Database Answers

Data Governance by Example

Governance

Risks
Threats
Security

RISK

Sensitive Data

Compliance

Barry Williams

Data Governance by Example
Governance, Risk and Compliance

1. Management Summary

1.1 Introduction

This is a companion volume to our other Amazon Kindle books entitled Data Modeling by Example and Data Warehousing by Example. Web Links are provided in Appendix D.

1.2 Best Practice for GRC

This document presents a Proposed Best Practice for Governance, Risk and Compliance (GRC) for a Data Warehouse.

It contains three major Sections :-

1. A Data Security Architecture (Section 2)

2. Links to the Teradata Web Site (AppendixB).

3. Specifications for a Risk Monitoring System

The Data Security Architecture and Risk Monitoring System are shown on this page on the Database Answers Web Site :-

- http://www.databaseanswers.org/teradata_security_for_data_warehouse.htm

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1.3 The First Steps

A GRC Strategy is an on-going process and not a one-off activity.

Here is a way to get started :-

- Carry out Gap Analysis
    - Map the requirements, create checklist and identify any discrepancies
- Get top-level buy-in and appoint :-
    - Assign a senior manager with responsibility for Security
    - Create the role of Security Administrator
- Establish GRC Policies that are compatible with existing Corporate and IT Policies
- Start small with a sub-set of data
- Classify the data – Top Secret, Secret, etc.
- Identify Users, Roles and Data Accesses privileges
- Define Key Risk Indicators
    - KRIs will be monitored and dashboards will continuous display the results.

1.4 GRC Scorecard

A GRC Scorecard will be defined in terms of major components, such as Data Quality, Governance Policies and so on.

The results of the Scorecard will be displayed in a **Dashboar**d so that management can easily monitor operational situation and apply the required precautions.

1.5 Data Security Architecture

This Architecture shows some examples at the three distinct levels of Governance, Risk and Compliance.
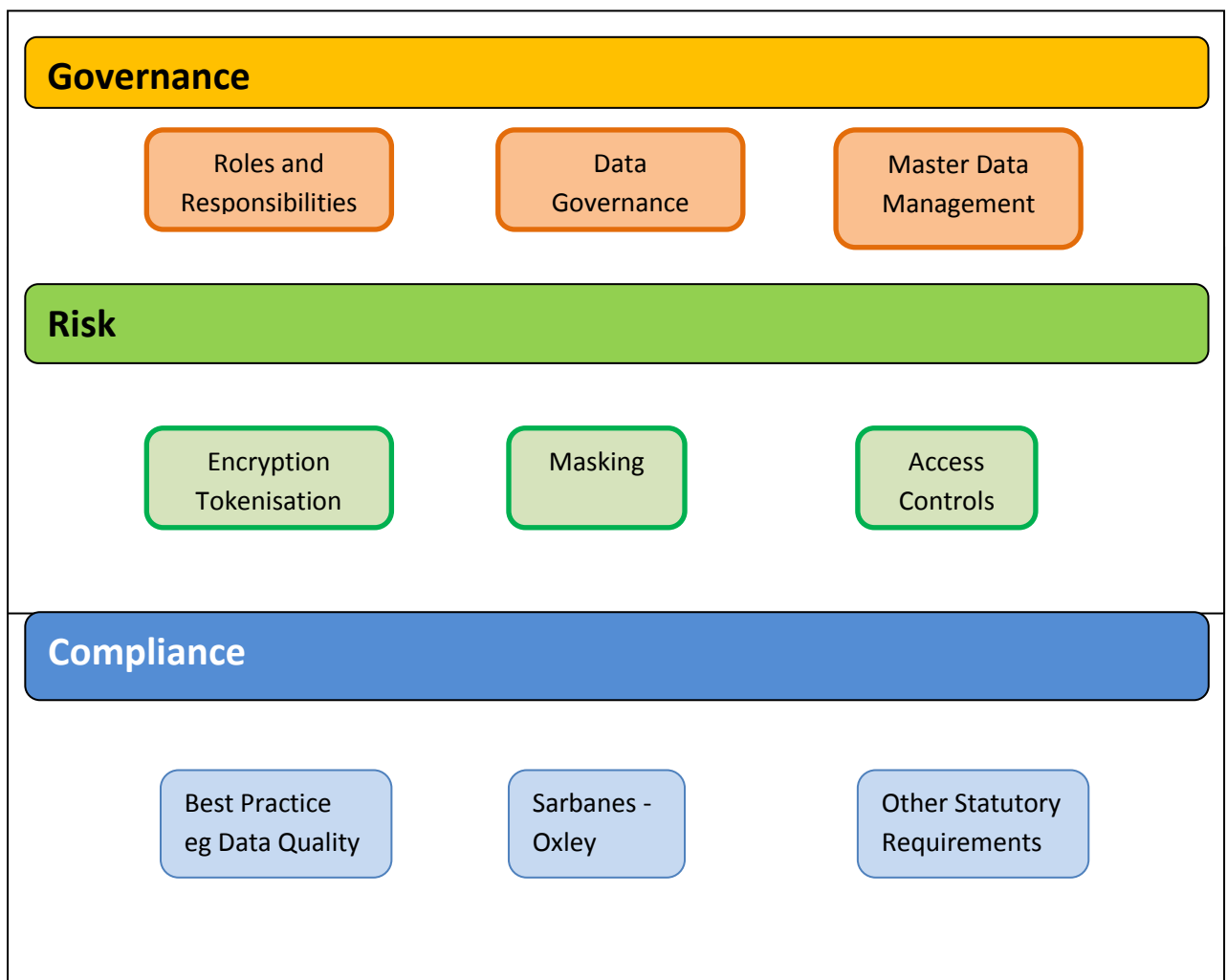
Data Governance by Example
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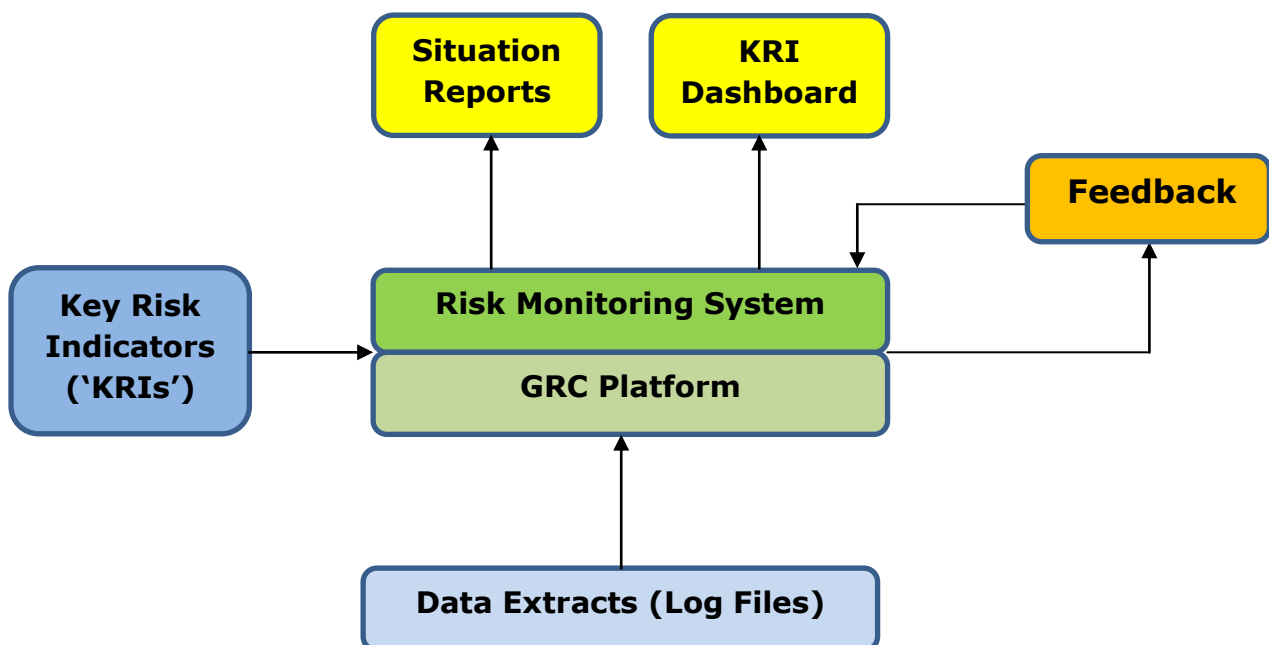
1.6 Risk Monitoring System

1.6.1 What is This ?

A Risk Monitoring System is an automated approach to tracking all the Risks in the environment.

A number of Key Risk Indicators ('KRIs') will have been identified and Dashboards produced regularly.

1.6.2 Why is it Important ?

The Risk Monitoring System is important because it helps us understand what does the future will look like and track progress in a controlled manner.

```
  ┌──────────────┐      ┌──────────────┐
  │  Situation   │      │     KRI      │
  │   Reports    │      │  Dashboard   │                  ┌──────────────┐
  └──────┬───────┘      └──────┬───────┘                  │   Feedback   │
         │                     │                          └──────┬───────┘
┌──────────────┐      ┌─────────────────────────┐                │
│  Key Risk    │      │  Risk Monitoring System │────────────────┤
│  Indicators  │─────▶├─────────────────────────┤                │
│   ('KRIs')   │      │      GRC Platform       │
└──────────────┘      └───────────▲─────────────┘
                                  │
                      ┌─────────────────────────┐
                      │ Data Extracts (Log Files)│
                      └─────────────────────────┘
```

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1.7 Maturity Model

This diagram shows different levels of Maturity from Nothing, to Basic, then Average and finally Ideal.

Red indicates that nothing significant has been accomplished, Amber shows something is under way and Green shows that achievement is substantial.

NOTHING	BASIC (AA)	BASIC (H)	AVERAGE (E)	AVERAGE (BG)	IDEAL
Data Governance	Data Governance	Data Governance	Data Governance	Data Governance	Data Governance
BI+Perf Rpts	BI+Perf Rpts	BI+Perf Rpts	BI+Perf Rpts	BI+Perf Rpts	BI+Perf Rpts
Data Marts	Data Marts	Data Marts	Data Marts	Data Marts	Data Marts
Data Integration	Data Integration	Data Integration	Data Integration	Data Integration	Data Integration
Data Sources	Data Sources	Data Sources	Data Sources	Data Sources	Data Sources
Info Catalogue	Info Catalogue	Info Catalogue	Info Catalogue	Info Catalogue	Info Catalogue

1.8 Strategy for Data Governance

After the Maturity Model has been used to assess the current 'As-Is' situation, we can use this diagram to help us plan a Migration from the As-Ifs to the required 'To-Be' situation.

This diagram shows some ways in which a Strategy can be put in place.

	BASIC	AVERAGE	IDEAL
Data Governance	Do Nothing	Define Roles and Responsibilities	Define Acountability, Data Lineage
BI+Perf Rpts	Establish KPIs	Create Templates and Users	Define Dashboards, Mashups
Data Marts	Do Nothing	Create Specific Data Mart	Create Generic Data Mart
Data Integration	Use SQL	Create Gen Data Model, Choose Tool-eg Informatica, MS SSIS	Put MDM in Place
Data Sources	Identify Basic Sources	Data Sources	Provide On-demand Details
Info Catalogue	Appoint Owner, Format	Info Catalogue	Obtain Top-level Sign-off

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2. Governance

This Section presents the current thinking about Governance and especially Data Governance for Data Warehouses.

2.1 What is This ?

Data Governance can be defined simply as 'Doing the Right Things' in Enterprise Data Management by complying with the appropriate Roles and Responsibilities.

This helps to guarantee that important data elements that can be trusted. This applies especially to corporate publications.

