Q3. The program and strategy are not aligned with corporate needs and goals *(level 2)*. Q4. Activities are executed in an ad hoc manner *(level 2)*. Q5. The program and strategy have been communicated to some people. Some people in the organisation are aware of the program and strategy *(level 3)*. **Average Level**: 3	• Work on aligning the program and strategy with corporate needs and goals and the daily work. • Define long-term activities for how to execute the program and strategy. • Improve the communication of the program and strategy to increase awareness.

Table 18: Identification of current maturity levels and actions to reach level 4 for the Strategy & Approach element.

A data governance program and strategy exist *(level 3)*. The strategy has been created by a cross-functional team *(level 4)*. However, since the data governance program and strategy were created approximately six months ago, no short- or long-term activities on how to execute the strategy have been identified *(level 2)*. According to the respondents and E1, the data governance strategy is not aligned with corporate needs and goals *(level 2)*. Only 9/20 respondents were aware of the strategy and only 6/20 were aware of the program, which indicates that it has not been widely communicated *(level 3)*. Based on the average, which has been rounded to the nearest integer, of the assigned levels for each question, Tech-X is assigned level 3 on the *Strategy & Approach* element.

Actions to reach level 4

To reach a higher level of maturity Tech-X needs to work on adapting the program and strategy to the organisation to ensure that it is aligned to corporate needs and goals *(level 4)* as well as the daily operational work. To reach level 4, Tech-X also needs to ensure that the strategy can be executed by defining some long-term activities *(level 4)*. Tech-X also needs to work on the communication of the data governance program and strategy throughout the organisation to

make the majority of the employees aware of them (*level 4*). Table 18 summarises the key findings, current status and the actions needed to reach level 4 of maturity.

5.2.1.2 Leadership

KEY FINDINGS FROM INTERVIEWS	CURRENT STATUS	ACTIONS TO REACH LEVEL 4
• Management was involved in the creation of the strategy, but they are not very committed to it. • Decisions are made both upon data and experience.	Q1. Leaders see data as important for the operational work *(level 3)*. Q2. Leaders have some insights in the strategy making, but they are not involved *(level 2)*. Q3. Decisions are mostly based upon experience, but some data is used *(level 2)*. **Average Level**: 2	• Leaders needs to see data governance as important to drive business growth. • Increase the commitment and involvement of leaders in the creation and execution of the data governance strategy. • Focus on increasing the amount of decisions based on data.

Table 19: Identification of current maturity levels and actions to reach level 4 for the Leadership element.

Data was described as an important asset for leaders at Tech-X in several ways. 9/20 described that the management wants to work with data since it is crucial for Tech-X's product. 3/20 respondents described the main reason to be to decrease costs while 6/20 described the main reason to be data-driven *(level 3)*. However, even though the management has been involved to some extent in the creation of the data governance strategy they could commit more time and effort regarding the execution of it, according to E1 *(level 2)*. Decisions are mainly based on past experiences, but decisions are sometimes based on data *(level 2)*. Based on the average of the assigned levels, which has been rounded to the nearest integer, Tech-X is assigned a level 2 on the *Leadership* element.

Actions to reach level 4

To reach a higher level of maturity, leaders need to recognise data governance as important to drive business growth *(level 4)*. The organisation also needs to make more decisions based upon data rather than experience *(level 4)*. Additionally, leaders need to commit more time and be involved in the strategy-making as well as in the execution of it *(level 4)*. Table 19 summarises the key findings, current status and the actions needed to reach level 4 of maturity.

5.2.1.3 Ownership Structure

KEY FINDINGS FROM INTERVIEWS	CURRENT STATUS	ACTIONS TO REACH LEVEL 4
• Ownership is assigned for some systems. • Low awareness of the ownership structure. • The ownership structure is not adapted to the organisation. • It is described to be beneficial to have multiple owners in some cases.	Q1. Some ownership is assigned on a system level *(level 2)*. Q2. Data is managed in silos *(level 2)*. Q3. No structure for managing multiple owners *(level 2)*.	• Assign ownership on a data asset level while making sure that the employees know who to contact if having questions. • Ensure that there is a formal structure for managing data. • Define a framework for how to manage multiple owners.
	Average Level: 2	

Table 20: Identification of current maturity levels and actions to reach level 4 for the Ownership Structure element.

Ownership of data assets is assigned on a system level at Tech-X *(level 2)*. However, only 5/20 respondents were aware of this structure. Some respondents meant that the structure is not reflecting reality. However, data is managed on a team level and thus in silos *(level 2)*. Regarding multiple owners, the respondents expressed that it could be favourable for some assets where several teams are using the data, but there is no such structure today *(level 2)*. Based on the average of the assigned levels, which has been rounded to the nearest integer, Tech-X is assigned level 2 for the *Ownership Structure* element.

Actions to reach level 4

To reach a higher level of maturity, Tech-X should start striving for defining the majority of data assets and decide upon responsibilities *(level 4)*, while also increasing the awareness of it in the organisation. They are also recommended to create a central team being responsible for managing the data assets *(level 4)*. To reach level 4, Tech-X also needs to define a framework for how multiple ownership of data assets should be managed *(level 4)*. Table 20 summarises the key findings, current status and the actions needed to reach level 4 of maturity.

5.2.1.4 Progress Measure

KEY FINDINGS FROM INTERVIEWS	CURRENT STATUS	ACTIONS TO REACH LEVEL 4
• Some metrics exist on a central level. • The metrics are tracked but not communicated throughout the organisation. • A few teams have defined their own metrics.	Q1. A few performance metrics have been defined but more are required *(level 3)*. Q2. The metrics are to some extent monitored *(level 3)*. Q3. Only a few people are aware of the progress *(level 3)*.	• Define more performance metrics and guidelines for how teams should work with data governance metrics. • Ensure that the metrics are monitored. • Show the progress to the main stakeholders.
	Average Level: 3	

Table 21: Identification of current maturity levels and actions to reach level 4 for the Progress Measure element.

Some performance metrics related to data governance exist on a central level and some teams have defined their own *(level 3)*. These performance metrics are also tracked and monitored by the organisation or by the teams to some extent *(level 3)*. On a team level, dashboards are used to communicate the progress. However, the progress of the central metrics is only communicated to the team working with data governance, which was shown as 14/10 of the respondents were not aware of them *(level 3)*. Hence, based on the average of the assigned levels, Tech-X is assigned level 3 within the *Progress Measure* element.

Actions to reach level 4

To reach a higher level of maturity, more performance metrics on a central level need to be defined *(level 4)* and monitored *(level 4),* while the progress is being shown and communicated to the main stakeholders *(level 4)*. Since a few teams have defined their own metrics, while other teams have not, it is also beneficial for Tech-X to create central guidelines for data governance metrics. Table 21 summarises the key findings, current status and the actions needed to reach level 4 of maturity.

5.2.1.5 Knowledge & Change Management

KEY FINDINGS FROM INTERVIEWS	CURRENT STATUS	ACTIONS TO REACH LEVEL 4
• Difficult for employees to see the value of data governance in their daily tasks. • No training related to data or data governance exist, except for data security & privacy. • No central guidelines regarding data governance and knowledge loss exist.	Q1. The organisation has implemented data governance, but most employees are reluctant to change *(level 3)*. Q2. No data training program exists *(level 1)*. Q3. Some individuals are documenting their work and share these in a commonplace *(level 3)*. **Average Level**: 2	• Work on making employees understand the value of data governance. • Create training programs. • Define central routines for how to capture data knowledge.

Table 22: Identification of current maturity levels and actions to reach level 4 for the Knowledge & Change Management element.

Regarding the attitudes towards data governance, it was described that some resistance can appear since employees are afraid that it will influence their preferred way of working or not be aligned with their operational work *(level 3)*. Further on, except for data security and privacy, no training related to data governance exists at Tech-X *(level 1)*. However, some routines for mitigating the risk that knowledge regarding data gets lost exist on a team level but not on a central level *(level 3)*. Hence, based on the average of the assigned levels, which has been rounded to the nearest integer, Tech-X is assigned level 2 for the *Knowledge & Change Management* element.

Actions to reach level 4

To reach a higher level of maturity, Tech-X needs to work on making employees recognise the value of data governance *(level 4)*. This could be done by creating and implementing data training programs offered to all employees *(level 4)*. If Tech-X makes these training sessions mandatory for all employees, it can help Tech-X to reach a maturity level of 5. Additionally, central guidelines need to be created to ensure that routines preventing data knowledge exist *(level 4)*. Table 22 summarises the key findings, current status and the actions needed to reach level 4 of maturity.

5.2.2 Policies

For the *Policies* dimension, Tech-X were assigned level 3, based on the average levels from the elements *Rules*, *Data Quality*, *Data Privacy & Security,* and *Data Lifecycle Management*. The determination and actions needed for Tech-X to reach their desired maturity level of 4, respectively 5 for *Data Security & Privacy*, within each element are described below.

