A framework for efficient information management

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Abstract: Since information is more and more recognised as a business relevant asset the need for an integrated information management approach grows steadily. Against this background large industrial companies begin to think about valid information governances and policies. In the following article the information management approach developed at E.ON is presented. It bases on a role concept, a meta-information repository and generic models for information quality management and information lifecycle management. It finally allows for an efficient implementation of the currently most important information management issues which are information quality and information lifecycle management.

1 Introduction

The spectacular Enron scandal in 2002 as well as the world-wide recognizable impact of the us-american sub-prime crisis with their far reaching effects are only two examples which show that issues like legal compliance, transparency or information quality are of great importance for all kinds of companies. This situation grows more severe since the need for high quality information grows and information continuously develops towards a business relevant asset. Against this background, companies must successfully cope with numerous legal requirements, like the Sarbanes-Oxley-Act or the European MiFID[1]. In order to do so, a number of different governances and policies is developed

[1] Markets in Financial Instruments Directive

concerning mainly information-related topics like compliance to legal frameworks, information quality, and security. Typically, those governance or policy documents focus on requirements towards an information management. Issues about the implementation, like organizational frameworks or methods, are hardly addressed, although this is crucial for a successful realization of a governance or policy.

In this paper we want to introduce a concept for an effective and efficient information management, which was developed at E.ON. It is mainly based on an organizational framework described in chapter 2, a meta-information repository (see chapter 3) and a couple of generic models for the efficient handling of the currently most important issues of information quality and information lifecycle, which are presented in chapters 4 and 5. The document concludes with a brief look at the current state of implementation at E.ON (chapter 6) and a summary.

2 Organizational framework

For the implementation of an information governance the establishment of a corresponding organizational framework is a necessary base. Without such a frame information governance cannot be brought forward. This framework has an enabling function for some major drivers for information integration which are master data management, business intelligence, and service oriented architecture. Vice versa, these drivers support its implementation, too. In this context, it is necessary that the meaning of the information to be integrated is clearly defined and understood all through the enterprise. Furthermore, the information quality must be reliable and the information lifecycle must be defined. These common issues are addressed by the topics covered by information governance:

- *Information architecture management*: Leads to unambiguously defined information and a common understanding of how information currently is and in future will be used across the enterprise. It is tightly coupled with the other disciplines of enterprise architecture management: business and application architecture management.
- *Information quality management*: Gathers systematically the requirements concerning availability and reliability of information. Gives guidelines on how to measure and report information quality and how a fulfillment of requirements can be approved. Addresses information quality risks.
- *Information lifecycle management*: Gathers systematically the requirements concerning information lifecycle. Controls the fulfillment of the requirements to reduce the costs for the provisioning of information.

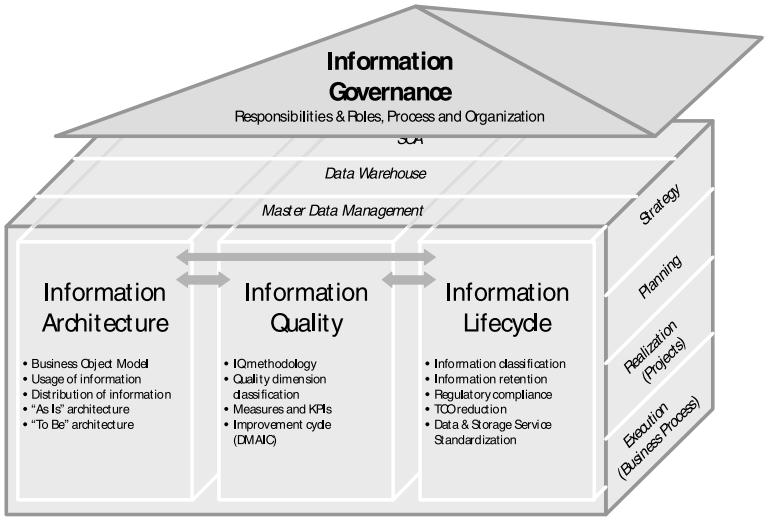

Figure 1: Organizational framework

2.1 Process Levels

Information governance is not established through stand alone, newly defined processes which solely address the needs of information. It rather should be ensured that (usually existing) processes are enriched in a way that awareness for information and adherence to guidelines and policies will be achieved. Information shall become a dedicatedly handled topic in these processes. Thus, the framework addresses "process levels" rather than "processes" and defines tasks to be fulfilled at these levels by the roles as described later on. Information governance becomes relevant at the levels of:

- *Strategy development*: At this level, the company's strategy derived from top level goals and the roadmap to achieve these goals are defined. This process level also subsumes the development of guidelines and policies, the setting of targets and the establishment of organizational changes (roles, processes).
- *Business- and IT-planning*: At this level e.g. demand management, mid-term planning and project portfolio management take place. Tasks are identified which are derived from strategic goals and business demands, prioritized and bundled to projects.
- *Realization of IT systems and organizational changes in projects*: A project is defined as any action that significantly changes business processes and/or IT systems. It is assumed that nearly every change is a result of a project. Size and duration of projects may vary significantly, but the basic organizational principles and rules stay the same. At E.ON, the project management guideline defines the underlying process.

- *Execution of business processes*: The day-to-day business performed at business- and IT-side.

2.2 Roles

The governance framework defines the roles that act in the context of the process levels described above. A role is a bundle of competencies, responsibilities and tasks that must be fulfilled to incorporate "information governance". A role can be assigned to one single person or to a group of persons. On the other hand, one person may have several roles assigned. It is not implied that every role must be assigned to one employee. A coupling with other, possibly existing roles is possible and for the steward-roles even recommended.

Strong management support is needed to lead the organization in a direction that in fact handles information as an asset. Defining responsibilities and roles, the placement of roles in an enterprise's organization and a clear commitment that governance related tasks must be fulfilled (and the fulfillment is proven) is crucial to bring information governance to life.

The ***information governance board*** with members out of the company's top management provides the management attention. They are able to drive the decisions necessary to incorporate information governance in a reasonable way which takes into account the balance of efforts vs. results. One task is the final confirmation of information strategy, target information architecture, policies and guidelines as prepared by the information architect. It is up to the information architect to thoroughly prepare the decisions to be made by the board. In case of conflict, the board may be consulted as a last level of escalation.

The ***information architect*** is accountable for the current and future information architecture and the definition of strategic guidelines and policies. He is the head of a (virtual) team of information managers.

The ***information manager*** is a specialist in the field of one or more business objects and accountable for the fulfillment of overall requirements concerning the objects he is responsible for across the company's processes and/or applications. He ensures reliable and consistent documentation of the information architecture and delivers operational support to resolve information quality issues together with the stewards.

The ***business information steward***, as a (business) specialist in the field of one or more business processes, is accountable for gathering information related business requirements and adherence to information governance guidelines and policies in his area of competence. Often this role will additionally be assigned to a role like "process owner".

The ***technical information steward***, as a (technical) specialist in the field of one or more applications, is accountable for the fulfillment of requirements concerning "information" and adherence to information governance guidelines and policies in his area of competence. Often this role will additionally be assigned to an application specialist.