A set of processes is implemented throughout the enterprise, empowering the right people to take control of data and processes.

It is worth checking out [Wikipedia on Data Governance](#)

The Questions are taken from this page on the Database Answers Web Site :-

* http://www.databaseanswers.org/best_practice_road_map/BP_Road_Map_Stage_5.htm

The material in this Section is taken from this page on Barry's Database Answers Web Site :-

- http://www.databaseanswers.org/data_governance.htm

2.1.1 Why is it important ?
The CEO of any organisation needs to able to put hand-on-heart and say 'The data in my company's Reports is 100% accurate'.

Prison is a very real outcome if it turns out that this statement is not true.

It is also very important that Users have confidence in the data in their Reports.

This has helped to focus a tremendous amount of attention on ensuring that all data produced for public or statutory reports has been traced at every step in its production, and that its derivation is completely verifiable.

B.3.3 How do we get started ?
Getting Started involves the following Steps :-
- ## Establish Policies, Procedures, Roles and Responsibilities
- Define Roles and Responsibilities
- Look for suitable Candidates
- Plan for interim results in 3 months and final results in 6 months

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B.3.4 How do I get a top-down view of Data Management in my organisation ?

Answers to this question are at different levels :-

- Data Governance at the top-level
- Master Data Management at the mid-level
- Data Integration at the mid-level
- Data Owners and Sources at the lowest level
- Information Catalogue mandated as the central repository of all this information
- Appropriate procedures in place to control all of these factors.

B.3.5 How do I verify the derivation of all data (the 'Data Lineage') in my Reports ?

This requires the use of an Information Catalogue that will record the source, processing steps and final delivery in a Report.
The transformations in the processing Steps must be specified in both the processing language, for example SQL, and in plain, unambiguous English so that the Data Owner can sign-off on the Data Lineage.

B.3.6 What is Best Practice in Data Governance ?

Successful Data Governance requires successful completion of many Tasks, most of which are not technical and all of which are complex and challenging.
The process of initially establishing Data Governance will always take much longer than anticipated.
Therefore, management of expectations is very important.

It is necessary to aim for collaboration and buy-in from the start.

This buy-in must be top-down and bottom-up.
The top-down buy-in manifests itself by, for example, a realization that "Data Quality is an Enterprise Issue".
The bottom-up buy-in is important because quality of Source data is critical and must be good, otherwise any Data Governance issue will fail.

Auditing, for example, of database changes, is a basic requirement.

B.3.7 What is Data Lineage ?

Data Lineage can be defined as being able to the trace the derivation of all items of data that appear in any important Performance Reports and Management Information.

That includes :-

- Who owns the original source data ?
- What validation and transformations are applied to the data in its life cycle ?

B.3.8 How do I verify the derivation of all data (the Data Lineage) in my Reports ?

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This 20-page PDF document describes the [Framework](#) from the Data Governance Institute.

B.3.9 How do I get a top-down view of Data Management in my organisation ?
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- Appropriate procedures in place to control all of these factors.

B.3.10 Why should my organisation have a Data Governance function ?
The existence of a Data Governance function is a measure of the maturity of Data Management within an organization
The first steps should be to establish a thin slice of Data Governance from top to bottom.

If you are active in this area, you should consider joining a professional organizational. This helps you to network with your peer group and will encourage you to keep up-to-date in knowledge and professional practice.

Here are two organisations that are playing active roles in Data Governance :-
i) The Data Governance Institute - Membership starts at $150 for individuals.

ii) The Data Governance and Stewardship Community of Practice - $150/year.   -
It includes coverage of some very useful Case Studies.

It also maintains a Data Governance Software Web Site, and a Sarbanes-Oxle Site.

2.2 Questions

Question : What is Data Governance ?

Data Governance can be defined simply as 'Doing things right' in Enterprise Data Management by following with the appropriate Roles and Responsibilities.

These will all be designed to make sure that data used throughout the Enterprise is good-quality data, certainly when it appears in Performance reports.

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Question : How do we manage Users ?

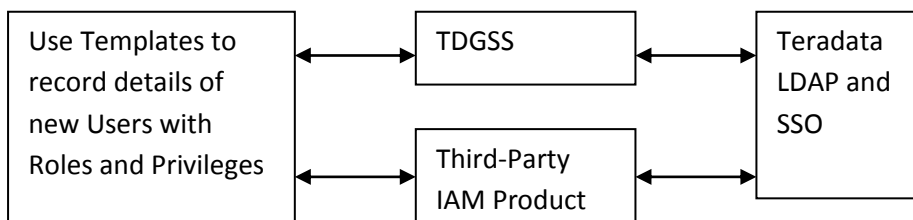Users have a lifecycle with three Phases :-

1. Join the organisation

2. Be created as a new User (currently called Onboarding) with Role(s) and be set up with Privileges corresponding to the Role(s).

3. Work as a member of staff with a defined Role

4. Leave the organisation.

There are two choices :-

1. Use Teradata's TDGSS utility.

2. Use a product from a third-party supplier that acts as a front-end to TeradatB.

   Two suitable suppliers included in Appendix B are :-

   a. AlertEnterprise

   b. Hitachi

Use Templates to record details of new Users with Roles and Privileges	⟷	TDGSS	⟷	Teradata LDAP and SSO
	⟷	Third-Party IAM Product	⟷	

The IAM products typically work by establishing an ODBC link to the Teradata Data Warehouse to load the data directly into the appropriate Tables.

Prices range from $30/user upwards.

Question : How do I get a top-down view of Data Management in my organisation ?

Answers to this question are at different levels :-

- Data Governance at the top-level
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Question : Why should my organisation have a Data Governance function ?

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Wikipedia on Data Governance
- http://en.wikipediB.org/wiki/Data_governance

Alignment of Enterprise Architecture with Business Goals –
- http://www.information-management.com/infodirect/2009_115/enterprise_architecture_togaf-10015189-1.html?ET=informationmgmt:e886:2099687a:&st=email

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- http://www.datagovernance.com/

ii) The Data Governance and Stewardship Community of Practice ($150/year) :-   -
   http://www.datastewardship.com/

It includes coverage of some very useful Case Studies :-

http://www.datastewardship.com/content.aspx?page_id=22&club_id=885168&module_id=37956

It also maintains a Data Governance Software Web Site :-

   http://www.datagovernancesoftware.com/

and Sarbanes-Oxley Web Site - http://www.sox-online.com/

2.3 Best Practice

Successful Data Governance requires successful completion of many Tasks, most of which are not technical and all of which are complex and challenging.

The process of initially establishing Data Governance will always take much longer than anticipated. Therefore, management of expectations is very important.

It is necessary to aim for collaboration and by-in from the start.

This buy-in must be top-down and bottom-up.

The top-down buy-in manifests itself by, for example, a realization that 'Data Quality is an Enterprise Issue'.

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Auditing, for example, of database changes, is a basic requirement.

This Weblink for the Data Governance Institute is relevant :-

- http://datagovernance.com/dgi_framework.pdf

2.4 Templates

Templates for Data Governance include standard documents.

These documents can be made available as Forms over the Internet.

They will control all aspects of the planning, management and control of Data Management.

Compliance will be ensured with overall Enterprise policy and procedures to ensure auditability and transparency.

2.5 Tools

Tools are those required to manage Templates and include Excel Spreadsheets and Databases..

2.6 Tutorial on Data Governance

Here is a step-by-step Tutorial for Data Governance :-

Step 1. Determine the principles and goals of Data Governance.

> For example 'Data Quality is an Enterprise Issue'.

Step 2. Clarify Roles and responsibilities, both top-down and bottom-up.

Step 3. Obtain agreement on how success will be measured.

Step 4. Determine Data Quality standards at all phases in ETL

Step 4. Avoid a demanding schedule.

Step 5. Establish a spirit of collaboration and ownership of a common problem.

> This will help obtain timely resolution of all issues.

This Presentation by Barry Williams on Data Standardisation in Public Sector is an excellent starting-point-

- http://www.databaseanswers.org/presentations/data_standards_in_public_sector.ppt

Here's another useful Presentation by Barry on a Strategy for Information Management :-

- http://www.databaseanswers.org/presentations/info_mgt_strategy.ppt

2.7 How do I ?

2.7.1 Get buy-in from key Stakeholders ?

It is essential to get key Stakeholders involved and one good way to achieve this is by arranging Facilitated Workshops. Where necessary, you can supplement these with one-on-one discussions between you or your team and specific individuals who have concerns that are best resolved before holding Workshops.

2.8 Personal Qualities for Success

To be successful in Data Governance it is important to be comfortable working with senior management and to have a clear idea of what is achievable in large organizations and how to establish agreement over overall goals for an enterprise.

Someone who works in this area is happy to work with senior management and will understand just enough about technology to make an effective contribution and to ensure that the role of technology is used to the maximum effect.

3. Risk

This Section presents the current thinking about Risk Management and especially how it applies to Threats to Data Warehouses.

4. Compliance

This Section presents the current thinking about Compliance and how it applies to Data Warehouses.

4.1 What is This ?

Data Compliance can be defined simply as 'Doing things Right' in Enterprise Data Management by complying with the appropriate Policies and Procedures.

One of the benefits of an Enterprise Data Warehouse is that it offers a 'Single View of the Truth'.

This makes it ideal for data validation using Best Practice in running SQL Scripts to ensure Data Consistency and Data Integrity.

These will all be designed to make sure that data used throughout the Enterprise is good-quality data, certainly when it appears in Performance reports.

5. Getting Started with Templates

This Section provides Templates that are used to set-up and enter data.

Our approach is to define Business Processes and the associated Data Governance policies.

This helps ensure good data quality.

5.1 Data and Classification

Classification of data is very important because it helps to identify these aspects :-

- Roles and privileges for data access

- Sensitive data that might we protected by Encryption.

5.2 Proposed Business Process

Every item of Secret and Top Secret data must be classified and appropriate safeguards must be in place to prevent unauthorised access.

5.3 Draft Data Governance Policy

The Levels of Classification will reflect existing corporate standards.

The following Levels of Classification have been proposed for discussion purposes :-

1) Top Secret (the highest)

2) Secret

3) Confidential

4) Unrestricted (the lowest)

5) Need to Know

The Owner of each Data Item will be responsible for completing this Template.

Data which is on a 'Need to know ' basis will be protected by Role-Based Access.

These Templates are used to define the Classification of Data.

Of particular interest is sensitive Data that must be handled by encryption, tokenisation and so on.

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Template D.1 : Data Classification

When completed, this Template will be approved and signed-off by the Owner, who in this case, in the Director of HR.

CATEGORY	DATA SET	ITEM	OWNER	CLASSIFICATION	TERADAT LINK
HR	Employee	Company ID	Director of HR	Confidential	B.6
HR	Employee	Date of Birth	Director of HR	Confidential	B.6
HR	Employee	First Name	Director of HR	Public	
HR	Employee	Last Name	Director of HR	Public	
HR	Employee	Salary	Director of HR	Secret	B.6

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5.4 Users and Roles

This Section shows how to get started with Templates for preparing the data that is required.

Template U.1 : Resources

This template shows the available Resources.

This data will change from time-to-time.

Resource Name	Resource Type	Description	Comments
Finance Report 123	Report	Weekly On-demand Report	
Finance Report 456	Report	Monthly On-demand Report	
DW_123	Database Access	Test Data Warehouse	

Template U.2 : Roles

This template shows specific Roles and the related Resources.

We show, among other things, two fictitious Roles in Finance, one that can run Reports and the other that has a little higher privilege that can run Reports, then change the data and save the changes.