5.2.2.1 Rules

KEY FINDINGS FROM INTERVIEWS	CURRENT STATUS	ACTIONS TO REACH LEVEL 4
• No organisation-wide rules related to data exist. • Some teams have created their own rules.	Q1. Each department develops their own rules *(level 2)*. Q2. Each department applies their own rules *(level 2)*. Q3. No routines for revision *(level 2)*. Q4. No commonplace for capturing data rules and definitions exists *(level 2)*. **Average Level**: 2	• Create rules on a central level based upon the needs of different departments. • Ensure that the rules are applied across the organisation to ensure alignment. • Create routines for revision of rules. • Create and communicate a commonplace for some data rules and definitions.

Table 23: Identification of current maturity levels and actions to reach level 4 for the Rules element.

No data rules that apply to the whole organisation exist *(level 2)*. Instead, some of the respondents described that their teams have developed their own rules *(level 2)*, while other respondents did not know if their team had any rules. Since there are no central data governance rules for the organisation, the respondents did not know if there were any routines for updating the rules in place *(level 2)*. A business glossary is currently in the creation process, according to EI, in which data rules and definitions will be captured in the future *(level 2)*. Hence, based on the average of the assigned levels, Tech-X is assigned level 2 for the *Rules* element.

Actions to reach level 4

To reach a higher level of maturity, a central structure for rules needs to be developed to ensure consistency within the organisation *(level 4)*. However, each team should be able to adapt these

to their operational work to ensure alignment, therefore the rules should be developed based upon needs from departments *(level 4)*. Tech-X is also recommended to hold planned sessions for revising the rules *(level 4)*. Additionally, a commonplace for some rules and definitions needs to be created and communicated *(level 4)*. Table 23 summarises the key findings, current status and the actions needed to reach level 4 of maturity.

5.2.2.2 Data Quality

KEY FINDINGS FROM INTERVIEWS	CURRENT STATUS	ACTIONS TO REACH LEVEL 4
• The responsibility of data quality is currently on a team level. • Data quality is being monitored to some extent. • Only a few teams communicate their work.	Q1. No formal data quality responsibilities exist *(level 2)*. Q2. Some data quality metrics and routines are defined and monitored *(level 3)*. Q3. Some data analysis and correction activities exist, but issues are mainly managed as they appear *(level 3)*. Q4. No structure for communication of data quality routines *(level 2)*. **Average Level**: 3	• Establish a data quality department and identify data stewards. • Ensure that data quality metrics exist, and that data quality is continuously monitored and improved. • Work on preventing data quality issues to protect critical data. • Communicate data quality routines to everyone to create awareness.

Table 24: Identification of current maturity levels and actions to reach level 4 for the Data Quality element.

The respondents presented different perspectives of the responsibility for data quality. However, the majority thought that the team using the data also takes the responsibility. Likewise, E1 explained that no formal structure for the data quality exists, instead the responsibility is on user level *(level 2)*. Since the responsibility is on the user level, each team has their own processes and routines to reduce data quality issues, hence the user of the data is responsible for it. Some respondents explained further that their teams have defined their own metrics related to data quality. However, there are currently no mandatory routines for monitoring and measuring data quality *(level 3)*. Although, according to a few respondents, some general guidelines for data quality issues are in place *(level 3)*. 18 respondents also mentioned that there are no routines for communicating the data quality throughout the organisation *(level 2)*. Hence, based on the average of the assigned levels, which has been rounded to the nearest integer, Tech-X is assigned level 3 for the *Data Quality* element.

Actions to reach level 4

To reach a higher level of maturity, a data quality department needs to be established and data stewards needs to be identified for all teams *(level 4)*. In addition, Tech-X a clearer structure for data quality is needed with defined metrics that are monitored on a regular basis *(level 4)*. Tech-X also needs to work more proactively with data quality issues to protect critical data *(level 4)*. The metrics and the routines for data quality should be communicated throughout the organisation to make the majority of all employees aware *(level 4)*. Table 24 summarises the key findings, current status and the actions needed to reach level 4 of maturity.

5.2.2.3 Data Security & Privacy

KEY FINDINGS FROM INTERVIEWS	CURRENT STATUS	ACTIONS TO REACH LEVEL 5
• Standards for data security and privacy exist. • No clear structure for granting access. • Processes for controlling collected data and for data disaster recovery are in place.	Q1. Standards are being implemented and rolled out to some business units. External access restrictions exist, but not internal *(level 3)*. Q2. All standards are communicated and easily accessible. Employees are trained and aware of their responsibilities *(level 5)*. Q3. Data breaches are prevented through access controls, firewalls etc. *(level 5)*. Q4. There are regular backups and tests to ensure recovery of critical systems *(level 5)*.	• Create internal restrictions for granting access.
	Average Level: 5 **Assigned Level:** 4	

Table 25: Identification of current maturity levels and actions to reach level 5 for the Data Security & Privacy element.

Tech-X has developed a privacy and security policy. The privacy and security policy can be found in the internal intranet and these are being communicated continuously through mandatory training *(level 5)*. There is a common principle at Tech-X that all employees should have access to all data, according to the majority of the respondents. Meaning that no specific internal standards for accessibility exist *(level 3)*. Several steps to manage unforeseen data breaches are mentioned by the respondents, for instance access controls, regular monitoring, firewalls as well as automatic alerts *(level 5)*. If a critical system is down, it seems to be of highest priority to fix it. Tech-X is working actively with managing potential crashes by regularly testing the systems and using backups *(level 5)*. If taking the average of the assigned levels for each question and rounding to the nearest integer, Tech-X should be assigned level 5 for this element. However, since internal access restrictions are lacking Tech-X is only at level 3 for one question. Resulting in that Tech-X is assigned level 4 instead of level 5 to show that this element still can be improved.

Actions to reach level 5

Tech-X are working effectively with data security and privacy, but to strengthen their work further and to be assigned level 5, Tech-X should create restrictions for how access is being granted internally (level 5). Table 25 summarises the key findings, current status and the actions needed to reach level 5 of maturity.

5.2.2.4 Data Lifecycle Management

KEY FINDINGS FROM INTERVIEWS	CURRENT STATUS	ACTIONS TO REACH LEVEL 4
• Some teams have identified stages of the data lifecycle. • Others have no routines for e.g., data archiving. • The current process for lifecycle is mainly done manually. • Classification standards are not implemented.	Q1. Some data have the creation stage defined but not for other stages *(level 2)*. Q2. Data is archived when there is a lack of storage *(level 2)*. Q3. Critical data has not been identified *(level 2)*. **Average Level**: 2	• Define the whole lifecycle for the majority and/or the critical data. • Ensure that critical data is archived automatically according to its lifecycle. • Identify the majority of critical data and implement classification standards.

Table 26: Identification of current maturity levels and actions to reach level 4 for the Data Lifecycle Management element.

The overall impression is that Tech-X has identified the lifecycle for some data but there is no long-term plan for how to work with this further *(level 2)*. The respondents were neither sure about the processes for data archiving. Some respondents answered that it is done automatically, others stated that it is done manually, and some did not know. E1 explained that on an organisational level data is only deleted when there is a lack of storage *(level 2)*. Similarly, the respondents gave different answers regarding how Tech-X is working with classification of data. According to E1, the organisation has standards in place, but they have not succeeded in the implementation of it yet *(level 2)*. Hence, based on the average of the assigned levels, Tech-X is assigned level 2 for the *Data Lifecycle Management* element.

Actions to reach level 4

Tech-X should start working on defining the whole lifecycle for their critical data with clear processes for managing them *(level 4)*. In addition, Tech-X should focus on improving the automation of this process to ensure that critical data is archived at the right time *(level 4)* and to identify the majority of critical data and to implement classification standards *(level 4)*. Table 26 summarises the key findings, current status and the actions needed to reach level 4 of maturity.

5.2.3 Capabilities

For the *Capabilities* dimension, Tech-X is assigned level 3, based on the average levels from the elements *Metadata Management*, *Master Data Management*, *Business Intelligence* and *Adherence*. The determination and actions needed for Tech-X to reach their desired maturity level of 4 within each element is described below.

5.2.3.1 Metadata Management

KEY FINDINGS FROM INTERVIEWS	CURRENT STATUS	ACTIONS TO REACH LEVEL 4
• Some metadata exists. • The metadata is in general easy to access. • No structured processes are in place for updating metadata.	Q1. Access is provided to a few users through a specialised tool *(level 3)*. Q2. Technical metadata exists for most data and operational metadata exists for some metadata *(level 3)*. Q3. Metadata is manually updated when necessary *(level 2)*. **Average Level**: 3	• Increase the accessibility to metadata. • Work on making business metadata available. • Create processes for updating metadata.

Table 27: Identification of current maturity levels and actions to reach level 4 for the Metadata Management element.