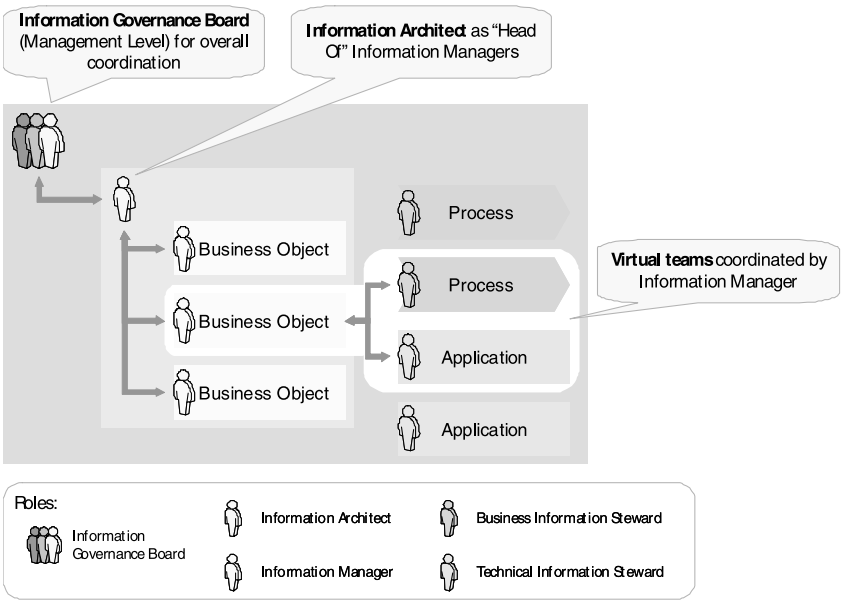

Figure 2: Cooperation between roles

The organizational link between information, processes and applications on an operational level is achieved by involving the steward roles in the governance organization. To be able to communicate, they need a common understanding of the things they are talking about. A meta-information repository helps to reach this common understanding and to systematically document the information items and their relation to processes and applications at different levels of abstraction. It serves as a public catalog of the objects affected by information governance, based on a committed standard for documentation.

3 The meta-information repository

The backbone for information governance activities is the repository which contains the documentation of the enterprise architecture. The enterprise architecture describes the objects affected by governance activities as well as their current and future state. As an outcome of governance activities, high-level classifications and requirements for the elements of the enterprise architecture are documented systematically and consistently. The elements serve as a container for a structured, traceable and reportable documentation that is centrally stored. Additionally, the person(s) responsible for a single item are documented.

The meta-model shown in *Figure 3* provides a coarse overview of the elements of the enterprise architecture and their relationships. Business processes, applications and application releases are considered in the context of the business- and application architecture.

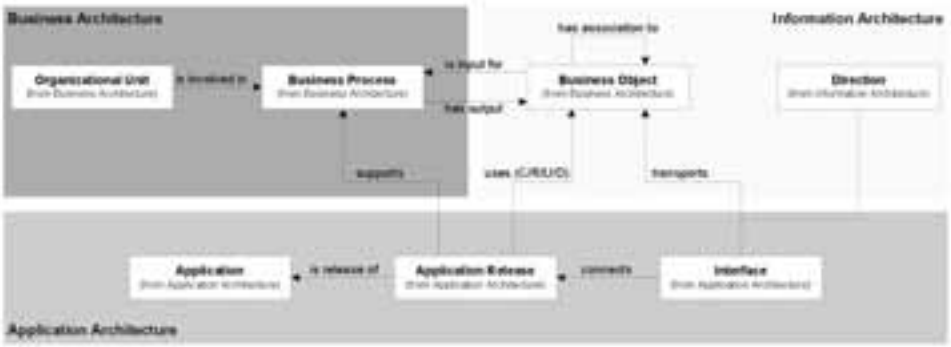

Figure 3: Enterprise Architecture meta-model (simplified)

The **business object** (BO) is the core element of an information architecture. Business objects are informational items which have major significance in the context of the business activity of a company. The primary question is: Which information items are relevant within the company, and which relationships exist between these items. On a BO level, no distinction is made between master data, transactional data, analytical data or metadata. Candidates for high level business objects are e.g. "product", "invoice" or "customer" and their respective specializations[2].

3.1 Business objects and their Context – the BO Profile

The BO-Profile shows a business object in its whole context, e.g. processes and applications using this business object. The profile can basically be used in two ways:

- It can serve as a template for manually specifying a business object, e.g. in the context of requirements management.
- It can be specified as a report in a specific modeling environment, like ARIS.

BO Profile for <Name>	
Description	<Description/Definition>
Contact persons	Information Manager: <Name > Modeler: <Name >
Associations to other business objects	⇨ <association role> <Name of business object> … (one line for every outgoing associations) ⇦ < Name of business object > <association role> … (one line for every ingoing associations)

[2] If meta-information is modeled within a business object model, a "Business Object" is a business object itself.

BO Profile for <Name>	
Business Value Class	<Business Value Class>
Lifecycle rules	Operational (following state: analytical): <operational rule(s)> Analytical (following state: archived): <analytical rule(s)> Archived (following state: removed): <archived rule(s)>
Using processes (incl. quality gates)	<Name of business process>: <In/Out>, QGC: <quality gate class> … (one line for every process using the object)
Using application releases	<Name of application> Type: <C/R/U/D> … (one line for every application release using the object)
Information flows	<Name of application 1> ⇨ <Name of application 2> … (one line for every information flow using the object)

Name and Description
Name and description of the business object. Under the given name you could find the object within an enterprise wide glossary.