Job Type	Role Name
Finance	Finance 1
	Finance 2
BI Consultants	BI Consultant 1
	BI Consultant 2
Data Analysts ('IT Consultants')	Data Analyst 1
	Data Analyst 2

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Template U.3 : Roles and Resources

This template shows the Resources that are available to specific Roles

This data might change from time-to-time.

Role	Resource
Finance 1	Run Report 123
Finance 2	Run Report and save Data Changes
BI Consultant 1	Create Reports
BI Consultant 2	Run SQL (Read-only)
Data Analyst 1	Run SQL (CRUD)
Data Analyst 2	Run DDL (Create Tables, etc)

Template U.4 : Users

We show a fictitious User called Anton Geesink who has two Finance Roles and another User called Wilhelm Ruska, who has a BI Consultant 1 Role.

User First Name	Last Name	Login	Password
Anton	Geesink	geesinka	Utrecht
Wilhelm	Ruska	ruskaw	Judo

The Teradata Approach to User management is based on LDAP and SSO, which involves configuring the Teradata Generic Security Services subsystem (TDGSS) to work with an LDAP infrastructure and configure Kerberos to support SSO.

Further details are available one-hour Online Training Course by Jim Browning on LDAP and SSO :-

- http://developer.teradatB.com/database/training/de-mystifying-ldap-and-sso-teradata-database-external-authentication

Template U.5 : Users and Roles

This template shows that Users can have one or many Roles.

We show a fictitious User called Anton Geesink who has two Finance Roles and Wilhelm Ruska, who has a BI Consultant 1 Role.

User First Name	Last Name	Login	Roles
Anton	Geesink	geesinka	Finance 1, Finance 2
Wilhelm	Ruska	ruskaw	BI Consultant 1

5.5 Master Data Template

This Section shows how to get started with Templates for preparing the data that is required.

AREA	ACTIVITY	TEMPLATE
Governance	Create Users, Roles and Resources	1 – 4 (above)

6. Planning for the Future
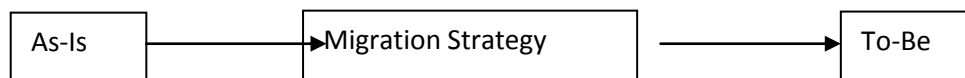
6.1 Introduction

Planning involves three steps :-

1. An assessment of the current 'As-Is' situation

2. A specification of the 'To-Be' situation

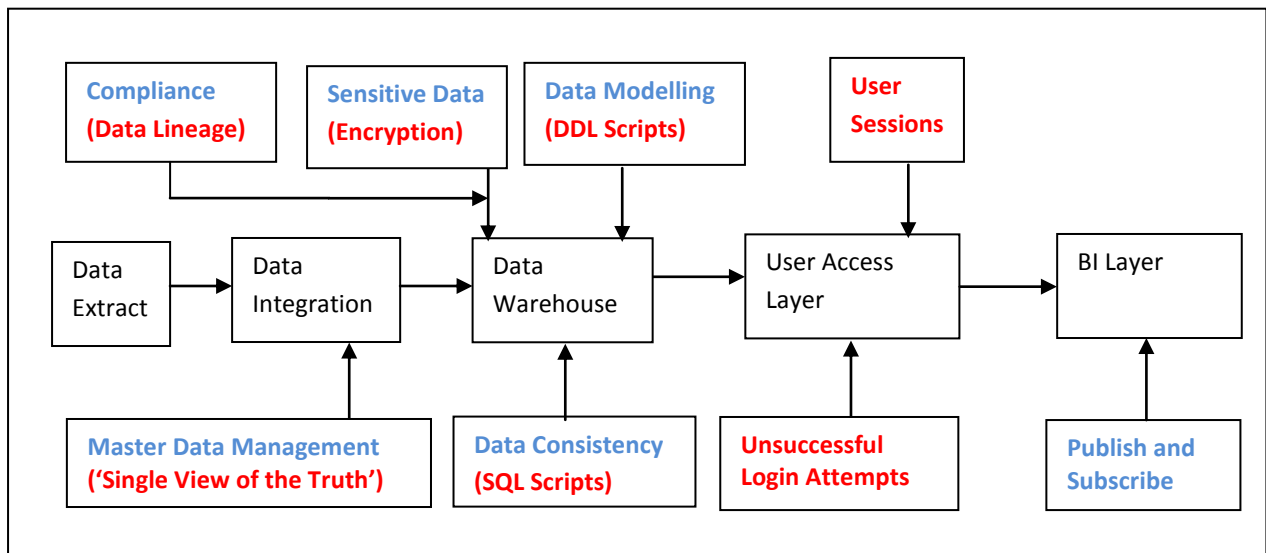   This will require involvement by all key stakeholders – the business, the users, IT and so on

3. Agreement of the Migration Strategy

This is shown in the following diagram :-

```
┌────────┐      ┌──────────────────┐        ┌────────┐
│ As-Is  │─────▶│ Migration Strategy│───────▶│ To-Be  │
└────────┘      └──────────────────┘        └────────┘
```

6.2 Data Migration Framework

This Data Migration Framework for Best Practice shows In Red Indicators for Phase 1 of the POC, and Green for later Phases.

6.3 Potential Role of Vendors

Many vendors offer what they call 'A GRC Platform'.

These all seem to offer the features that we need for the POC under the heading of 'Monitoring', including the following facilities :-

- Continuous Monitoring, with Audit and Reporting
- Dashboards
- Issue & Task Management
- Remediation Actions

It is recommended that a shortlist of three be drawn up and they should be invited to give presentation against a statement of Requirements.

This is very useful to establish the level of awareness and 'thought-leadership' that the vendor offers.

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Appendix A. Compliance for Data Models

This Appendix presents Best Practice in Compliance to ensure that the data integrity passes a series of stringent tests for accurate and consistent data.

It provides a checklist that can be used to determine whether a Data Model corresponds to Best Practice.

The Best Practice combines theoretical material based on the thinking of Ted Codd, the father of Relational Theory with a substantial body of knowledge based upon the experience of practitioners.

Our page dedicated to Ted Codd is available on the Database Answers Web Site :-

- http://www.databaseanswers.org/codds_page.htm

It may include a number of Templates to be used in an assessment.

It is intended to encourage collaboration and the accumulation of shared experience so if you would like to contribute please email us on barryw@databaseanswers.org.

A.1 What is This?

This chapter is a tutorial to help you in looking at a data model, understanding it and determining whether it is of an acceptable quality.

A.2 Why is it Important?

It is important because it helps you to understand a data model, even if it is not one of your principal concerns.

A.3 What Will I Learn?

You will learn how to read a data model, so that you will be comfortable looking at any model, regardless of the notation and style and you will be able to understand the underlying logiA.

The approach is largely based on the concept of design patterns, which are general solutions to common problems that occur on a regular basis.

This tutorial starts with some simple concepts and then discusses common design patterns based on these concepts.

The tutorial applies in two situations:

i) Data models created by **reverse engineering** existing databases.

ii) Other data models.

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This tutorial will help in the quality assurance (QA) of these data models, which might be

produced internally or externally, by partners, for activities such as **data migration**.

i) For the first situation, it is not appropriate to attempt a quality assurance of the model.

This is primarily because databases in operational systems have usually gone through a series of changes and usually the impact on design has not been thought through and there has not been time to redesign the database. The objective is primarily to understand the database.

The many-to-many pattern will not occur because this cannot be implemented directly in a relational database. This applies also to **inheritance** (*see* Section 3.4), which can only be identified by implication when the model for the database is examined.

It is often useful to create a general business data model that renames tables as appropriate to replace the physical table names with corresponding business terms.

This is different from a logical model and can usually be implemented in Microsoft Word, rather than a data modeling tool.

For complex databases, it is usually valuable to create a top-level data model with lower-level subject area models.

It is important to try to establish a **glossary of terms** covering descriptions of the most important tables, attributes and reference datB.

Another important activity is to establish the **business rules** that define the logic underlying any database.

Some simple examples that can be used as templates have been shown in this book.

ii) For the second situation it is appropriate to perform a quality assurance of the model.

This would include a number of tasks, such as:

Looking for examples of the design patterns being used where appropriate.

Review of the reference datB.

A.4 Types of Data Models

There are three different types:

Business data model - this can also be called a *conceptual* model because it focuses on the important 'things of interest' and how they are related. It can be created in Microsoft Word and is very useful for discussion with business users.

Logical - this usually shows primary and foreign keys. It is invariably produced in a data modeling tool like Dezign or ERWin.

Physical - this is usually close to the design of the database.

Conceptual models are often business data models, intended to be understood by non-technical users.

Logical models add primary and foreign keys.

Physical models are often used to generate SQL to create database tables. They can also be created by reverse engineering from an existing operational database.
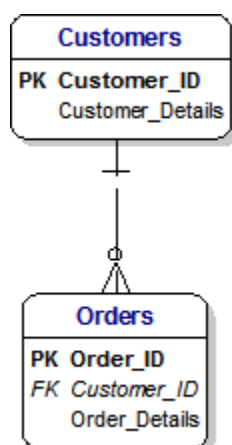
A.5 Concepts

A.5.1 One-to-Many Relationships

A customer can place many orders for products. This defines a one-to-many Relationship.

A data modeler would say "For every customer, there are many orders".

This is shown in a data model as follows:

Sample Template:

TERM	AUTHOR	DEFINITION
Customer	Joe Bloggs	Any person or organization that can raise an order
Order	Joe Bloggs	A request for products to be supplied. The format of a request can be an online form, a paper document and so on.

Business rules:

- A customer can raise zero, one or many orders.

- An order must be associated with a valid customer.

Blank Template:

TERM	AUTHOR	DEFINITION

A.5.2 Many-to-Many Relationships

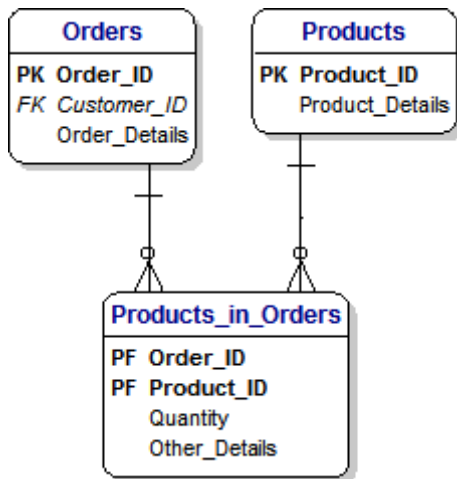We can also say that an order can request many products. A data modeler would say "An order can request many products, and each product can be in many orders". This defines a many-to-many relationship and is shown in a data model as follows:

Many-to-many relationship cannot be implemented in relational databases. Therefore we resolve this many-to-many into two one-to-many relationships, which we show in a data model as follows:

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Orders
PK	Order_ID
FK	Customer_ID
	Order_Details

Products
PK	Product_ID
	Product_Details

Products_in_Orders
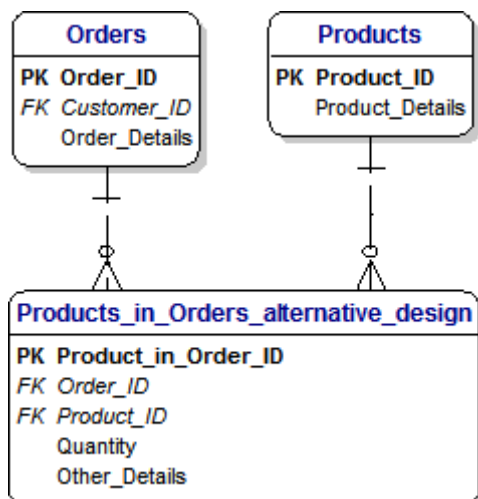|	
PF	Order_ID
PF	Product_ID
	Quantity
	Other_Details

When we look closely at this data model, we can see that the primary key is composed of the Order_ID and Product_ID fields. This reflects the underlying logic, which states that every combination of order and product is unique. In the database this will define a new record.