The respondents described that metadata is easily accessible at Tech-X *(level 3)*. However, the three types of metadata (technical, operational, and business) do not exist for all data assets. While most technical metadata and some operational metadata are available for a majority of the data assets, business metadata does not exist at all, according to E1 *(level 3)*. Additionally, there is no central process for updating and reviewing metadata and therefore metadata is updated when needed *(level 2)*. Hence, based on the average of the assigned levels, which has been rounded to the nearest integer, Tech-X is assigned level 3 for the *Metadata Management* element.

Actions to reach level 4

To reach a higher level of maturity, Tech-X need to increase the accessibility of metadata to ensure that more users can get hold of the information needed through a specialised tool *(level 4)*. Tech-X also needs to work on making business metadata available *(level 4)* and to create central guidelines and automatic processes for updating metadata with periodic reviews *(level 4)*. Table 27 summarises the key findings, current status and the actions needed to reach level 4 of maturity.

5.2.3.2 Master Data Management

KEY FINDINGS FROM INTERVIEWS	CURRENT STATUS	ACTIONS TO REACH LEVEL 4
• Tech-X is not working with MDM in a structured and central way. • No central repository is identified.	Q1. A central repository does not exist, but MDM is to a small extent manually managed *(level 2)*. **Average Level**: 2	• Implement a central data repository for key data assets.

Table 28: Identification of current maturity levels and actions to reach level 4 for the Master Data Management element.

Regarding master data management, the answers differed among the respondents. 9/20 described that Tech-X is solely working with MDM for some critical data. However, according to E1, Tech-X is working with MDM to a low extent and not in a structured and central way. Meaning that there is no common data repository but that an informal structure for MDM exists in some of the teams *(level 2)*. This resulted in Tech-X being assigned level 2 for the *Master Data Management* element.

Actions to reach level 4
A central data repository needs to be identified or implemented for key data assets in order for Tech-X to reach a maturity level of 4 *(level 4)*. Table 28 summarises the key findings, current status and the actions needed to reach level 4 of maturity.

5.2.3.3 Business Intelligence

KEY FINDINGS FROM INTERVIEWS	CURRENT STATUS	ACTIONS TO REACH LEVEL 4
• The data is trustworthy. • There are both reliable and less reliable sources of data. • Tech-X sees the value of automating processes for BI activities. • Data is in general moved smoothly between systems.	Q1. BI activities are executed, mostly manually, but automatic to some extent *(level 3)*. Q2. Some data is controlled before use, some data sources are reliable *(level 3)*. Q3. A small part of the data is integrated and controlled automatically *(level 3)*. Q4. No standards for moving data exist, hence data is moved when necessary *(level 2)*.	• Create a roadmap for BI activities. • Ensure that critical data is controlled before use and integrated automatically. • Define standards for how to move data between systems.
	Average Level: 3	

Table 29: Identification of current maturity levels and actions to reach level 4 for the Business Intelligence element.

The reporting and analytical requirements were described to be fulfilled to a large extent by the respondents. Although, some manual work was described as required to generate insights from some data *(level 3)*. In general, all employees trust the data. However, data is generated from both reliable as well as not reliable sources. Meaning that some data goes through a qualification control before being used while others do not *(level 3)*. It was described that automated solutions regarding integration and controlling of data exist, but several respondents describe that there is potential for improvement *(level 3)*. 8/20 of the respondents thought or assumed that Tech-X has the techniques available for moving data between systems. However, others described that these tools just exist for some systems and that no structure exists *(level 2)*. Hence, based on the average of the assigned levels, which has been rounded to the nearest integer, Tech-X is assigned level 3 for the *Business Intelligence* element.

Actions to reach level 4
For Tech-X to reach a higher level of maturity, they need to create a roadmap for BI activities *(level 4)*. Tech-X is also recommended to ensure the majority of the data sources are reliable, that the critical data is controlled before use *(level 4)* and integrated automatically *(level 4)*.

Tech-X should also define standards for moving data between systems and ensure that most data is moved between systems according to standards and guidelines *(level 4)*. Table 29 summarises the key findings, current status and the actions needed to reach level 4 of maturity.

5.2.3.4 Adherence

KEY FINDINGS FROM INTERVIEWS	CURRENT STATUS	ACTIONS TO REACH LEVEL 4
• No controls to ensure that internal rules and standards are being followed. • Each team is responsible for adherence to external data regulations with guidance from the legal department.	Q1. Controls for rules and standards do not exist *(level 2)*. Q2. A few people are specialised in external regulations, these are not widely accessible *(level 2)*. **Average Level**: 2	• Implement data rules and standards into systems to ensure adherence. • Establish a formal and centralised team responsible for external regulations.

Table 30: Identification of current maturity levels and actions to reach level 4 for the Adherence element.

The majority of the respondents did not know if there are any controls in place at Tech-X to ensure that internal rules were followed. E1 explained that controls do not yet exist but will be developed and created in the future as part of the data governance program *(level 2)*. Nine respondents thought that the legal department was solely responsible for meeting external laws and regulations, while E1 described that each department together with the legal department are responsible *(level 2)*. Hence, based on the assigned levels, Tech-X is assigned level 2 for the *Adherence* element.

Actions to reach level 4

To reach a higher level of maturity Tech-X needs to implement controls for rules and standards related to critical data in systems to ensure adherence *(level 4)*. Over time, they should incorporate a formal and centralised team being responsible for adherence to external regulations *(level 4)*. Table 30 summarises the key findings, current status and the actions needed to reach level 4 of maturity.

5.2.4 Summary of Tech-X's Maturity Assessment

This section gives an oversight of the assigned maturity levels of Tech-X. Each element is weighted equally in the average calculation on request from Tech-X.

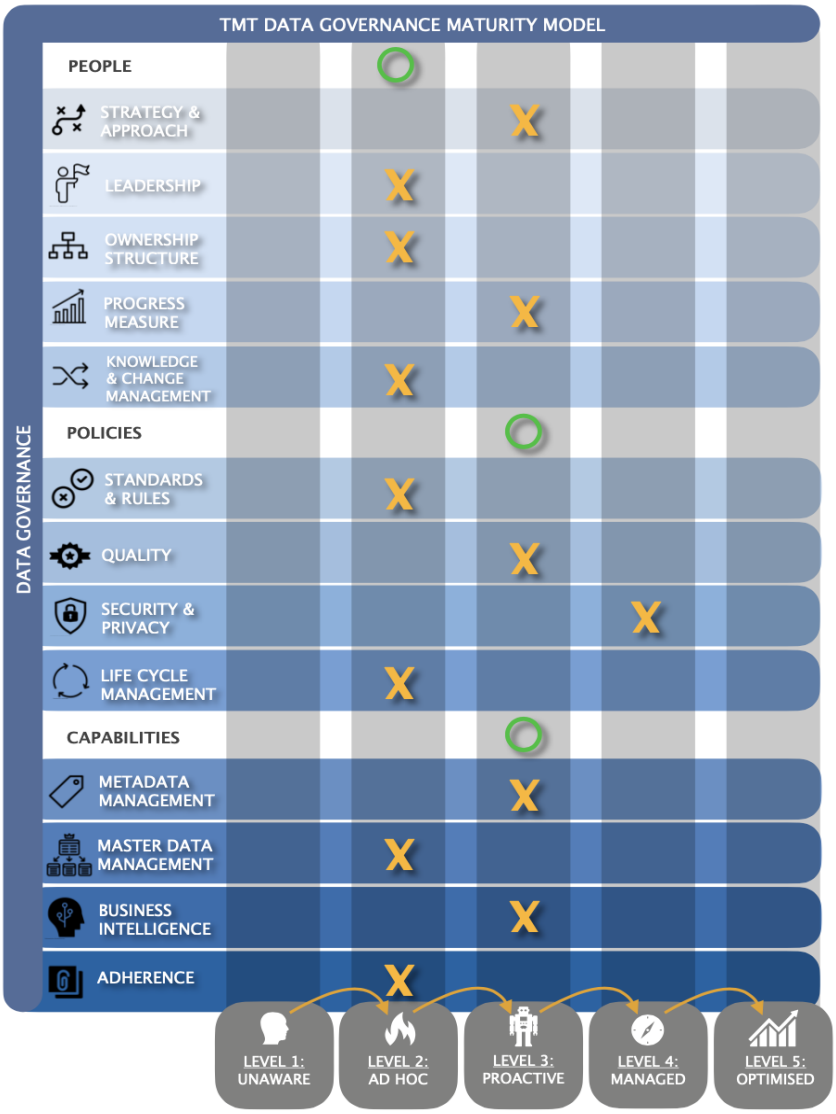

Figure 8: The maturity levels of the dimensions and elements within data governance.