Contact Persons
Information manager responsible for the business object and the modeler who modeled the object. Both may be the same person.

Associations to other business objects
A business object may have one or more directed associations with other business objects. For every association the role of the association and the associated business object are stated. E.g., in the BO-Profile for the business object itself one would see the associations[3]

- ⇨ Business Object *is input for* Business Process
- ⇨ Business Object *has association to* Business Object
- ⇦ Application Release *uses* Business Object
- ⇦ Business Process *has output* Business Object
- ⇦ Business Object *has association to* Business Object
- ⇦ Interface *transports* Business Object

[3] see also Figure 1

Business Value Class
Assignment of a value-class to business objects from a business perspective. Business objects are rated from "*not important to operations*" to "*mission critical information*" according to their contribution to business operation (see chapter 5.3).

Lifecycle Rules
Rules that apply to the business object to trigger the end of one of the lifecycle phases[4]. The rule defines under which condition(s) the next phase starts. A rule is defined in the form

IF <condition> THEN following lifecycle state begins

<condition>: any condition (or combination of conditions) in human readable terms.

Using processes
Shows the processes that are using the business object and whether the business object is input for a process, output of a process, or both (e.g. if the object is changed during this process). Additionally, the "*quality gate class*" (QGC) of the using business process is shown (see chapter 4.2).

Putting together the *quality gate class* of the using process and the *business value class* of the business object itself, the quality dimensions and quality thresholds can be derived that are applicable within the respective business process (see chapter 4). This information allows to deduce which quality checks should be applied to the business object. Especially for business critical information, at least one process should be stated which validates the information quality of the business object.

Using application releases/information flows
Shows the using application releases and the information flow (incl. direction of the flow) between application releases. It is also defined how the business object is used within one application release. Possible values are (in any combination):

- C: Information is newly created
- R: Information is read
- U: Information is updated
- D: Information is deleted

[4] The lifecycle phases and the lifecycle rules are defined in the context of information lifecycle management, see chapter 5.

3.2 The costs behind a BO-Profile

In a BO-Profile no "new" meta-information is documented. While designing a business process or writing a system proposal, the questions leading to the documented facts are normally addressed anyway. Therefore, there is little additional effort to gather and document this information in a structured way. The most effort lies in defining the structure (meta-model) of the repository, training people using this structure, gaining acceptance for documenting systematically, keeping the gathered information correct and consistent and, at last, deciding which objects to put into the repository to keep it manageable and on the right level of abstraction. Since at least for the beginning, the BO-Profiles can be maintained in a spreadsheet-table the initial system requirements are not very high. But it has to be considered that with an increasing number of profiles a simple spreadsheet-based solution quickly reaches its limits. Then, a professional tool for information architecture should be used.

4 Information Quality Management

This chapter introduces a generic model for **information quality measurement** that aligns the information quality analysis processes with business processes [Lo01]. To achieve the alignment between business processes and quality measures one has to know

- where to measure – the business processes
- what to measure – the relevant information quality attributes
- measure thresholds – which quality is "adequate" on dependence of the business value class of the business object.

The generic model enforces to think about information quality proactively at a time of process design. As a result, business processes obtain high(er) information quality, better project cycles (projects in budget) and process maintenance costs are reduced.

4.1 Where to measure – the process class

The decision which processes should be enriched by checks for information quality can be made easier by classifying the processes by *process classes*. Defined process classes are:

- **supply** – forward information into the system (application)
- **acquisition** – accepts information from external suppliers and injects it into the system
- **creation** – manual data entry
- **processing** – any stage that accepts input and generates output
- **packaging** – information is collected, aggregated and summarized for reporting purposes

- **analysis –** the point where human interaction is required
- **delivery –** the point where packaged information objects are delivered to a known data consumer

Figure 4: Definition of process classes[5]

If a relevant process class can be found for a business process, a quality gate – a check-point for information quality – of a certain type should be designed into the process. For every process class a corresponding quality gate class – the appropriate "type" of the quality gate – is defined. For the current application at E.ON a 1:1-relation between process class and quality gate has proven to be suitable. The quality gate class defines a set of information quality attributes to be checked within the business process.