When we see this situation in a database, we can say that this reflects a many-to-many relationship. However, we can also show the same situation in a slightly different way, to reflect the standard design approach of using a surrogate key as the primary key and show the order and product IDs simply as foreign keys. We learnt in Section 2 that a surrogate key is simply a key that stands for something else. It is a meaningless integer that is generated automatically by the database management software, such as Oracle or SQL Server. The values are usually consecutive integers, starting with 1,2,3,4 and so on.

The benefit of this approach is that it avoids the occurrence of too many primary keys if more dependent tables occur where they cascade downwards. The benefit of the previous approach is that it avoids the possibility of orphan records in the Products in an Order Table.

 In other words, invalid records that have invalid order ID and/or product ID values.

Orders
PK	Order_ID
FK	Customer_ID
	Order_Details

Products
PK	Product_ID
	Product_Details

Products_in_Orders_alternative_design
PK	Product_in_Order_ID
FK	Order_ID
FK	Product_ID
	Quantity
	Other_Details

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TERM	AUTHOR	DEFINITION
Order		A request for products to be supplied. The format of a request can be an electronic message, a paper form and so on.
Product		An item that can be supplied on request.

Business rules:

An order can refer to one or many products.

A product can appear in zero, one or many orders.

In other words, there is a many-to-many relationship betweenorders and products.

A.5.3 Rabbit Ears

We start with the definition of a customer, which at its simplest, looks like this:

In this case, we use a meaningless ID for the customer ID, which is simply an automatically generated unique number.

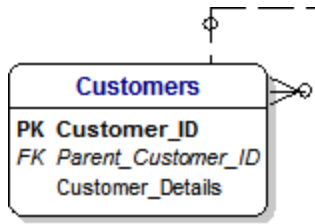**Customers**
PK Customer_ID
Customer_Details

Then we think about the fact that every business customer is part of a larger organization.

In other words, every customer reports to a higher level within the overall organization.

Fortunately, we can show this in a very simple and economical fashion by creating a relationship that adds a parent ID to every customer. This is accomplished by adding a relationship that joins the table to itself. This is formally called a *reflexive* or *recursive* relationship, or informally called *rabbit ears*, and looks like this:

The customer at the very top of organization has no one to report to, and a customer at the lowest level does not have any other customer reporting to it.

In other words, this relationship is **optional** at the top and bottom levels. We show this by the small letter *O* at each end of the line that marks the relationship. Note that we have positioned the Parent_Customer_ID field immediately below the Customer_ID field.

This is in line with our best practice policy of putting all key fields at the beginning of the list, with primary (PK) fields first.

A.5.4 Inheritance

Inheritance is a very simple and very powerful concept. We can see examples of inheritance in practice when we look around us every day. For example, when we think about houses, we implicitly include bungalows and ski lodges, and maybe even apartments, beach huts and house boats.

In a similar way, when we discuss aircraft we might be talking about rotary aircraft, fixed-wing aircraft and unmanned aircraft.

However, when we want to design or review a data model that includes aircraft, then we need to analyze how different kinds of aircraft are shown in the design of the data model.

We use the concept of **inheritance** to achieve this. Inheritance in data modeling is just the same as the general meaning of the word. It means that at a high level, we identify the general name of the 'thing of interest' and the characteristics that all of these things share.
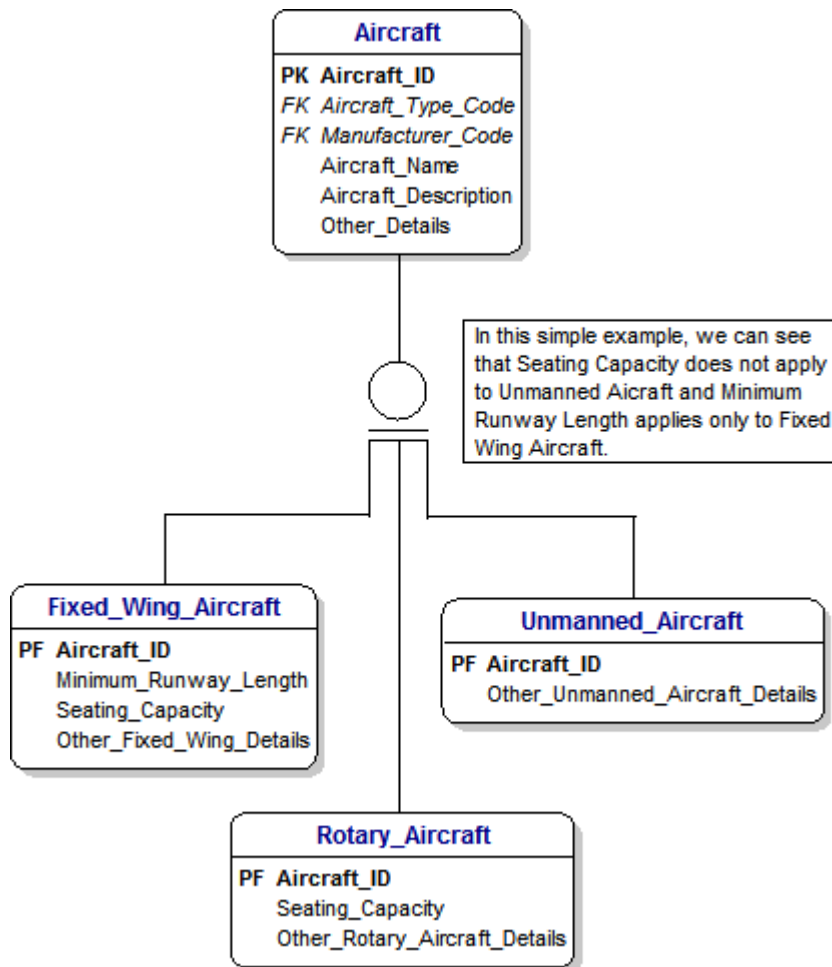
For example, an aircraft will always have a name for the type of aircraft, such as Tornado and it will be of a certain type, such as fixed-wing or rotary.

At the lower level of fixed-wing aircraft, an aircraft will have a minimum length for the runway that the aircraft needs in order to take off.

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This situation is shown in the following diagram:

Aircraft

PK	Aircraft_ID
FK	Aircraft_Type_Code
FK	Manufacturer_Code
	Aircraft_Name
	Aircraft_Description
	Other_Details

In this simple example, we can see that Seating Capacity does not apply to Unmanned Aicraft and Minimum Runway Length applies only to Fixed Wing Aircraft.

Fixed_Wing_Aircraft

PF	Aircraft_ID
	Minimum_Runway_Length
	Seating_Capacity
	Other_Fixed_Wing_Details

Unmanned_Aircraft

PF	Aircraft_ID
	Other_Unmanned_Aircraft_Details

Rotary_Aircraft

PF	Aircraft_ID
	Seating_Capacity
	Other_Rotary_Aircraft_Details

A.5.5 Reference Data

Reference data is very important. Wherever possible, it should conform to appropriate external standards, particularly national or international standards. For example, the International Standards Organization (ISO) publishes standards for country code, currency codes, languages codes and so on.

For addresses, the UK Post Office Address File (PAF file) is used to validate addresses within the UK. For customers, the overall structure is classified.

This diagram shows two basic examples of reference data that might apply to our simple aircraft data model.

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A.6 Data Warehouses and ERDs

Different considerations apply to data warehouses than apply to **Entity-Relationship-Diagrams** (ERDs). For the purpose of this discussion, we include data marts with data warehouses.

A.6.1 Design of an ERD

This data model is an Entity-Relationship-Diagram (ERD) for customers and orders. In passing, we observe that we use the prefix 'Ref_' to indicate reference datB.
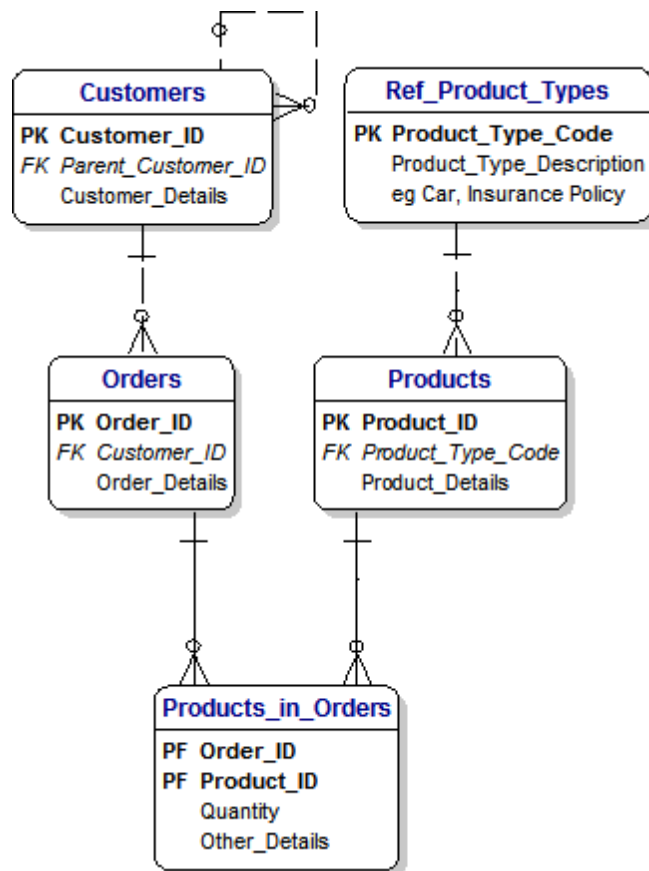
We could describe it in these terms:

"Customers place orders for products of different types."

A.6.2 Design of a Data Warehouse

This data model shows the corresponding data warehouse for customers and orders.

The design of this data warehouse simply puts all data into a big basket to satisfy any request for information from management and the business community.

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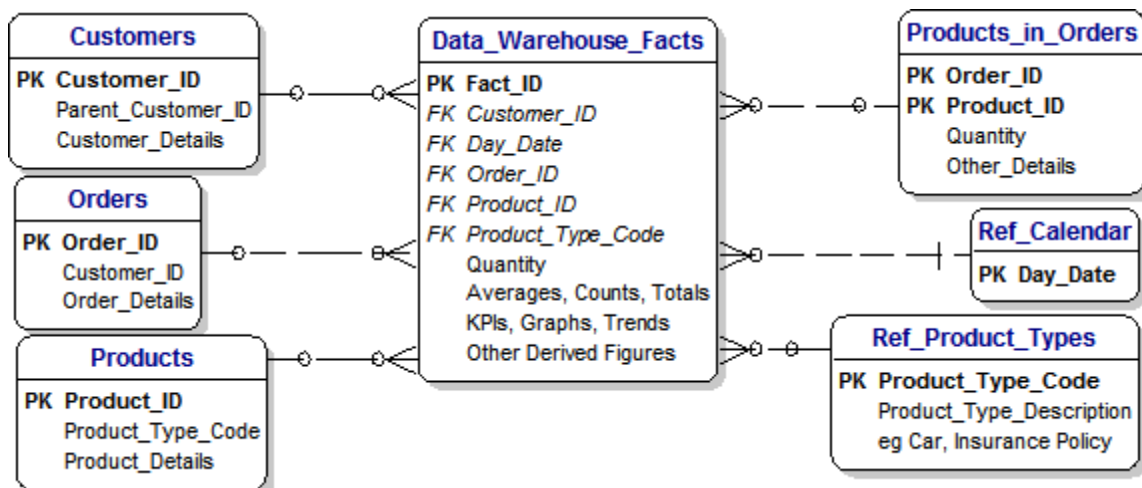
A.6.3 Reviewing the Design of a Data Warehouse

The design of any data warehouse will conform to this pattern with dimensions and facts.