Figure 8 illustrates the current status of the dimensions *People, Policies* and *Capabilities* as well as the 13 elements. Based upon the average of the assigned levels for the elements within each dimension, the *People* dimension receives a level 2, the *Policies* dimension receives a level 3, and the *Capabilities* dimension receives a level 3, which results in that Tech-X in general receives levels between 2 and 3. However, since Tech-X is not yet at level 3 they will be assigned level 2, but with an indication that they soon can reach level 3 if they continue to improve their work with data governance. Meaning that the people dimension was assigned the lowest level of all three dimensions. Indicating that it can be beneficial to investigate the causes why, since it can negatively impact Tech-X's work with data governance. For the people dimension, the elements *Knowledge & Change Management*, *Structure,* and *Leadership* were assigned the lowest levels.

5.3 Improvement Areas

This section presents the improvement areas for Tech-X to improve their data governance program. The identified actions to reach level 4, respectively 5 for the *Data Security & Privacy* element, for each element were, as discussed in section 5.2, similar and thus three main improvement areas were identified. These have been analysed in line with the literature. The three improvement areas are *Creation, Awareness,* and *Alignment.*

5.3.1 Creation

According to Mosley (2011) and Bhansali (2014), data governance is an ongoing program and a continuous improvement process. When determining Tech-X level of data governance it was discovered that several elements had aspects that did not exist or needed to be improved in order for Tech-X to be assigned a higher level of maturity. One example concerns the *Ownership Structure* element where Tech-X currently has ownership assigned on a system level. Tech-X is therefore recommended to develop their formal ownership structure, ensuring that there is an assigned owner on a content level which is needed to be assigned a higher level of maturity. Another example regards the *Rules* element, where Tech-X currently only has data rules on a team level, resulting in that some teams have rules defined while others do not. To reach a higher level of maturity, rules on an organisational level need to be defined. A final example concerns the *Data Lifecycle Management* element, where Tech-X needs to create routines for data archiving to reach a higher level of maturity. Other elements which could be further developed are *Data Security & Privacy, Metadata, Master Data Management, Business Intelligence,* and *Adherence*. Therefore, Tech-X needs to enhance their data governance program by continuously developing or defining parts that do not yet exist.

5.3.2 Awareness

A recurring problem, which was identified in several of the elements, was the low awareness of the data governance program. Since the general impression was that the majority of the respondents had not heard of, for instance the data governance program and strategy, rules, and the ownership structure, it can be assumed that these elements have not been widely communicated. Also, several of the respondents expressed that the data governance program and strategy could have been better communicated. R2 explained that "*I am not aware of the data governance strategy or program, so I do not think that it has been communicated*". Bhansali (2014) and Sarsfield (2009) describe that a key component in a well-functioning data governance program is communication, coordination, and involvement of all employees. This is because communications help increase the awareness of the data governance program (Kurniawan et al., 2019). Therefore, Tech-X is recommended to focus on increasing the communication of their data governance program and strategy to create awareness among the employees. The data governance program and strategy can, for instance, be communicated through publishing newsletters via email or by making information announcements at department meetings (Mosley, 2010).

Another potential explanation of why many of the respondents are not aware of the data governance program and its included elements can be explained by low motivation and bad attitudes among the employees. For instance, when talking about the data governance program R1 described that "*It does not add any value to their employees' practical tasks*". A negative attitude could result in employees being reluctant towards the initiative which will complicate the implementation of it. Likewise, Ladley (2012) stated that it is common that resistance will arise when implementing a data governance program. Thus, Tech-X is recommended to work on changing employees' way of thinking to enhance the organisational data culture. To do this, Tech-X must ensure that their employees understand the value of data governance (Ladley, 2012; Bhansali, 2014). One way to make the employees understand the value is to educate them in data governance (Ladley, 2012). According to the experts, mandatory training is the best option. At the moment, Tech-X does not have any training related to data governance yet, which thus can be an explanation of the low motivation and bad attitudes among employees. Therefore, Tech-X is also recommended to implement mandatory training related to data governance. The training should ensure that everyone keeps track and learns new information if the data governance program has changed. The training for existing employees should be done continuously, preferably once to twice a year.

5.3.3 Alignment

One of the most common reasons why an organisation fails with its data governance program is a lack of alignment to the organisation and business needs (Arbanas et al., 2019; Ladley, 2019). Likewise, Cheon & Chang (2007), Ladley (2019), and Marchildon et al., (2018) described that one success factor is that the data governance program should be aligned with business needs and goals. This is in line with one of the main findings from the interviews which were that the current data governance program and strategy is not aligned with the operational work at Tech-X. R18 explained that "*It is difficult to apply the strategy to the job that is performed on lower levels in the organisation*". Ladley (2012) describes that if the data governance strategy or program is not aligned to business needs, employees could find it difficult to recognise the value of working with data governance. The ownership structure, which is a crucial part of a data governance program (Cheon & Chang, 2007; Mosley, 2010; Bhansali, 2010), at Tech-X was also described as not being aligned with the daily work. However, at Tech-X several respondents described that the existing ownership structure does not reflect reality and that the poor ownership structure harms other parts of the data governance program, such as data quality.

Involvement of employees in a data governance program is crucial for its success (Bhansali, 2014; Sarsfield, 2009), to ensure the fit to the organisation's way of working, according to the experts. Likewise, Ladley (2012) stated that the involvement of employees in the strategy-making process is important as it makes people more positive towards data governance while ensuring alignment to the daily work. Hence, it is argued that involvement of employees can help the organisation to improve the alignment between the data governance program and the daily operational work of the teams. Therefore, Tech-X is recommended to involve the

employees in the data governance program and when defining the ownership structure to make employees more positive towards data governance.

Another area where the alignment regards the overall work with data governance in the organisation. Since guidelines on an organisational level were missing for several elements, it was discovered that different teams were working differently with data governance. This was, for instance, the case regarding metrics and central guidelines regarding change management, data rules in general as well as rules regarding data lifecycle management, master data management and data quality. Bhansali (2014) described that an effective data governance program requires that central rules and guidelines exist and that these should not be decided by individual business units. However, Bhansali (2014) and the experts highlighted that the rules still should be adapted to the needs of the different teams. Additionally, having rules applying for the whole organisation is also important for the alignment to the business needs (Ladley, 2012; Bhansali, 2014). Therefore, Tech-X is recommended to establish a central structure and central guidelines to ensure that the most basic principles related to data governance are being followed across all teams. However, it is important to note that each team still needs to have the possibility to adapt the central guidelines and develop their own rules to ensure that it is applicable to their work.

5.4 Insights from Testing the Model

When testing the *TMT Data Governance Maturity Model* on Tech-X, general insights regarding the use of it and interpretation of the result were obtained. Before applying a maturity model, it is important to adapt it to the individual organisation (Kurniawan et al., 2019). Meaning, since the model has been created to fit Tech-X and the TMT industry, other companies might need to adapt it before using it to derive the highest value from it. Therefore, one advice is to weigh the elements and questions differently based upon what is most relevant for the organisation. The elements or interview questions that are not relevant should preferably not be taken into consideration in the assessment.

The model also enables for identification of how different departments are working with data governance. Likewise, Bhansali (2014) described that an assessment of the current maturity level helps to understand the interactions and collaborations among different departments. Lack of coordination and alignment is argued to harm the data governance program since it requires the whole organisation to pay attention (Ladley, 2012). Meaning that by being able to identify differences between departments, a maturity model helps to understand what needs to be improved to ensure that the organisation is working with data governance in a coordinated way. In addition, by comparing the answers from different departments, the model can help organisations in identifying where issues in the program are located in the organisation. In the case of Tech-X, it was discovered that teams are working differently with regards to, for instance, data governance rules, data quality and data lifecycle management. To exemplify, this was the case regarding data archiving as one team had automatic processes in place for data archiving while another team was not archiving data at all. Hence, to enable comparison

between departments, it is important to interview employees from different departments to get a comprehensive view of the result. Thus, to choose participants for the assessment the user must clarify whether the model should be tested on department or organisational level.

By applying the model on Tech-X, the current status of maturity could be identified, which was also explained by Kurniawan et al. (2019), Olaitan, Herselman, and Wayi (2019). Since maturity levels were assigned for each question, element, dimension as well as in general, the model indicates which areas have the greatest potential for improvements. Hence, by comparing the assigned levels for the elements, the *TMT Data Governance Maturity Model* is providing Tech-X with their current strengths and weaknesses, which is also described by Kurniawan et al. (2019), Bhansali (2014) and Ladley (2012).

When assessing the levels, each respondent's answer should be compared with the element's criteria in the model. An average of all respondents' answers can thereafter be calculated. The average should be rounded to the nearest integer. However, the user needs to be aware of that, even if the majority of the respondents give one specific answer, it does not necessarily need to reflect the reality (King, 2003). Meaning, the average is not necessarily an appropriate method to use for all questions if the respondents are not aware of the actual situation. Hence, the levels for some questions could need to be determined based upon other internal information, for instance by searching on intranet. The choice of method depends on each specific organisation.