4.2 What to measure – the Quality Gate Class

Each quality gate class defines a set of information quality attributes (CTQs[6]) to be checked by a quality gate within a business process. Defined quality gate classes are:

- **Receiver –** receive external data or data from the supply chain
- **Creator –** data entry
- **Processor –** information from different data sources is merged or manipulated
- **High profile stages –** a processing stage that consumes a large percentage of company resources
- **Collector –** information is aggregated and prepared for reporting or for storage
- **Broadcaster –** prepares information for many consumers

The following matrix shows which information quality attributes are considered to be relevant for each of the quality gate classes:

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[5] IT processes (packaging, analysis, delivery) are treated as business processes and have to be modelled accordingly.

[6] CTQ: Critical to Quality

	Quality Gate Class (Process Class)						
	Supply-Receiver (supply)	**Acquisition-Receiver** (acquisition)	**Creator** (creation)	**Processor** (processing)	**Profile Stage** (packaging)	**Collector** (analysis)	**Broadcaster** (delivery)
1 -Believability	☑	☑				☑	☑
2 -Accuracy			☑	☑	☑	☑	☑
3 -Objectivity	☑	☑			☑	☑	
4 -Reputation	☑	☑					
5 -Valued-added	☑	☑					☑
6 -Relevancy	☑	☑	☑		☑	☑	☑
7 -Timeliness			☑	☑	☑	☑	☑
8 -Appropriate amount	☑	☑	☑				☑
9 -Completeness	☑	☑	☑	☑	☑	☑	☑
10-Interpret-ability	☑	☑					☑
11-Ease of under-standing		☑	☑		☑	☑	☑
12-Represen-tational consis-tency					☑	☑	☑
13-Concise repre-sentation					☑	☑	☑
14-Accessibility	☑	☑					☑

	Quality Gate Class (Process Class)						
	Supply-Receiver (supply)	**Acquisition-Receiver** (acquisition)	**Creator** (creation)	**Processor** (processing)	**Profile Stage** (packaging)	**Collector** (analysis)	**Broadcaster** (delivery)
15-Access Security	☑						☑

Figure 5: Quality gate classes to define information quality attributes (example developed for E.ON)

4.3 Bringing where and what together – Quality Gates

A quality gate is a checkpoint for information quality in a business process. This may be a single step or a complete sub process. The measurement of information quality is done for the quality attributes as defined by the quality gate class of the quality gate. The measure itself can be an organizational assessment or just a technical monitoring task.

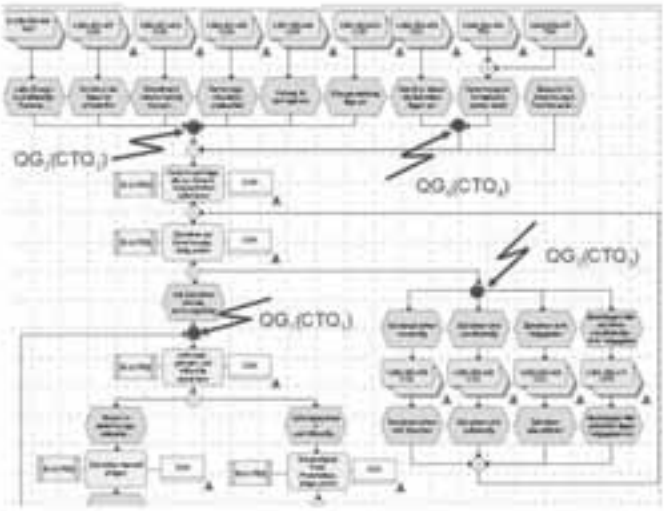

Figure 6: Quality gates in business processes

Whether information quality of a business object (resp. a group of business objects) is appropriate or not can be determined by comparing the outcome of the measure to a defined quality threshold. This threshold can be derived from the business value class of the business object and the quality gate class of the measuring quality gate.

4.4 Measure thresholds

The predefined threshold for information quality, i.e. the interpretation of what "appropriate" information quality is in a given context, is derived from the business value class of the business object under assessment and the quality gate class of the quality gate.