Dimensions correspond to primary keys in all the associated tables (i.e. the entities in the ERD) and the facts are the derived values that are available.

Therefore, reviewing the design of a data warehouse involves looking for this design pattern.

With one exception, the relationships are optional because the inquiries need not involve any particular dimension. The one exception to this rule is that the relationship to the calendar is mandatory because an inquiry will always include a date. Of course, an inquiry might include all data since the first records, but the principle still applies.

The purpose of the data warehouse is to make it easy to retrieve data in any combination in order to answer questions like this:

Which customers ordered the most products?

Which were the most popular products in the first week of April?

What was the average time it took to respond to orders for washing machines?

How many orders did we receive in May?

A.7 Design Patterns

A.7.1 Addresses

Addresses can be a problematic area to handle correctly in databases.

The usual approach is to simply store:

- Three lines for the address, called simply Line_1, Line_2 and Line_6.

- The Town or City

- The Postcode

- The County

- The Country

However, in the United States, the US Postal Service has established a standard of two lines for addresses.

A professional approach is to store addresses in a dedicated address file. One great benefit of this approach is that this allows the use of commercial software to validate the addresses.

In the UK, the Post Office PAF file is used for validation of addresses and to support a standard format for storing addresses.

A variety of vendors, such as QAS, offer software to use the PAF file for validation.

A.7.2 Customers and Orders

The design of the ERD in the chapter on data warehouses shows a typical customers and orders data model, which represents a widespread kind of application.

A.7.3 Customers, Products and Orders

This data model demonstrates the power of rabbit ears. It shows customers in an organizational hierarchy and product types in a hierarchical catalog.
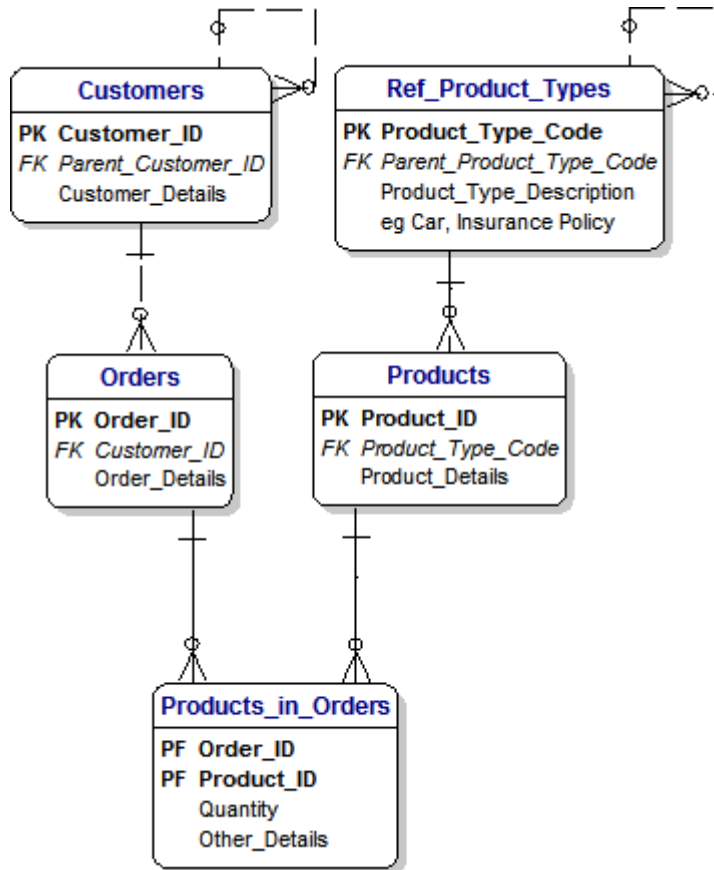
A.7.4 Deliveries

A.7.4.1 A Simple Design Pattern

This data model covers the activities of delivering an order to a customer at a designated address. The process of reviewing a data model is to ask:

"How do I describe the business rules behind this model?"

In this case, we could say "A customer can raise an order for products to be delivered to a specified address".

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Customers
- 🔴PK **customer_id**
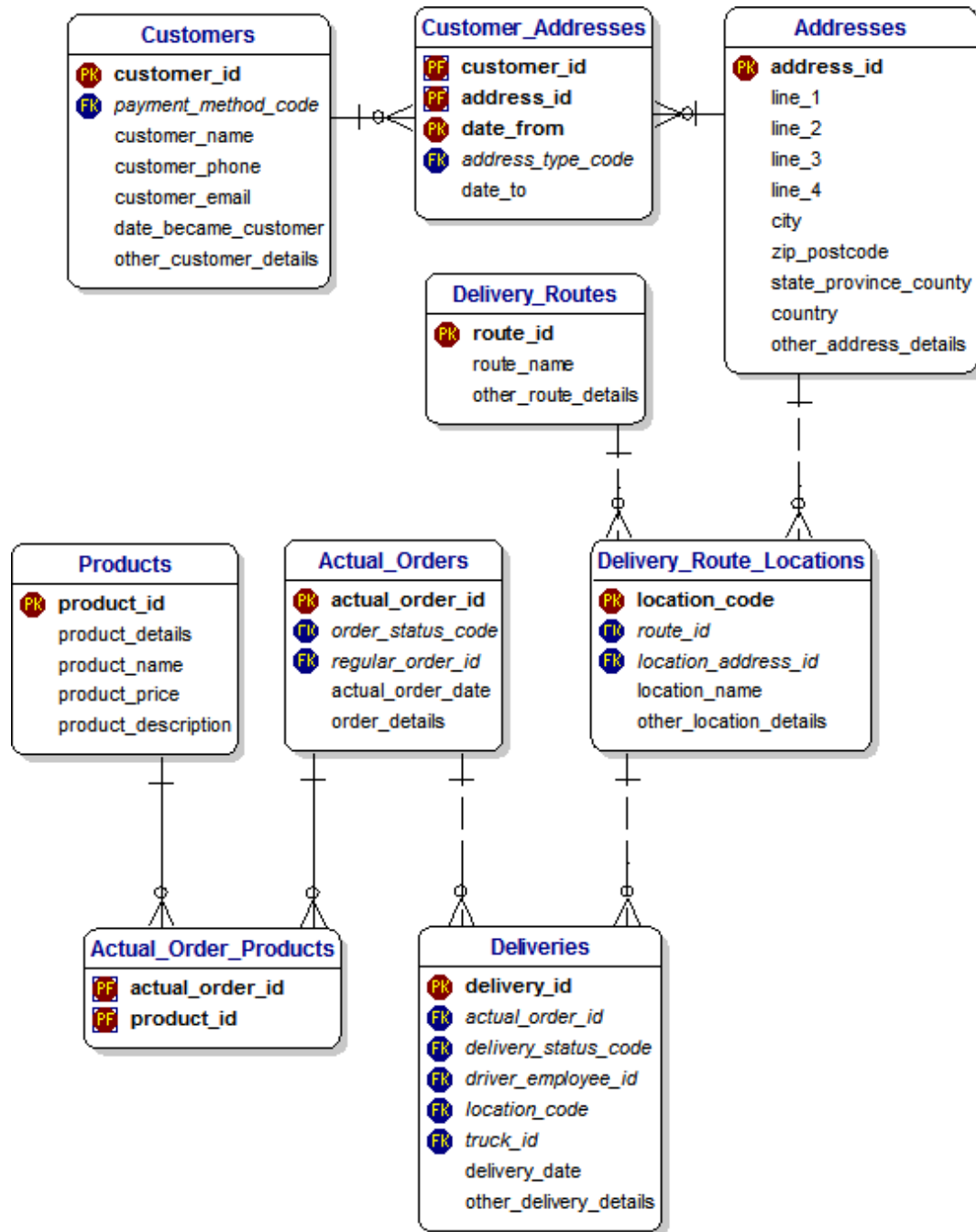- 🔵FK *payment_method_code*
- customer_name
- customer_phone
- customer_email
- date_became_customer
- other_customer_details

Customer_Addresses
- 🟦PF **customer_id**
- 🟦PF **address_id**
- 🔴PK **date_from**
- 🔵FK *address_type_code*
- date_to

Addresses
- 🔴PK **address_id**
- line_1
- line_2
- line_3
- line_4
- city
- zip_postcode
- state_province_county
- country
- other_address_details

Delivery_Routes
- 🔴PK **route_id**
- route_name
- other_route_details

Products
- 🔴PK **product_id**
- product_details
- product_name
- product_price
- product_description

Actual_Orders
- 🔴PK **actual_order_id**
- 🔵FK *order_status_code*
- 🔵FK *regular_order_id*
- actual_order_date
- order_details

Delivery_Route_Locations
- 🔴PK **location_code**
- 🔵FK *route_id*
- 🔵FK *location_address_id*
- location_name
- other_location_details

Actual_Order_Products
- 🟦PF **actual_order_id**
- 🟦PF **product_id**

Deliveries
- 🔴PK **delivery_id**
- 🔵FK *actual_order_id*
- 🔵FK *delivery_status_code*
- 🔵FK *driver_employee_id*
- 🔵FK *location_code*
- 🔵FK *truck_id*
- delivery_date
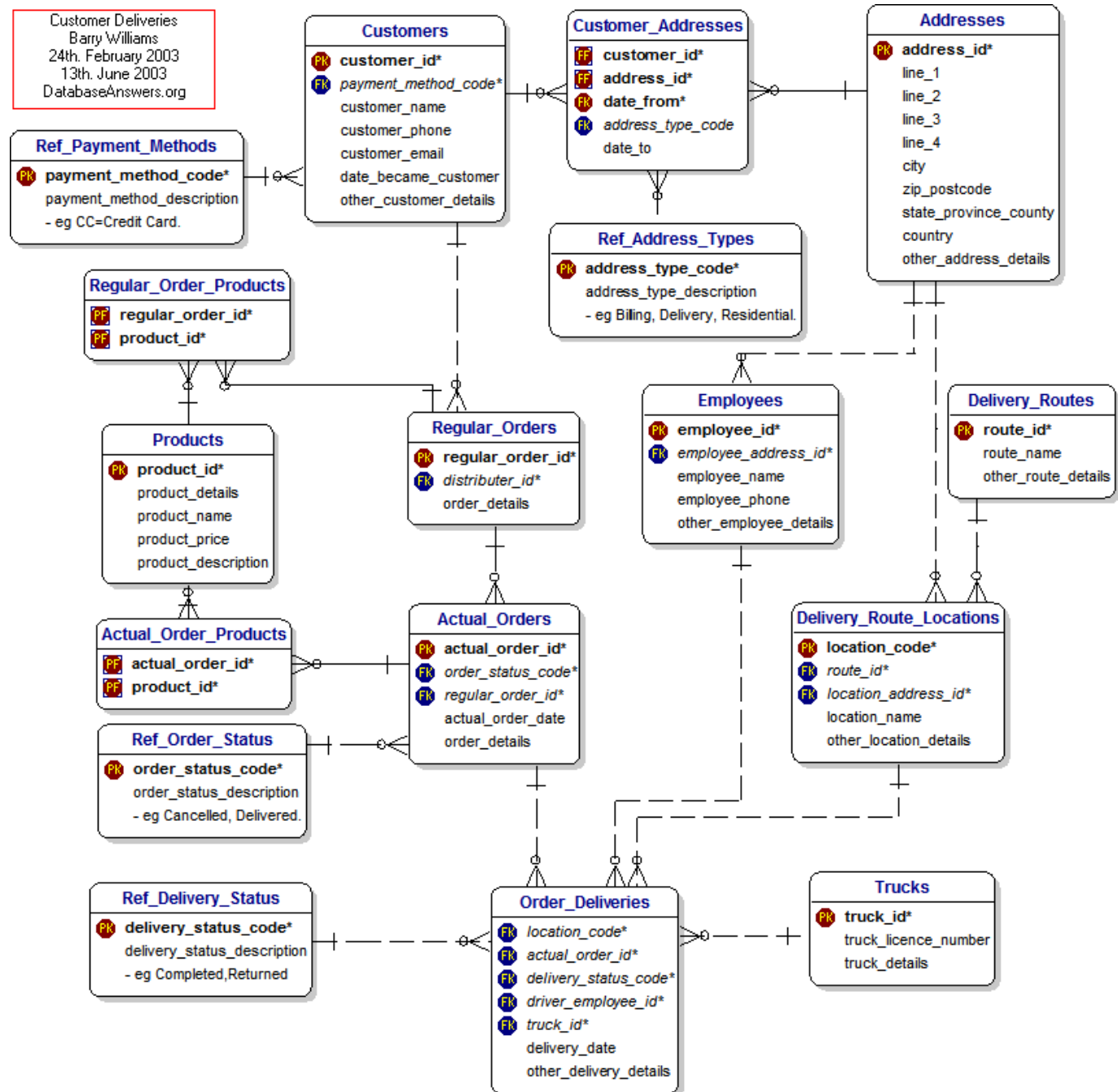- other_delivery_details

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A.7.4.2 A Complex Design Pattern

This shows a complex pattern that adds regular orders to the simple model shown above.