Additionally, it cannot be ensured that the answers can be connected to a criterion of a level. Therefore, some subjectiveness could be needed to assign the appropriate level of maturity. As discussed by Velden et al. (1996), the reality is more complex than assigning levels on a scale. Thus, the outcome from using the model should only work as an indication of current maturity. Meaning that further investigations on the current status and potential improvement areas could be necessary. If choosing between two different levels when comparing the respondents' answers with the criterions, the user of the model should either choose the most appropriate alternative, the lower alternative, or the average, depending on the specific question and element. The methods used for each question in this study are presented in appendix 7.

Furthermore, Kurniawan et al. (2019) as well as Olaitan, Herselman, and Wayi (2019) explained that maturity models describe the actions needed to get from the current to the desired maturity level, which was also an identified function of the *TMT Data Governance Maturity Model*. This since the gap between the assigned level and the desired maturity level indicates the actions to reach a higher level of maturity. However, a higher level of maturity must not necessarily be the best option to strive for. For instance, some organisations might not see a need for a data quality department, which is one criterion in level 5 for the data quality element. According to Bhansali (2014), an organisation needs an understanding of their long-term vision of data governance to understand what they should focus on to reach higher levels. Hence, another aspect to take into consideration when interpreting the result, is to first think what the organisation wants to achieve with its data governance program and thus of what levels are satisfactory for their business. Thereafter, they should compare their assigned levels

accordingly to find out what is needed to reach their vision. For instance, Tech-X considered level 4 to be a suitable level to strive for. Hence, their assigned level was compared to level 4 for all elements, except for the *Data Security & Privacy* element where they strive for level 5, to determine the actions needed to improve.

6. Conclusion

In this final chapter, the conclusion of the study is presented. Initially, the research question is answered. The research question will first be answered practically by presenting the TMT Data Governance Maturity Model created in this study. The research question will then be answered theoretically by discussing the outcome from using the model. Thereafter, recommendations for how Tech-X can improve their data governance is presented. Finally, potential areas of future research will be discussed.

6.1 Answering the Research Question

As a consequence of the growing power of data, data governance has become crucial for companies to meet legal requirements and to be competitive. To maximise the value derived from data, it needs to be available, secure, relevant, and of high quality which can be assured by data governance. The increasing need for data governance puts pressure on organisations to control how they work with data and thus a need to improve. Hence, to know what to improve an organisation needs an understanding of their current strengths and weaknesses which can be identified by using a maturity model. Although, there is a gap in existing literature in which available data governance maturity models do not only miss out on aspects within data governance, but also on how to use the model to determine the current status and hence how it can help an organisation to improve. Therefore, this thesis aimed to answer the following research question:

How can a maturity model support organisations in improving data governance?

Practical Contribution

To answer the research question, a data governance maturity model initially needed to be created, since available data governance maturity models miss out on several aspects within data governance. Hence, a theoretical framework and workshops with data governance experts were conducted. The theoretical framework and workshops eased the understanding of what aspects to include in the model to give an organisation a comprehensive view of their data governance program. The result of this study shows that to assess an organisation's level of data governance maturity, different stages of maturity needed to be included in the model. As argued by one of the experts, "*what you cannot measure, you cannot improve*". Hence, maturity levels were seen as an important aspect when creating the data governance maturity model. The maturity levels enable organisations to measure their progress by identifying their current status and areas of improvement to advance in their data governance program. The findings from literature and workshops resulted in five maturity levels being identified: *Unaware, Ad Hoc, Proactive, Managed,* and *Optimised*. These levels aim to cover the main stages of data governance maturity

This study also identified 13 elements as crucial to be included in the model: *Strategy & Approach, Leadership, Structure, Progress Measure, Knowledge & Change Management,*

Rules, Data Quality, Data Security & Privacy, Data Lifecycle Management, Metadata Management, Master Data Management, Business Intelligence, and *Adherence*. To ease the understanding of the construction of the model, these elements were further divided into three different dimensions: *People*, *Policies,* and *Capabilities*. Another finding from literature and workshops was that each element needed to include interview questions that cover all aspects within the element. Hence, each level consists of one to five interview questions. In addition, the five maturity levels needed to be adapted to each element and question to facilitate the assessment and make the model easy to use. Therefore, criteria for each question and level were developed. Hence, the interview questions and criterions are therefore used to determine an organisation's current status.

Figure 9 shows an illustration of the created model, called the *TMT Data Governance Maturity Model.* A comprehensive description of the model can be found in chapter 4.2 and instructions for how to use the model can be found in appendix 10.

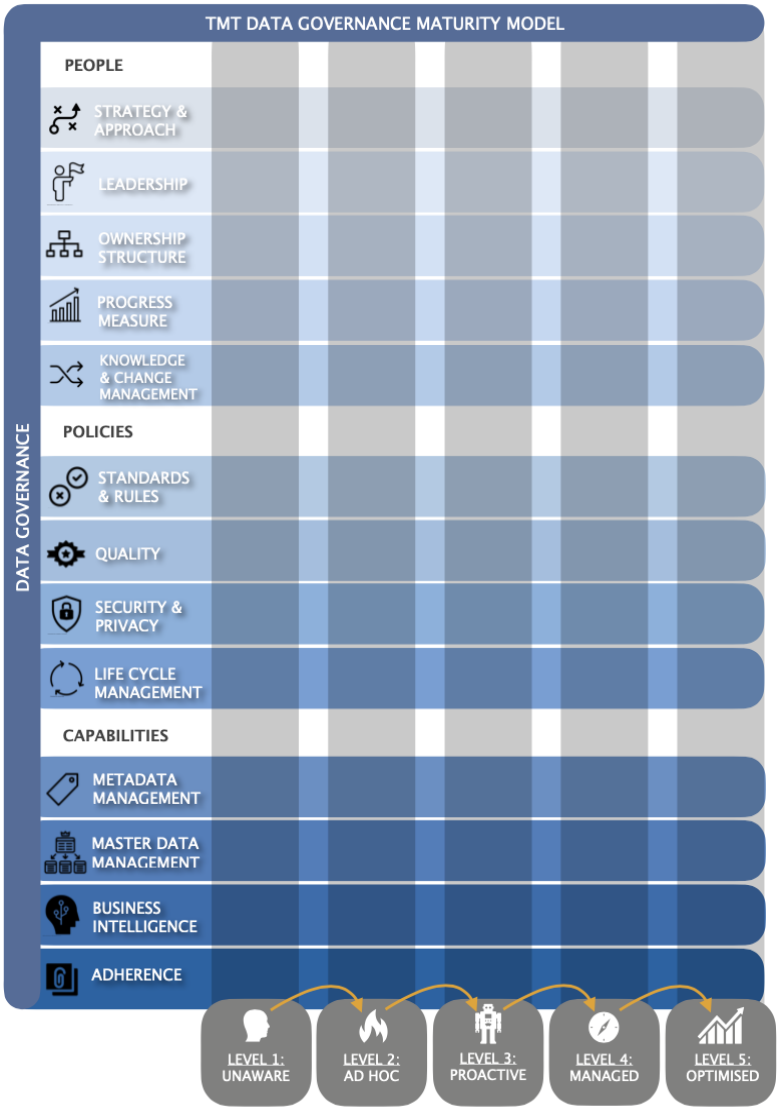

Figure 9: The TMT Data Governance Maturity Model created in this study.

The model aims to support organisations in providing a comprehensive understanding of their current maturity for the included elements and dimensions. The idea with the model is to

provide organisations with their current strengths and weaknesses regarding their data governance program. However, as the area of data and data governance is constantly changing, the context of the terms used in the maturity model are also likely to change. Meaning that the generic model in itself does not have a time limit, but it should be revised, and the terminology should be changed to ensure that it is contemporary. Hence, being an important aspect to take into consideration when using the model.

Theoretical Contribution

To gain insights of how a maturity model can support organisations in improving data governance, hence, to answer the research question and fill the theoretical gap, the *TMT Data Governance Maturity Model* was tested on a case company. It was considered crucial to test the function of the model to ensure its feasibility and to understand how a maturity model can support organisations in improving data governance.

By using a data governance maturity model, an organisation could be assigned their current status of maturity, both in general as well as for each dimension, element, and question. The result of this study also showed that by identifying the gap between the current level of maturity and higher levels, suggestions on actions that can be taken to reach higher levels could be identified. Meaning, by using a maturity model an organisation could gain an understanding of what is needed to improve its data governance. However, it is important to interpret the outcome as guidance of an organisation's strengths and weaknesses. Meaning, since the reality is more complex than assigning a level on a scale, further investigations could be necessary to understand what an organisation should focus on to improve. Thus, the model should only work as an indication of the current maturity. In addition, a higher level of maturity does not necessarily need to be the best option to strive for in all elements. Therefore, another aspect to take into consideration when using the model to find improvements is to first identify what level an organisation strives for in all elements. Thereafter, the assigned levels should be compared accordingly to be able to identify what actions are needed to improve.