The threshold values are calculated by weighted quality dimension attributes (CTQs) within the quality gate classes. The basic idea: More critical information – i.e. a business object with higher business value – has higher requirements for information quality, and higher information quality requirements lead to a higher quality threshold limit (expressed in %). Figure 5 shows an example for a quality threshold matrix.

	Quality Thresholds for Business Value Classes				
Quality Gate Classes	**critical information [%]**	**business performance information [%]**	**essential information [%]**	**sensible information [%]**	**non-critical information [%]**
Supply Receiver	91-100	71-90	31-70	10-30	0
Acquisition Receiver	81-100	61-80	21-60	10-20	0
Creator	81-100	61-80	21-60	10-20	0
Processor	81-100	61-80	21-60	10-20	0
Stages	81-100	61-80	21-60	10-20	0
Collector	81-100	61-80	21-60	10-20	0
Broadcaster	81-100	61-80	21-60	10-20	0

Figure 7: Quality thresholds

4.5 Example

A business process acquires external market data. This process can be classified as "acquisition"-process. The corresponding quality gate class is "acquisition receiver". Having identified the quality gate class one knows the relevant quality attributes and can measure information quality for these attributes. In order to decide whether the result is appropriate, the business value class of the business object "market data" must be considered. Let us assume, it is "business performance information". After all this information

has been collected one can lookup the aimed threshold, which is 61% to 80% and compare it to the result.

The single steps at a glance:

1. identify the process class of the business process
2. identify the corresponding quality gate class
3. model and implement a quality gate in the relevant business processes
4. identify the business value class of the business object to be assessed
5. perform a quality check for the business object according to the relevant quality attributes derived from quality gate class
6. perform quality evaluation for the business object according to the aimed threshold derived from quality gate class and business value class

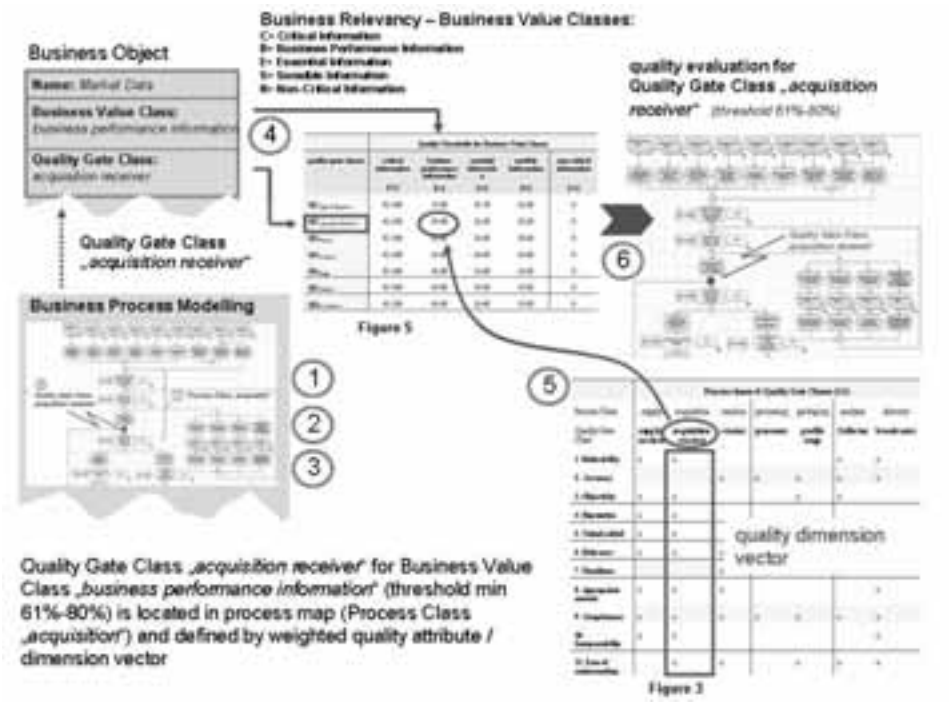

Figure 8: Quality gate measures in context with business objects and business process modeling definitions

5 Information lifecycle management

The fundamental idea behind information lifecycle management is the fact that the value and therefore the patterns of information access of most information changes over time. Information provisioning should follow this in order to fulfill business requirements

efficiently which means to align the business value of information to the most appropriate infrastructure and services. Information lifecycle managements consists of the supply of policies, processes, best practices and services to manage information in a consistent manner [Bi04].