Customer Deliveries
Barry Williams
24th. February 2003
13th. June 2003
DatabaseAnswers.org

Customers
- PK customer_id*
- FK payment_method_code*
- customer_name
- customer_phone
- customer_email
- date_became_customer
- other_customer_details

Customer_Addresses
- FF customer_id*
- FF address_id*
- PK date_from*
- FK address_type_code
- date_to

Addresses
- PK address_id*
- line_1
- line_2
- line_3
- line_4
- city
- zip_postcode
- state_province_county
- country
- other_address_details

Ref_Payment_Methods
- PK payment_method_code*
- payment_method_description
- - eg CC=Credit Card.

Ref_Address_Types
- PK address_type_code*
- address_type_description
- - eg Biling, Delivery, Residential.

Regular_Order_Products
- PF regular_order_id*
- PF product_id*

Products
- PK product_id*
- product_details
- product_name
- product_price
- product_description

Regular_Orders
- PK regular_order_id*
- FK distributer_id*
- order_details

Employees
- PK employee_id*
- FK employee_address_id*
- employee_name
- employee_phone
- other_employee_details

Delivery_Routes
- PK route_id*
- route_name
- other_route_details

Actual_Order_Products
- PF actual_order_id*
- PF product_id*

Actual_Orders
- PK actual_order_id*
- FK order_status_code*
- FK regular_order_id*
- actual_order_date
- order_details

Delivery_Route_Locations
- PK location_code*
- FK route_id*
- FK location_address_id*
- location_name
- other_location_details

Ref_Order_Status
- PK order_status_code*
- order_status_description
- - eg Cancelled, Delivered.

Ref_Delivery_Status
- PK delivery_status_code*
- delivery_status_description
- - eg Completed,Returned

Order_Deliveries
- FK location_code*
- FK actual_order_id*
- FK delivery_status_code*
- FK driver_employee_id*
- FK truck_id*
- delivery_date
- other_delivery_details

Trucks
- PK truck_id*
- truck_licence_number
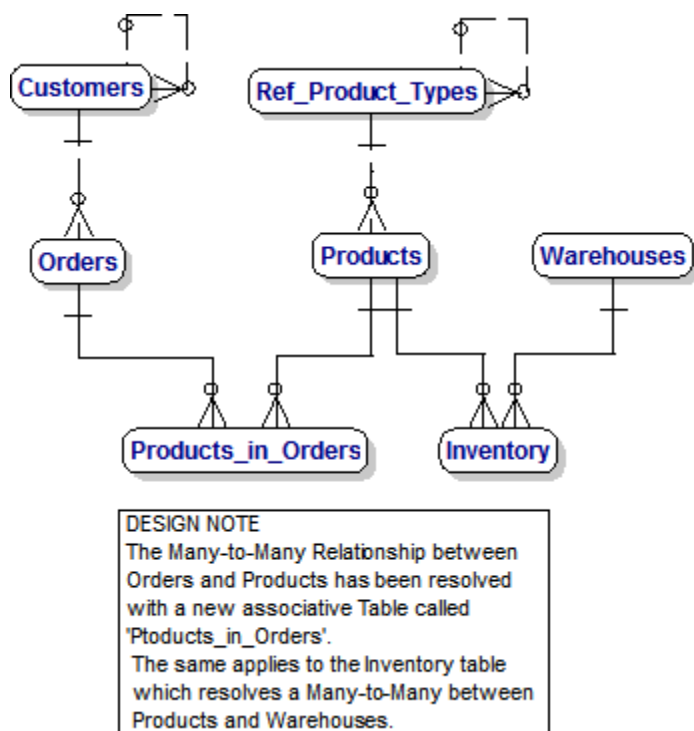- truck_details

A.8 Subject Areas

Complex data models that are common in large organizations can best be understood when they are broken down into a top-level model and lower-level subject areas. Typical subject area models are 'Deliveries and Maintenance'.

These are shown in earlier Sections of this document.

A.9 Top-Level Model

This is a top-level model showing the entities that are important at the top level. It provides a suitable form of communication with a wide range of stakeholders.

Lower-level models have been created for the subject areas.

DESIGN NOTE
The Many-to-Many Relationship between Orders and Products has been resolved with a new associative Table called 'Ptoducts_in_Orders'.
The same applies to the Inventory table which resolves a Many-to-Many between Products and Warehouses.

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A.10 What Have We Learned ?

In this chapter we have learned about a range of complex concepts and how they are achieved in data models. When we have mastered this understanding we can truly consider ourselves advanced in the art and science of interpreting sophisticated data models.

At this stage, it would be interesting and educational to look at a range of models and consider how we could redesign them. On many occasions, there is only one really good design but on others, there might be a choice. Trying to decide which category a particular model falls into is a challenging and valuable exercise.

It would be useful practice to look at this data model where you can see examples of each of these concepts and describe them out loud:
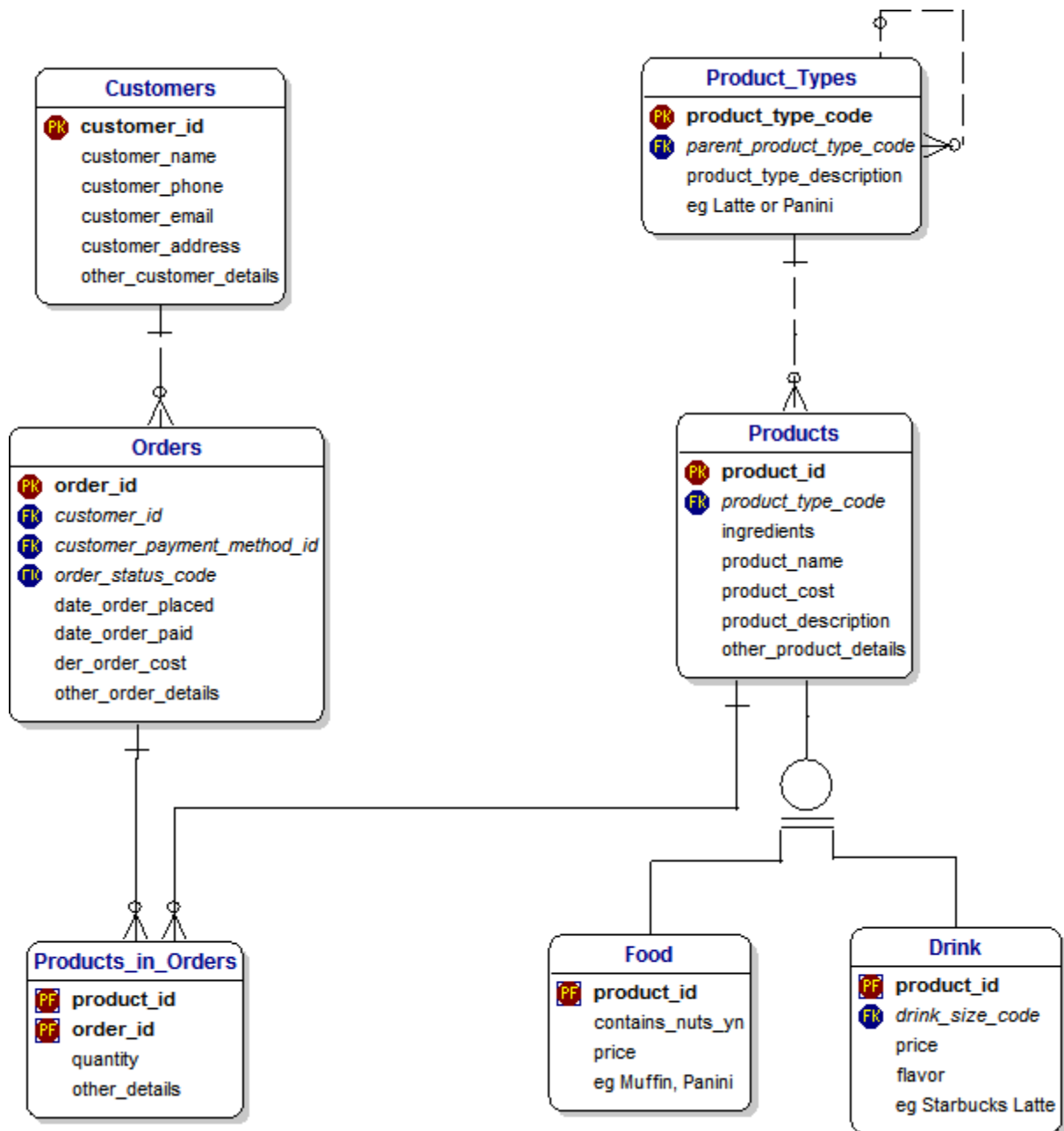
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Appendix B.Teradata Links

This Appendix lists a number of very useful Teradata Links, some of which are repeated elsewhere for convenience.

Some of these are articles are written by Jim Browning, the Enterprise Security Architect at Teradata, who is an excellent writer.

Others are links to one-hour Online Training Courses, which cost $195 each.

Teradata Blogs are a valuable source of peer-group information :-

- http://www.teradatB.com/blogs/

B.1 Architecture and Models

Teradata considers that of Architecture and Models are vitally important to the success of a Data Warehouse.