This study further shows that the model enables for identification of differences between how departments are working with data governance. This supports organisations in identifying which departments in the organisation are immature with regards to data governance. Hence, the model can support organisations in identifying where issues in the program are located in and what needs to be improved. In this study, this enabled the researchers to identify one area of improvement which was lack of alignment between departments. If an organisation wants to use the model for this reason, it is important to clarify whether the model should be applied on an organisational, department, or team level to ensure that suitable employees are participating in the assessment.

Another important aspect identified when testing the model on Tech-X is to always adapt the model to suit the context of the single organisation. Since all organisations are unique, all aspects included in the *TMT Data Governance Model* are not necessarily relevant for all companies. Hence, it is essential to adapt the model to ensure that it is of value for the organisation it should be applied to. One way to adapt the model could be by weighing the

elements differently depending upon their importance for each particular organisation.

To conclude, by allowing for identification of the current status of data governance as well as what actions are needed to reach higher levels, a maturity model can support an organisation in improving its data governance. In addition, improvements can be identified on both a department and organisational level, supporting the development and implementation of a data governance program throughout the organisation. A successful data governance program is crucial for an organisation to derive the highest value from data. Therefore, the program should be seen as an ongoing initiative which needs continuous enhancement. Hence, a maturity model can be of value for organisations wanting to improve their data governance.

6.2 Recommendations for Tech-X

The created *TMT Data Governance Maturity Model* was tested and applied on Tech-X. The interview questions included in the model were asked to 20 employees working at Tech-X, and the answers were used to determine the levels of maturity. Based on the assigned levels, actions for how to reach a higher level of maturity were identified and improvement areas were defined.

The result of this study shows that Tech-X is assigned level 2 on an organisational level. For the dimensions, Tech-X is assigned level 2 for the *People* dimension and level 3 for both the *Policies* and the *Capabilities* dimension. This could indicate that Tech-X has the greatest potential for improvement in regard to the People dimension. By investigating the *People* dimension, it was discovered that Tech-X were assigned the lowest levels for the *Leadership*, *Ownership Structure*, and *Knowledge & Change Management* element. Indicating that it can be beneficial for Tech-X to do further investigations and focus their improvement efforts on these elements. Note that this is only a suggestion and does not necessarily need to be the best option, as discussed in 5.4. The element with the highest level was *Data Security & Privacy*, which is part of the *Policies* dimension. However, even though Tech-X was assigned the highest level for the *Data Security & Privacy* element it can still be improved with regards to internal data access restrictions.

When the current levels of maturity had been determined, actions for how to reach Tech-X desired maturity level of 4, respectively 5 for the *Data Security & Privacy* element, could be identified for each element. These were then divided into three main areas of improvement: *Creation, Awareness and Alignment.* These areas can be seen as recommendations for what Tech-X needs to work on to improve their data governance program and thus reach a higher level of maturity.

The first identified improvement area, *Creation*, represents all the aspects that are not yet included in Tech-X's data governance program or could be further developed to reach a higher level of maturity. Meaning, to enhance the program, Tech-X is recommended to continuously work on developing it. Some parts of the program that were identified in this research were,

for instance, to define data rules on an organisational level and to create routines for data archiving.

During the assessment, it was also identified that the awareness of the data governance program was low among the respondents. Therefore, the next improvement area, *Awareness*, recommends Tech-X to inform employees to a larger extent of the data governance program to make them understand the value of it. The awareness could be increased by improving the communication, for instance by publishing newsletters or by making information announcements at department meetings, as well as by implementing a mandatory data governance training program.

Finally, it was discovered that the current program is not aligned with daily work and that each team has its own way of working with data governance. Therefore, Tech-X is recommended to work on *aligning* the program to the daily operational work. This could, for instance, be done by including employees in the development of the program. Tech-X is further recommended to ensure that a central structure and guidelines regarding data governance exists, both on an organisational and team level, to ensure coordination and consistency throughout the organisation.

6.3 Future Research

The purpose of this research has been to investigate what aspects are important when creating and using a maturity model to improve data governance. However, additional future research could enhance the knowledge of the studied topic.

A suggested topic for future research is the execution of the suggested improvement areas identified from using the model. This study has not explored how the result retrieved from the assessment can be implemented in the organisation and whether this will result in a higher level of data governance. Meaning, that another topic for future research is to explore how an organisation can use a maturity model over time to improve its data governance. Another potential topic for future research is to investigate whether the maturity model could be used for self-assessment. Meaning, that instead of interviewing employees to determine an organisation's level of maturity, which has been made in this study, an option is to send out the model to employees for self-assessment. It could be interesting to investigate if the user would receive similar results if the employees answered the questions by themselves.

In addition, this research has not investigated how stakeholders' and suppliers' work with data governance should be included in the maturity model or how this can impact the use of the data governance maturity model. Therefore, performing studies on how to use a maturity model to improve data governance while incorporating stakeholders' work could give a more accurate view of the situation. This can hence be a subject for future research.

Finally, as technology advances, new concepts within the topic of data emerge, such as cloud computing and big data. These concepts create several new risks as well as governance, privacy and quality issues and thus it can impact data governance. However, this study has not investigated how this influences data governance and how such aspects could be incorporated into a maturity model since they are not currently of relevance for Tech-X. Therefore, a final area for future research is to create a data governance maturity model which includes aspects such as cloud computing and big data.

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Appendices

Appendix 1 - Key Search Words Used in the Systematic Literature Review

First Keyword	Second Keyword	Third Keyword
Maturity Model		
Data	Maturity	Model
Data	Quality	
Data	Security	
Data	Leadership	
Data	Ownership	
Data	Performance	Management
Data	Performance	Metrics
Data	Stewards	
Data	Lifecycle	Management
Data Governance	Maturity	Model
Data Governance	Rules	
Data Governance	Council	
Data Governance	Structure	
Data Governance	Strategy	
Data Governance	Success factors	
Data Governance	Challenges	
Metadata	Management	
Master Data	Management	
Business Intelligence		

Appendix 2 - Interview Guide Workshops

1. How would you describe the levels of data governance maturity?

2. Which elements within data governance do you think is important? What do you think of the elements that we have included in the model based on literature?

3. Would you say that the questions included in the model reflect the relevant issues in an organisation? Do you think something is missing?

4. Would you say that the defined criteria for each question reflects the relevant roadmap for organisations today?

Appendix 3 - Interview Guide for Semi-Structured Interviews

Presentations of the researchers and subject.

Background information

1. Could you please give us a short presentation about yourself?
2. Could you please describe your position and responsibilities?

Definition of included concepts:

- Data Governance
- Master Data Management
- Metadata (business, technical, operational)
- Data Asset
- Data Lifecycle Management

Introduction to data:

3. How would you define data?
4. How important is data in your daily job?
5. What do you think of data governance?
6. Do you think maturity models are a good way to measure data-drivenness? To measure and identify improvements. Challenges/pitfalls with maturity models?

Elements:

Strategy & Approach:

7. What do you know of your organisation's data governance strategy and program?
8. How is the data governance strategy executed?
9. How has the data governance strategy and program been communicated?

Leadership

10. How would you describe the involvement and engagement of top management regarding data?
11. How are decisions being made?
12. Do you feel that leaders at different levels are available if having questions regarding data?

Ownership Structure

13. How would you describe the data ownership structure at your organisation?
14. How does your organisation manage data assets with multiple owners?
15. Who manages the data in your organisation? Is it the same person who owns it?

Progress Measure:

16. How does your organisation measure the progress of the data governance program?
17. How does your organisation communicate the progress?

Knowledge & Change Management:

18. How does your organisation work with onboarding and offboarding of employees regarding data? Such as training and to prevent knowledge and routines from getting lost.

Processes:

19. What do you know of the data governance rules in your organisation?

Data Quality:

20. Who is responsible for the quality of data in the organisation?
21. How does your organisation work with data quality and monitoring of it?
22. How have the routines for data quality been communicated?

Data Privacy & Security:

23. How does your organisation work with data security? For instance, accessibility, data breaches or other data related disasters.

Data Lifecycle Management:

24. How does your organisation work with data lifecycle management and classification of data?

Metadata Management:

25. How would you describe your organisation's work with metadata?
26. How accessible is the metadata in your organisation?

Master Data Management:

27. How does your organisation work with Master Data Management? Meaning, how does your organisation ensure that only one version of the data exists?

Business Intelligence:

28. Does the data at your organisation fulfil the requirements for being used for reporting and analytics? Is this automatic? Are there tools and techniques available for moving data between systems?
29. How trustworthy is the data in your organisation? Do you trust the data when making decisions?

Adherence:

30. How does your organisation monitor that internal data rules are followed?
31. Who is responsible for meeting external regulations?

Concluding Questions

32. Is there anything specific that you think your organisation could improve in its data governance program?
33. Is there anything else that you would like to discuss further?