There are many approaches to information lifecycle management provided by the storage industry, such as system managed storage [Ge99], [YCA99], storage resource management [Th03], hierarchical storage management or even information lifecycle processes [Gi03]. To meet the business requirements we choose a combined approach based on the framework of SNIA[7] [Pe04], [Sn04] and the process descriptions of BITKOM[8] [Bi04].

The active management of information over their whole lifecycle comprises the implementation of a rule set composed of methods, processes and technology. The business value of information faces the optimization of information service and storage costs. The basic objects of treatment are business objects defined by the information architecture.

5.1 Requirements

The most important reasons to establish information lifecycle management are the increase of information growth, storage and service costs, complexity and the regulatory constraints.

- *Increase of information growth*: The annual increase of information affects all industries. Data bases grow on average between 100% and 125% per year, while static data grow by 60%. Digitally content (films, music, etc.) grows by 50% per year [Da04], [Ly03].
- *Storage and service costs*: The cost of storage services is increasing between 23% – 30% annually, despite the fact that hardware costs are decreasing every year.
- *Complexity*: The complexity of infrastructures is increasing. New technologies like hierarchical storage management facilities, online and near line storage or enterprise information infrastructures are producing new requirements for IT management and services.
- *Regulatory constraints*: Regulations and laws require specific information management activites and their audits.

[7] SNIA: Storage Networking Industry Association

[8] BITKOM: Bundesverband Informationswirtschaft, Telekommunikation und neue Medien e.V.

5.2 Information lifecycle phases

The information lifecycle consists as minimal requirement of the four phases Operational, Analytical, Archived and Removed. Every entity of a business object used within the enterprise is at a given time in one of the four lifecycle phases. The change conditions from one lifecycle phase to another are defined by lifecycle phase rules. These rules are to be applied to business objects. As an example, safekeeping and retention time-spans are defined as lifecycle phase rules.

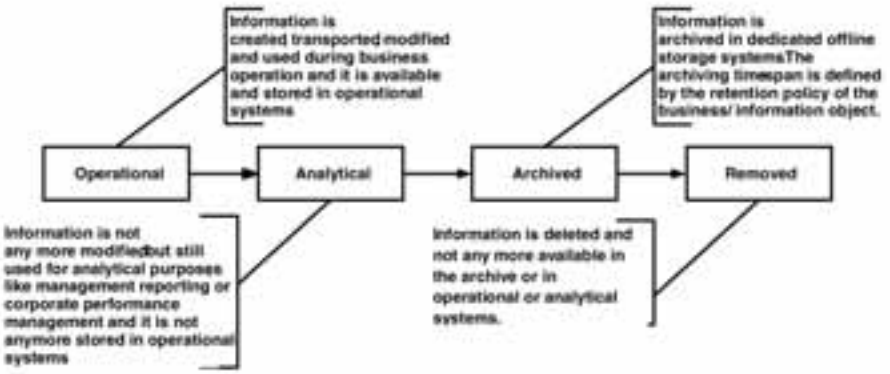

Figure 9: The information lifecycle

5.3 Information business value classes

The information business value classes are an assignment of value to business objects from a business perspective. The main reason for this classification is the possibility to treat information objects according to their relevance. This treatment is supported by constraints for infrastructure and operating service requirements deducted from the business value class. Business value classes are an integrated component of information lifecycle management as well as of information quality management.

Figure 10: The information business value classes

The objective assignment of value to information is difficult, because of the missing accounting rules for information. Different approaches to measure information's value are possible, such as the information productivity [Di04], the information value function [Cr97], the subjective value of information [Ra03], no price for information [Ba96], or the cost of missing information [Re98]. We used a purely subjective approach. It is the responsibility of the business to assign value to a given information object.