An extract of their views from this article is shown below :-

- http://www.teradatB.com/resources/brochures/Solving-the-Data-Management-Challenge-eb5427/?type=BR

1. **Build a flexible, scalable architecture.** Over time, you will want to add more data, users and subjects, so pay attention to the architecture. A **data warehouse architecture** (and data management architecture) that's flexible and scalable will allow for orderly evolution instead of growth by assimilation.
2. **Implement a vibrant enterprise model.** Integrated enterprise modeling (both logical and physical) is critical to a data warehouse's design and alignment to business needs. The model determines how business and IT will define, use, view, update and maintain datB. Don't constrain the data warehouse's evolution with a data model that imposes inflexible assumptions about the business, fails to allow for new subject areas or is unable to provide a foundation for insight

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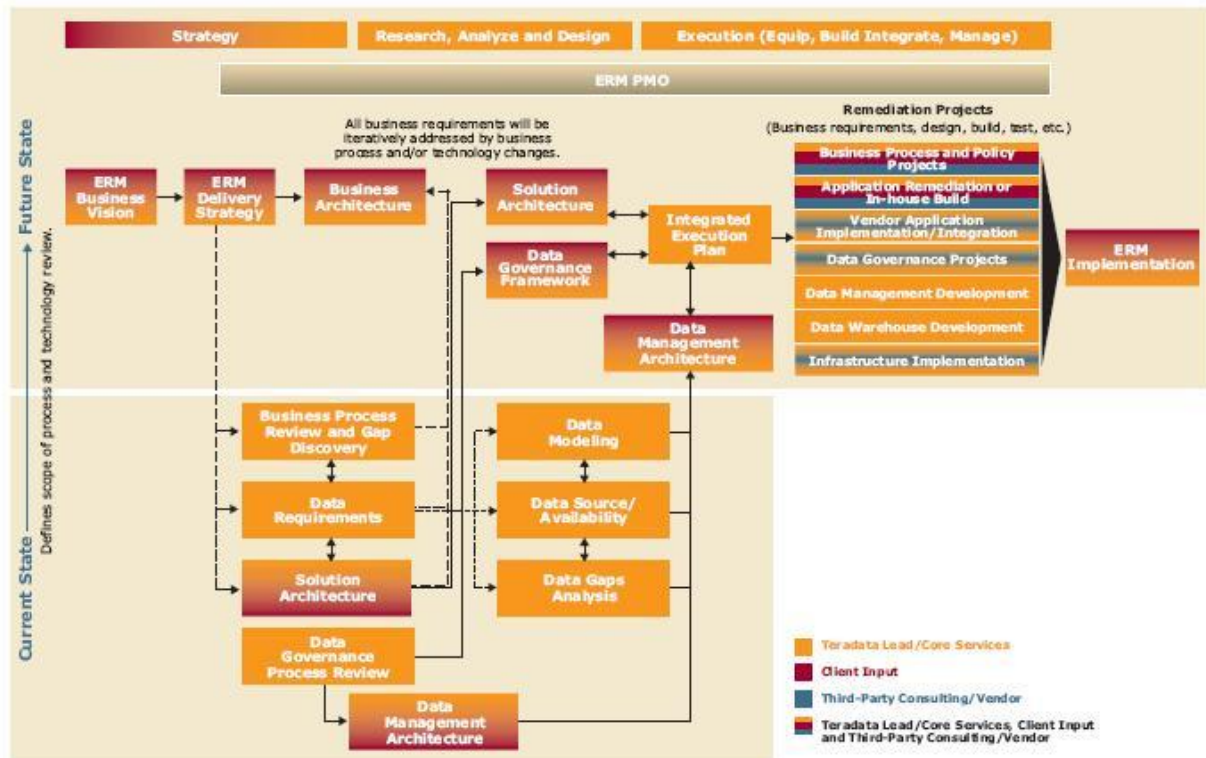This diagram shows their Risk Program Implementation Methodology :-

Figure 2. Teradata's Enterprise Risk Program Implementation Methodology (ERPIM) provides a cohesive view of all work necessary to successfully complete a complex ERM program on the foundation of the risk data warehouse, and clearly positions Teradata's role and competencies within an overall program.

B.2 Best Practices

This is a link to a one-hour Online Training Course by Jim Browning on Best Practices for securing a Teradata Data Warehouse :-

- http://developer.teradatB.com/database/training/defense-in-depth-best-practices-for-securing-a-teradata-data-warehouse

B.3 Blogs

Teradata Blogs are a valuable source of peer-group information :-

- http://www.teradatB.com/blogs/

B.4 Center of Excellence

In December, 2009 Teradata opened an Information Security Center of Excellence.
They have also created an Information Security Best Practices Scorecard.

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Links given in B.21 and B.22 provide more details of these exciting developments.

Release 14 introduced the full gamut of **Teradata's recommended security best practices** and provided **a valuable metric** for measuring improvement in security in addition to standards for data security **for specific industries.**

B.5 Cloud-based Facility

This Developer Exchange article explains in detail how to set up your own Teradata 14 facility running in Amazon's EC2 Cloud :-

- http://developer.teradatB.com/database/articles/teradata-express-14-0-for-ec2-config-guide

B.6 Data Classification and Encryption

The Teradata Approach to Data Classification and Encryption is defined in the following terms :-
"Encryption is widely supported within Teradata systems to secure access to systems.

This presentation describes how to enable and use the various encryption features provided with the Teradata Database and platforms, and offers some important best practices."

More details are available here (B.6) :-

- http://developer.teradatB.com/database/training/now-you-see-it-now-you-cant-how-to-use-encryption-in-teradata-systems

B.7 Data Governance

This is a link to a one-hour Online Training Course on the What and Why of Data Governance :-

- http://developer.teradatB.com/general/training/data-governance-what-is-it-why-you-need-it

It covers data security, data quality, data integration, data architecture, metadata and steps to a build a data governance program.

B.8 Data Quality

B.8.1 Introduction

Data Quality is closely related to Compliance with Best Practice which specifies that procedures should be in place to ensure good quality data and that checks should be run on a regular basis to identify and correct any quality problems.

Teradata offers a Training Course on Data Quality :-

- http://developer.teradatB.com/general/training/ten-practical-steps-for-building-data-quality-into-your-data

B.8.2 Proof-of-Concept

Here's how to set up a data quality solution in a four-week **Proof-of-Concept** (POC):
Follow POC data quality business rules:
- Identify key data stewards and IT users
- Document 10 representative data quality business rules
- Implement the rules
- Populate the data quality rules data model with all 10 rules8
- Test the rules

Create a POC environment:
- Acquire Teradata Data Quality Rules Manager (DQRM) and Teradata Warehouse Miner's 7Teradata Profiler
- Install the software

Produce data quality reports and scorecard:
- Identify and design 10 data quality reports and scorecard
- Configure the reporting tool to produce the reports and scorecard
- Implement and test them

Implement a knowledge transfer:
- Develop documentation on the rules, reports and scorecard
- Deliver knowledge transfer onto Teradata Profiler and DQRM for data stewards and IT users

B.8.3 Seven Steps to Data quality Compliance

This material is taken from an article in the Teradata Magazine :-
- http://teradatamagazine.com/v11n03/tech2tech/cut-out-bad-data/

This illustrates how to use two Teradata Tools to explore a typical Business rule that 'the value of a Customer Order should never be negative' :-

- The Data Quality Rules Manager (DQRM)
- The Data Warehouse Miner's Profiler

The seven Steps are as follows :-
1. Connect to the Teradata system containing the datB.
2. Create a new (or open an existing) project to hold the analyses that the data steward wishes to create for data exploration should never be negative".
3. Add at least one analysis to the project. For example, pick a Teradata Profiler Frequency Analysis.
4. Configure the analysis by picking the tables and column of interest—age or date of birth— from the drop-down menu.
5. Set any non-default output options or configure a Where clause, such as "Order Value < 0."
6. Execute the analysis using the run icon.
7. Examine, interpret and use the results.

The Data Steward can repeat steps 3-7 for any data quality question he or she wishes to ask, either as a prelude to entry in DQRM or as a follow-up to rules violations reported by that tool.

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B.9 Database Overview

This overview explains what makes Teradata different from other databases and makes it possible for Teradata to deliver unlimited scalability in every dimension, high performance and simple management

- http://developer.teradatB.com/database/training/teradata-database-architecture-overview

B.10 DBQL Query Tracking

This article in Carrie's Blog explains how DBQLog is used to track Database performance :-

- http://developer.teradatB.com/blog/carrie/2012/07/intrepreting-dbql-delaytime-in-teradata-13-10

B.11 Disaster Recovery

This is an interesting Blog by Darryl McDonald.

Here is a link to a Disaster Recovery Plan :-

- http://blogs.teradatB.com/darryl-mcdonald/a-disaster-doesnt-have-to-be-a-disaster/

B.12 Encryption

This is a link to a one-hour Online Training Course by Jim Browning on How to use Encryption in Teradata :-

- http://developer.teradatB.com/database/training/now-you-see-it-now-you-cant-how-to-use-encryption-in-teradata-systems

B.13 Enterprise Reference Architecture

This is another example of Teradata's thinking :-

- http://www.teradatB.com/web-seminars/enterprise-reference-architecture/

B.14 Information Exploitation

This article on the Teradata Web Site discusses the effective use of data for business purposes :-

- http://apps.teradatB.com//tdmo/v07n02/Features/QandA/InformationExploitation.aspx

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B.15 LDAP and SSO

B.15.1 Approach

This Teradata Training course provides an overview of the steps required to configure the Teradata Generic Security Services subsystem (**TDGSS**) properties to work with an LDAP infrastructure and the steps required for configuration of the Kerberos subsystem to support Single Sign-On (SSO) :-

- http://developer.teradatB.com/database/training/de-mystifying-ldap-and-sso-teradata-database-external-authentication

This is achieved by editing an XML file called TDGSS.xml.

B.15.2 Authentication made Simple

This is Part 2 of two articles by Jim Browning entitled 'User Authentication made Simple' :-

- http://developer.teradatB.com/database/training/teradata-security-part-2

B.15.3 De-Mystifying

This is a link to a one-hour Online Training Course by Jim Browning :-

- http://developer.teradatB.com/database/training/de-mystifying-ldap-and-sso-teradata-database-external-authentication

It provides an overview of the steps required to configure the Teradata Generic Security Services subsystem (TDGSS) to work with an LDAP infrastructure and configure Kerberos to support SSO.

B.16 Query Banding for Security Views

This is a very useful article (because it provides detailed syntax example) in the Applications group in the Developer Exchange :-

- http://developer.teradatB.com/applications/reference/using-teradata-query-banding-to-handle-security-views

B.17 Securing Network Access

This is Part 1 of two articles article by Jim Browning.
It covers TDGSS Security Architecture, Using Authentication, Password Controls and Encryption :-
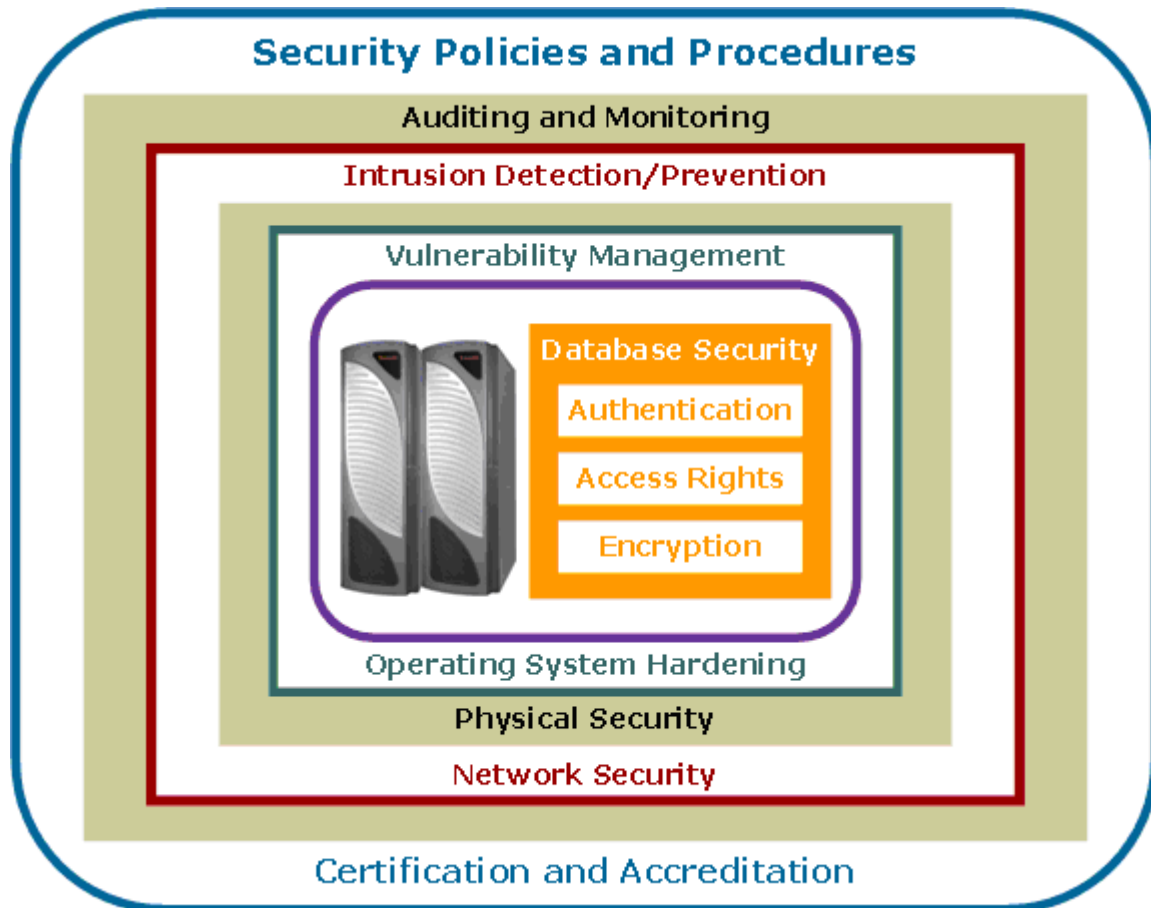
- http://developer.teradatB.com/database/training/teradata-security-part-1