Appendix 4 - Process for Creation of General Levels

Level	Literature	Experts	General Level
1	The first level, "Initial", indicates that processes are unpredictable and not in control (Saputra, Handika, and Ruldeviyani, 2018) The first level is called "Initial", which means that the individuals in the organisation have the authority over data and that no rules exist (Ladley, 2012)	Organisations at the first level typically are not aware of data governance or the importance of it, thereby they are performing their day-to-day businesses without any data governance activities (E1, E2).	**Unaware** - The organisation is not aware that data governance is important. Hence, the organisation is doing their daily business without taking data governance in consideration.
3	The third level is "Defined", meaning that an organisation has characterised processes for the whole organisation and that the organisation is acting proactively towards changes (Saputra, Handika, and Ruldeviyani, 2018). The third level, "Defined" means that the organisation has started to consider an enterprise-wide focus on data (Ladley, 2012).	Organisations at the third level usually have some sort of plan and strategy for how to work with data, but only short-term and not long-term. These organisations usually have no control to see if the data governance activities are being followed. Additionally, only a few people are aware of the data governance program since it has not been widely communicated. (E1, E2)	**Proactive** - The organisation has some sort of short-term plan and some structure for data governance on company level, but the plan is not tracked or considered long-term. The awareness of the program is low since it only has been communicated to a few people.

5	The fifth level is called "Optimising", organisations at this level typically focus on continuous improvement of the processes (Saputra, Handika, and Ruldeviyani, 2018) The fifth level "Optimised", indicates that the organisation manages data and information effectively while being aligned with the overall business (Ladley, 2012).	Organisations at level five have such a good structure of their data governance program that, when changes in the environment happen, the organisation can easily adapt and change their data governance program accordingly. They also described that organisations at this level, everyone is aware of the program since it is continuously communicated (E1, E2).	**Optimised** - The organisation has a fully developed and integrated data governance program throughout the organisation with a long-term perspective. The program is adapted in accordance with changes in the environment and continuously improved. Everyone in the organisation is aware of the program, hence it is continuously communicated to everyone.

Appendix 5 - Process for Deciding Upon Elements & Interview Questions

Literature	Experts	Elements	Questions in the TMT Data Governance Maturity Model
Data governance should ensure that data quality is monitored and evaluated on a daily basis (Ladley, 2012)	*"It is important to have some steps in place to reduce the number of data quality issues" (E1)* *"...to measure and monitor the quality of data, and to continuously follow up the metrics..."(E2)*	Data Quality	What steps are taken to reduce data quality issues? What processes are in place for monitoring and measuring data quality?
A successful data governance program requires the management unit to be engaged, committed, and involved (Bhansali, 2014; Ladley, 2012).	*"A leader which is committed to data governance typically is very involved in data governance strategy making" (E2)*	Leadership	What is the value of data to leaders? How would you describe leaders' involvement in the execution of the data governance strategy?

Appendix 6 - Process for Deciding Upon Criteria for Levels per Questions and Element

General Level	Interview Questions	Criteria for levels in the Strategy & Approach
Level 1 - The organisation is not aware that data governance is important. Hence, the organisation is doing their daily business without taking data governance in consideration.	1.What is the data governance program in the organisation? 2.What is the strategy to maximise the value of data assets in the organisation? 3.Who has been part of shaping the data governance strategy? 4.How is the data governance strategy executed in the organisation? 5.Has the data governance strategy been communicated? 6.Is the data governance strategy aligned with the corporate needs and goals?	Level 1: Q1, Q2, Q3, Q4 & Q5. No program or strategy exists.
Level 3 - The organisation has some sort of short-term plan and some structure for data governance on company level, but the plan is not tracked or considered long-term. The awareness of the program is low since it only has been communicated to a few people.		Q1. A short-term program and strategy exists. Q2. The program and strategy have been created by a few key stakeholders (E2). Q3. The program and strategy are to some extent aligned with corporate needs and goals (E2). Q4. Some short-term activities are executed (E1, E2). Q5. The program and strategy have been communicated to some people. Some people in the organisation are aware of the program and strategy.
Level 5 - The organisation has a fully developed and integrated data governance program throughout the organisation with a long-term perspective. The program is adapted in accordance with changes in the environment and continuously improved. Everyone in the organisation is aware of the program, hence it is continuously communicated to everyone.		Level 5: Q1. A well-defined program and strategy with long-term activities exist. Q2. The program and strategy have been created by the data governance council (Barker, 2016). Q3. The program and strategy are aligned with corporate needs and goals (Ladley, 2012). Q4.There is a clear roadmap on short- and long-term activities. Activities are re-prioritises as needed (E2). Q5. The program and strategy are communicated and published for everyone, both when created and updated. Everyone is aware of these (Mosley, 2010, E2).

Appendix 7 - Method for Calculating the Levels for the Questions and Elements

Strategy & Approach

Element	Question	Level	Method	Comment
Strategy & Approach	Is there a data governance program and strategy in the organisation?	Level 3	Average	A data governance strategy exists but it was recently created (6 months ago).
	Who has been part of shaping the data governance program and strategy?	Level 4	Based on expert opinion	Cross-functional team of 15-20 participants.
	How is the data governance strategy executed in the organisation?	Level 2	Average	No formal activities for the execution since it is not yet aligned to daily work.
	Has the data governance strategy been communicated?	Level 3	Average	Only 9/20 were aware of the data governance strategy.
	Is the data governance strategy aligned with the corporate needs and goals?	Level 2	Average	The strategy is not applicable or relevant on team level.
		Level 3	**Average**	

Leadership

Element	Question	Level	Method	Comment
Leadership	What is the value of data to leaders?	Level 3	Based on expert opinion.	Data is crucial for Tech-x's product or for Tech-X to become data-driven.
	How would you describe leaders' involvement in the execution of the data governance strategy?	Level 2	Average	Leaders have delegated to it but not committed time/effort for the execution of it.
	How does the organisation make decisions?	Level 2	Average	Today, decisions are made based upon gut feeling/experience/data. Tech-X strives to use data in decision making.
		Level 2	**Average**	

Ownership Structure

Element	Question	Level	Method	Comment
Ownership Structure	Who owns the data assets in the organisation?	Level 2	Average	Only 5/20 were aware that documentation of the ownership structure exists.
	Who manages the data assets in your organisation?	Level 2	Average	Many respondents did not see how this differed from ownership of data. Several suggested that it is the team using the data.
	How should data assets that have multiple owners be handled?	Level 2	Average	In some cases it could be beneficial to have a multiple ownership assigned.
		Level 2	**Average**	

Progress Measure

Element	Question	Level	Method	Comment
Progress Measure	To what extent are metrics defined to measure the progress of the data governance program?	Level 3	Average	Some data governance metrics exist on a central level, no one is aware of them. Some teams have identified their own.
	How are these metrics monitored?	Level 3	Average	The defined metrics are being monitored and tracked.
	How is the progress communicated?	Level 3	Average	The data governance metrics are not being communicated throughout the organisation. Some teams use dashboards to show the progress.
		Level 3	**Average**	

Knowledge & Change Management

Element	Question	Level	Method	Comment
Knowledge & Change Management	How would you describe the understanding and the value of data governance in the organisation?	Level 3	Average	No data education initiative exists.
	Does your organisation have a data training program?	Level 1	Average	No clearly described central routines. teams ensure this by individual documentation.
	How do you mitigate the risk that knowledge and routines related to data get lost when an employee changes position or leaves the company?	Level 3	Average	Difficult for employees to see the value of data governance in their daily tasks. No training or central guidelines regarding data and knowledge loss exist.
		Level 2	**Average**	

Processes

Element	Question	Level	Method	Comment
Processes	How are data related rules developed?	Level 2	Average	No central data rules exist. Some teams have their own.
	Are data rules applicable to the whole organisation or do each department have their own?	Level 2	Average	Created by teams.
	What is the frequency for revising data rules?	Level 2	Average	No routines exist.
	Is there a commonplace where data rules and definitions are captured? How are the rules communicated?	Level 2	Average	A business glossary is being created, but no one was aware of it.
		Level 2	**Average**	

Data Quality

Element	Question	Level	Method	Comment
Data Quality	Who/which department is responsible/accountable for the data quality?	Level 2	Average	No one knows. Guessing that it is the team using the data.
	What processes are in place for monitoring data quality?	Level 3	Average	There are some requirements on minimum quality. Some teams are monitoring the quality.
	What steps are taken to reduce data quality issues?	Level 3	Average	Some teams have created their own metrics, some are showing the progress on a dashboard.
	Are routines for data quality communicated?	Level 2	Average	No routines related to data quality seem to have been communicated.
		Level 3	**Average**	