5.4 Activities in the context of information lifecycle management

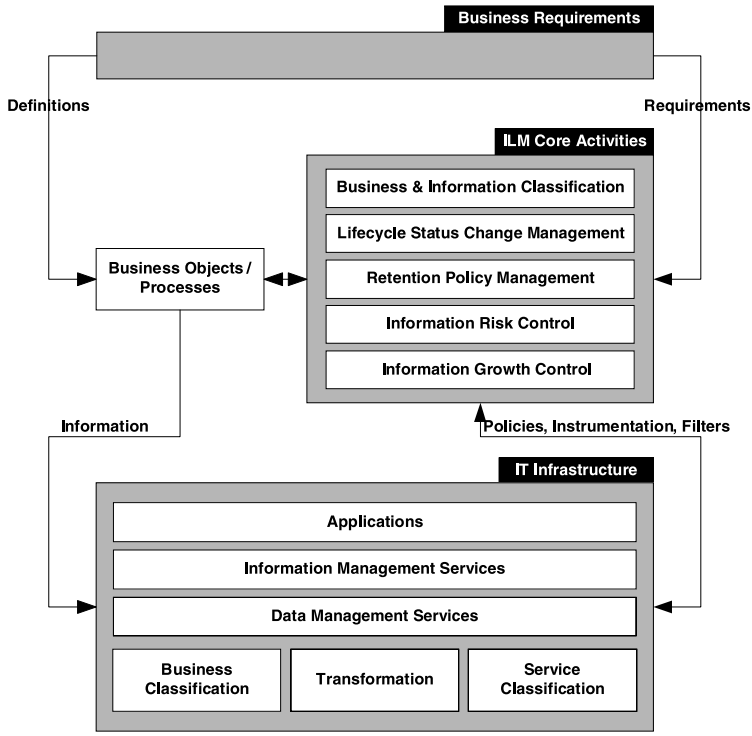

Figure 11: Information lifecycle management core activities

The information lifecycle management core activities are focused on the business objects and business processes defined by the enterprise architecture. Business requirements are the basic constraints of all core activities. The core activities are business and information classification (assigning business value classes to information objects), lifecycle status change management (applying phase rules to information objects), retention policy management (controlling regulatory rules), information risk control (comparing information business value with the actual information treatment done by IT operations), and information growth control (monitoring and forecasting).

6 Implementation at E.ON – The current state

The organizational framework and methods described above are considered as a basic framework for information management at E.ON. Due to the existing organizational structure which consists of regional or functional responsible market units and subsequent business units the implementation has to be unit-specific. Basically, an approach of minimal changes to existing organizations is pursued since it improves acceptance and minimizes reservation [Se07a], [Se07b].

Currently, one business unit which has the role of a pilot has implemented the complete framework consisting of the relevant roles and an enterprise architecture covering business process modeling, information architecture, and application architecture. The implementation for this unit has shown that remarkable efforts in time and man power are necessary to realize a complete implementation.

Because the realization of information issues, like information quality, is often time critical for future roll-outs it is planned to implement the organizational framework and a kind of 'light' information architecture in the context of major corporate projects. The basic idea is that during project activities the persons representing the information key roles of an information architect or information manager can be easily identified. During the project roll-out the identified persons inherit these roles for daily business and keep them alive. To minimize the initial efforts for the creation of an information architecture the relevant business object meta-information can be collected using the BO-Profile in form of a spreadsheet-table (see chapter 3). Then, independent from time-critical project requirements this information base can be transferred step by step into an information architecture tool.

7 Summary

E.ON as one of the major companies in the European utility sector identifies information as a business-critical asset. To cope with the resulting information management requirements, an information governance and a corresponding methodological framework was developed. A major element of the organizational framework is the role model which consists of three information related roles. These are an information governance board, information architects and information managers. In order to ensure the important connection to business processes and IT the additional roles of technical information stewards and business information stewards are established.

The organizational framework is accompanied by a set of generic process models for information quality and information lifecycle management and a meta-information repository. This repository, the so-called business object (BO-) profile, can be assumed as central part of an information architecture. It serves for collecting and storing BO-meta-information. The in the context of information quality and information lifecycle management relevant BO-meta-information items are information business value class and lifecycle phase rules. The developed process models need only the above mentioned BO-meta-information as necessary external input. With this framework information quality initiatives or lifecycle management can be carried out with minimum additional efforts.

The developed framework consisting of the role-concept, the information architecture and the connection to business process modeling and application architecture is successfully implemented in one E.ON business unit. Basing on these experiences a future roll-out of the concept in combination with major corporate projects is planned. In order to increase acceptance a strategy of minimum impact on existing organizations is pursued.

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