B.18 Securing Policies and Procedures

This 'Security Policies and Procedures' diagram is taken from this Teradata White Paper :-
http://developer.teradatB.com/database/articles/defense-in-depth-best-practices-for-securing-a-teradata-data-warehouse

B.19 Semantic Layers

This is a one hour Training Course that discusses Semantic Layers and complex views and how Teradata executes them.

This helps to avoid complex views that are problematic :-

- http://developer.teradatB.com/database/training/how-to-design-complex-views

B.20 Solving the Data Management Challenge

Teradata also calls this "A Self-Assessment Data Governance procedure" but it doesn't seem to live up to that billing :-

- http://www.teradatB.com/resources/brochures/Solving-the-Data-Management-Challenge-eb5427/?type=BR

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B.21 Supply Chain Risk Management

This is a very interesting article that demonstrates the quality of Teradata's thinking :- .

- http://www.teradatB.com/resources/white-papers/Making-Supply-Chain-Risk-Management-Part-of-Your-Core-Management-Process-eb5030/
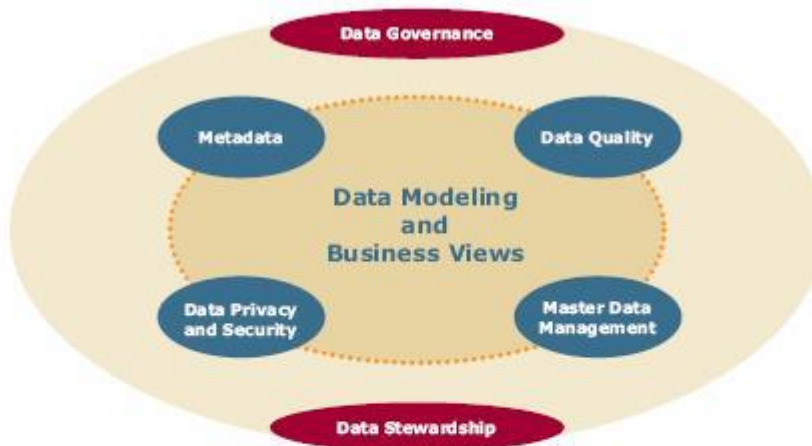

B.22 Risk Management Methodology

Teradata has developed its own approach to a Methodology for managing Risk.

It is described on this article :-

- http://www.teradatB.com/resources/brochures/Solving-the-Data-Management-Challenge-eb5427/?type=BR

This diagram shows their Data Management Topology :-

Metadata. Correct, comprehensive, and consistent usage of data.

Data Quality. Managing the accuracy, timeliness, completeness, and usefulness of data.

Master Data Management. Underpinning risk reporting, including customer data, hierarchies, grouping (e.g., industry), etc.

Privacy and Security. Control of access and usage of information for legal, compliance, and internal requirements.

Data Governance. Proper warehouse ownership and involvement promoting leveraged use of data.

Data Stewardship. Corrective action and proactive visioning of data completeness and quality.

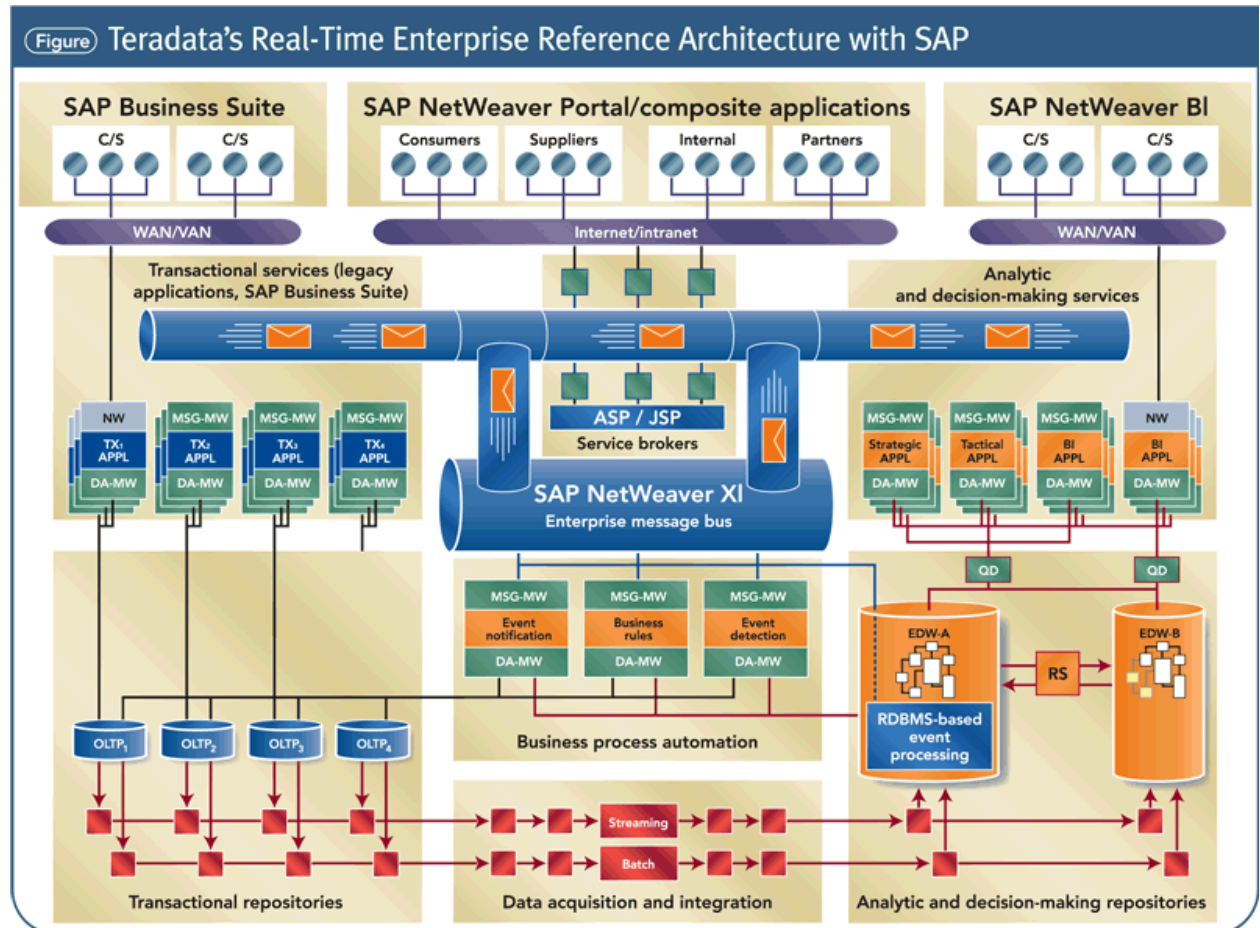Figure 1. Data management topology.

B.23 SAP SOA

Teradata and SAP have collaborated on a Service-Oriented Architecture :-

- http://apps.teradatB.com//tdmo/v07n03/Tech2Tech/AppliedSolutions/BlueprintForTheNextLevel.aspx

Figure: Teradata's Real-Time Enterprise Reference Architecture with SAP

B.24 Third-Party Online Training

This is worth checking out for price and quality and whether it is available for Release 14 :-

- http://www.onlineinformaticatraining.com/online-teradata-training/

B.25 Wallet for Password Management

The Teradata Wallet was introduced in Teradata Tools and Utilities 14.00 and offers state-of-the-art facilities for managing Passwords :-

- http://developer.teradatB.com/tools/articles/introducing-teradata-wallet

It uses the the 'tdwallet' utility and can be used with LDAP.

B.26 User Authentication

This is Part 1 of two articles by Jim Browning covering User Authentication, LDAP and SSO :-

- http://developer.teradatB.com/database/training/teradata-security-part-1

B.27 Viewpoint

B.27.1 Definition

Viewpoint is a Teradata BI-type front-end that can display Dashboards using **permissions are role based.**
It is most widely used to monitor the performance of a Teradata Database, such as CPU Utilization.
This is a Starters-Guide to Dashboards. :-

- http://developer.teradatB.com/viewpoint/articles/a-starters-guide-to-portlets-and-dashboards

B.27.2 Getting Started

This Blog entry is called "Raising Intelligence - Viewpoint Learning to Learn" :-
- http://developer.teradatB.com/blog/gryback/2010/01/raising-intelligence-viewpoint-learning-to-learn

B.27.3 Security Model

This is an article in Developer Exchange :-
- http://developer.teradatB.com/viewpoint/reference/viewpoint-portlet-security/domains-permissions-and-resources

It describes conceptually how the Viewpoint Security Model is based on these concepts :-

- Domain
- Permission
- Dependency
- Resource

Data Governance by Example
Governance, Risk and Compliance

Appendix C. GRC Platform Vendors

C.1 Acuity Risk Management GRC

We downloaded free trial on Tuesday, November 20th. – irritating procedure.

UK-based in Regent Street, London, from this page :–

- http://www.acuityrm.com/

C.2 Optial

Details from this page :-

- http://www.optial.com/Solutions.aspx

C.3 GRC Tools

There is a List of Tools and useful commentary - http://www.grc-resource.com/?page_id=16

C.4 SAP

Details from this page :-

- http://scn.sap.com/docs/DOC-8879

C.5 IAM Suppliers

For Identity and Access Management (IAM) products, two suppliers are :-

Contacts :   AlertEnterprise in Holland - Rob Kraanen

               Hitachi - Bruce MacDonald in Canada

                 - Colin Duffy in Holland

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Appendix D. Other Web Links

D.1 Database Security from the US NSA

This is a link to the American National Security Agency guidelines on Database Security.

NSA has developed and distributed configuration guidance for Oracle9i, Oracle 10g and Microsoft SQL Server. These guides are currently being used throughout the government and by numerous entities as a security baseline.

http://www.nsa.gov/ia/mitigation_guidance/security_configuration_guides/database_servers.shtml

D.2 Mapping Data Governance to Processes

A thought-provoking paper :-

- http://www.information-management.com/news/how-to-map-data-governance-policies-to-business-processes-10023600-1.html

D.3 Standards fort IT Risk Management

COBIT proposes standards for IT Risk Management :-

- http://en.wikipedia.org/wiki/COBIT