Data Security & Privacy

Element	Question	Level	Method	Comment
Data Security & Privacy	Are there any data privacy/security standards, such as access, in place?	Level 3	Average	Privacy policies exist. However, everyone has access to all data.
	How are the data privacy and security standards being communicated?	Level 5	Average	These are communicated through mandatory and continuous training.
	What is the process for preventing or managing data breaches?	Level 5	Average	Access controls, firewalls and other processes and controls are in place.
	If a critical system goes down, what is the process for data disaster recovery?	Level 5	Average	There are regular back ups and tests.
		Level 4	Average Level: 5 **Assigned Level: 4**	

Data Lifecycle Management

Element	Question	Level	Method	Comment
Data Lifecycle Management	To what extent do your data assets have a defined lifecycle?	Level 2	Average	Some teams have defined the lifecycle for the data assets, some have not.
	Are there any established processes for data archiving?	Level 2	Average	A few teams had well-defined processes in place. But in general deleted when needed.
	Have the critical data been identified or is all data treated equally?	Level 2	Average	There are standards regarding classification of data, but these are not successfully implemented.
		Level 2	**Average**	

Metadata Management

Element	Question	Level	Method	Comment
Metadata Management	How accessible is the metadata?	Level 3	Average (rounded down)	The metadata is accessible to a large extent.
	What is the extent of coverage of metadata?	Level 3	Average (rounded down)	Operational and technical metadata exist for many data assets, but not all. Business metadata does not exist yet.
	What is the process for updating and maintaining metadata?	Level 2	Average (rounded down)	There are no specific processes for updating and maintaining metadata.
		Level 3	**Average**	

Master Data Management

Element	Question	Level	Method	Comment
Master Data Management	Not working with MDM in a structured and central way. No central repository is identified.	Level 2	Based on expert opinion.	Several respondents thought they had MDM processes in place. However, this is not happening in a structured manner.
		Level 2	**Average**	

Business Intelligence

Element	Question	Level	Method	Comment
Business Intelligence	To what extent are requirements for BI activities fulfilled?	*Level 3*	Average	The requirements are fulfilled to a large extent, some manual interventions are needed.
	Is the data controlled before use?	*Level 3*	Average	The data is reliable. Some sources have a qualification assessment, some have not.
	What is the level of automation for integrating new data and controlling existing data?	*Level 3*	Average	There are automated solutions but the level of automation can be increased.
	Are there standards available for moving data in a structured way?	*Level 3*	Based on expert opinion.	Respondents assumed this is in place. But this is only in place for some systems.
		Level 3	**Average**	

Adherence

Element	Question	Level	Method	Comment
Adherence	Are there any controls in place to ensure adherence to internal data rules?	Level 2	Average	No controls are in place.
	Who is responsible for adherence to external data regulations?	Level 2	Average	The respondents were guessing that it is legal.
		Level 2	**Average**	

Appendix 8 - Process for Identifying Improvement Areas

ELEMENT	QUESTION	RESPONSES FROM INTERVIEWS	ASSIGNED LEVEL	LEVEL 4	ACTIONS TO REACH LEVEL 4	IMPROVEMENT AREA
Strategy & Approach	Has the data governance program and strategy been communicated?	11/20 (majority) of the respondents had not heard of the strategy.	*Level 2*: The program and strategy have not been communicated. Only the people who have created the program and strategy are aware of it.	*Level 4*: The program and strategy have been communicated when created across the organisation. A majority are aware of these.	Communicate the program and strategy across organisation to create awareness	Awareness
Rules	Are data rules applicable to the whole organisation or do each department have their own?	9/20 of the respondents answered that their teams had defined their own data rules. E1 (own judgement) explained that no central rules exist.	*Level 2*: Each department applies their own rules.	*Level 4:* The majority of the rules are applied across the organisation.	Ensure that rules are applied across the organisation.	Alignment

Appendix 9 - Interview Questions in the TMT Data Governance Maturity Model

Descriptions of concepts:

- *Data Governance:* Data governance ensures that the data in the organisation is correct, useful, complying to external laws and regulations while also ensuring that it is secure. Data governance also ensures that there is someone in the organisation who is accountable and responsible for the data and that makes sure that the data creates value.
- *Data Lifecycle Management:* Rules for how the data should be created, used, retained and archived or purged
- *Metadata*: Information about data.
    - *Business metadata:* Definitions around hierarchy, metrics and business rules connected to data.
    - *Technical metadata:* Information about format and structure.
    - *Operational metadata:* Data about processing and access of data.
- *Master Data Management:* Ensures that there is only one version of the data by deciding upon a system which should be the master. Hence, when changes are made on data in the main system, changes in other systems will be made accordingly.

Dimension 1 - People

Element 1 - Strategy & Approach

1. Is there a data governance program and strategy in the organisation?
2. Who has been part of shaping the data governance strategy?
3. Is the data governance strategy aligned with the corporate needs and goals?
4. How is the data governance strategy executed in the organisation?
5. Has the data governance program and strategy been communicated?

Element 2 - Leadership

6. What is the value of data to leaders?
7. How would you describe leaders' involvement in data governance strategy making?
8. How does the organisation make decisions?

Element 3 - Ownership Structure

9. Who owns the data assets in the organisation?
10. Who manages the data assets in your organisation?
11. How should data assets that have multiple owners should be handled?

Element 4 - Progress Measure

12. To what extent are metrics defined to measure the progress of the data governance program?
13. How are these metrics monitored?
14. How is the progress communicated?

Element 5 - Knowledge & Change Management

15. How would you describe the understanding and the value of data governance in the organisation?
16. Does your organisation have data governance training programs?
17. How do you mitigate the risk that knowledge and routines get lost when an employee changes position or leaves the company?

Dimension 2 - Policies

Element 6 - Rules

18. How are data related rules developed?
19. Are data rules applicable to the whole organisation or do each department have their own?
20. What is the frequency for revising data rules?
21. Is there a commonplace where data rules and definitions are captured? How are the rules communicated?

Element 7 - Data Quality

22. Who/which department is responsible/accountable for the data quality?

23. What processes are in place for monitoring data quality?
24. What steps are taken to reduce data quality issues?
25. Are routines for data quality communicated?

Element 8 -Data Security & Privacy

26. Are there any privacy/security standards, such as access, in place?
27. How are the data privacy and security standards being communicated?
28. What is the process for preventing or managing data breaches?
29. If a critical system goes down, what is the process for data disaster recovery?

Element 9 - Data Lifecycle Management

30. To what extent do your data assets have a defined lifecycle?
31. Are there any established processes for data archiving?
32. Has the critical data been identified or is all data treated equally?

Dimension 3 - Capabilities

Element 10 - Metadata Management

33. How accessible is the metadata?
34. What is the extent of coverage of metadata?
35. What is the process for updating and reviewing metadata?

Element 11 - Master Data Management

36. How is it ensured that only one version of the data exists?

Element 12 - Business Intelligence

37. To what extent are requirements for BI activities fulfilled?
38. Is the data controlled before use?
39. What is the level of automation for integrating new data and controlling existing data?

40. Are there standards in place for moving data in a structured way?

Element 13 - Adherence:

41. Are there any controls in place to ensure adherence to internal data rules and standards?

42. Who is responsible for adherence to external data regulations?

Appendix 10 - Instruction for Using the TMT Data Governance Maturity Model

The number of interviews should be decided based on the size of the organisation. The questions should preferably be answered by employees in different positions and departments, to get a comprehensive view of the current status in the organisation. If not, all questions could be answered in the interviews, the user is recommended to complement the information gathered by making other internal investigations. This could for instance be made by searching on the intranet or in internal documents. The model can also be applied to different teams or departments to enable comparison.

The findings from interviews and internal investigations should be compared with each element's criteria described in the model. Hence, the most suitable level should be chosen. If having answers that can be connected to different levels in the model, the user of the model should choose either the most appropriate alternative, the lower alternative or the average, depending on the specific question and element. Meaning that each respondent's answer could be beneficial to compare with the element's criteria described in the model. An average of all the respondent's answers can thereafter be calculated. The average should be rounded to the nearest integer. This will in turn give an indication of the appropriate level for the whole organisation regarding that specific element. However, in some cases the average could be misleading if the respondents are not aware of how something actually is in the organisation. For instance, all respondents might not know who has participated in the strategy sessions, resulting in a lower level could be given by taking the average than by deciding the level upon who actually participated. In such cases, the average is not appropriate to use to determine the level. Hence, when the average is appropriate to use depends on each specific organisation and something the user needs to determine itself.

To determine the level for each dimension, the average of the levels retrieved from the elements within a dimension are recommended to be taken. However, if seen as appropriate, the elements could be weighted differently based on the values or needs of the organisation. For instance, if data quality is considered particularly important for a company, this element should be calculated more heavily compared to the other elements. A company could, for example, use percentages to devote the level of importance of the dimensions and elements. If the organisation is between two different levels, the user should determine the level based on the specific context. However, if the user has nothing to relate the options to, the lower level should be chosen.