CMMI Technology Conference and User Group
November 15-18, 2004

Evolving New Data Management to the CMMI Environment

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Because Data Transcends Time

Evolution of DM since 2000

- DM was not appropriate for, or responding to, digital data or acquisition streamlining
- USG was persuaded to take another look at DM
  - Revolutionize and reinvent it
- Aggregate 160 persons from industry and government have participated
- DM Five Year Plan is the blueprint for change
- Focus is on acquisition of data that cannot be otherwise accessed and used
- Sustainment and life cycle considerations are key

Data Definitions

Data *- Recorded information of any nature (including administrative, managerial, financial, and technical), regardless of medium or characteristics. EIA-649 (V.4); MIL-STD-2549*

Data Management - DM The process of applying policies, systems, and procedures for identification and control of data requirements;

- for the timely and economical acquisition of such data;
- for assuring the adequacy of data;
- for the distribution or communication of the data to the point of use; and
- for analysis of data use.

GEIA-859 Status

ANSI standards

are in

"continuous maintenance"

GEIA-859 is

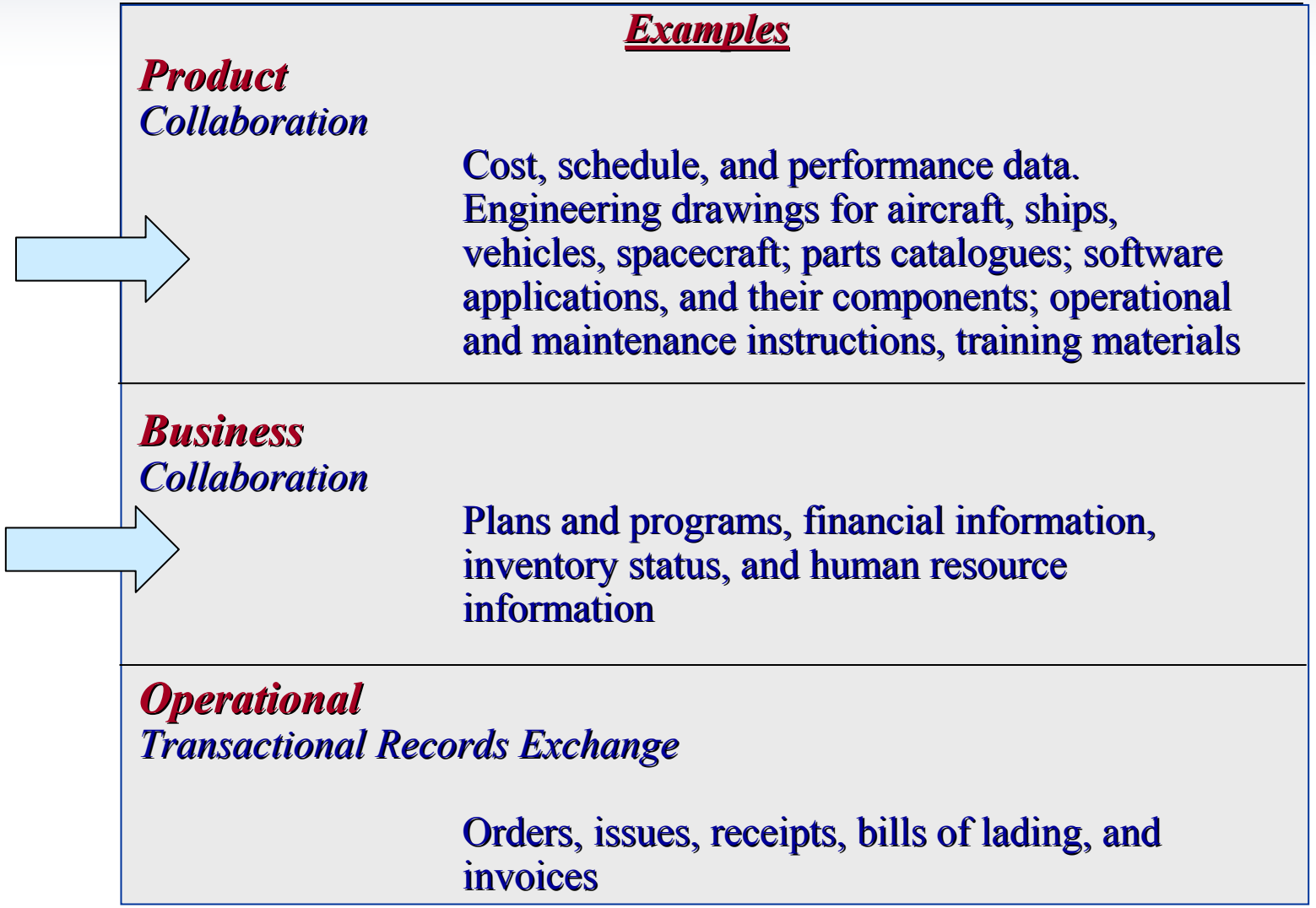
in ANSI progression

now – currently released

as an ANSI standard

- ✓ Successful ballot
  - Unanimous "yes"
  - No conditional votes
- ✓ Comments now adjudicated (~500, total)
  - Currently internal to GEIA
  - Soon to be disseminated
- ✓ Profile of comments
  - Standard did not take on the full range and depth of perceived weak spots associated with DM-
    - IT,
    - data administration,
    - enterprise data,
    - records management.
  - Indications are that the Handbook will need to pick up that slack, in part
  - Newest revision copy of 859 will be broader and deeper, as well

Data Types & Usage



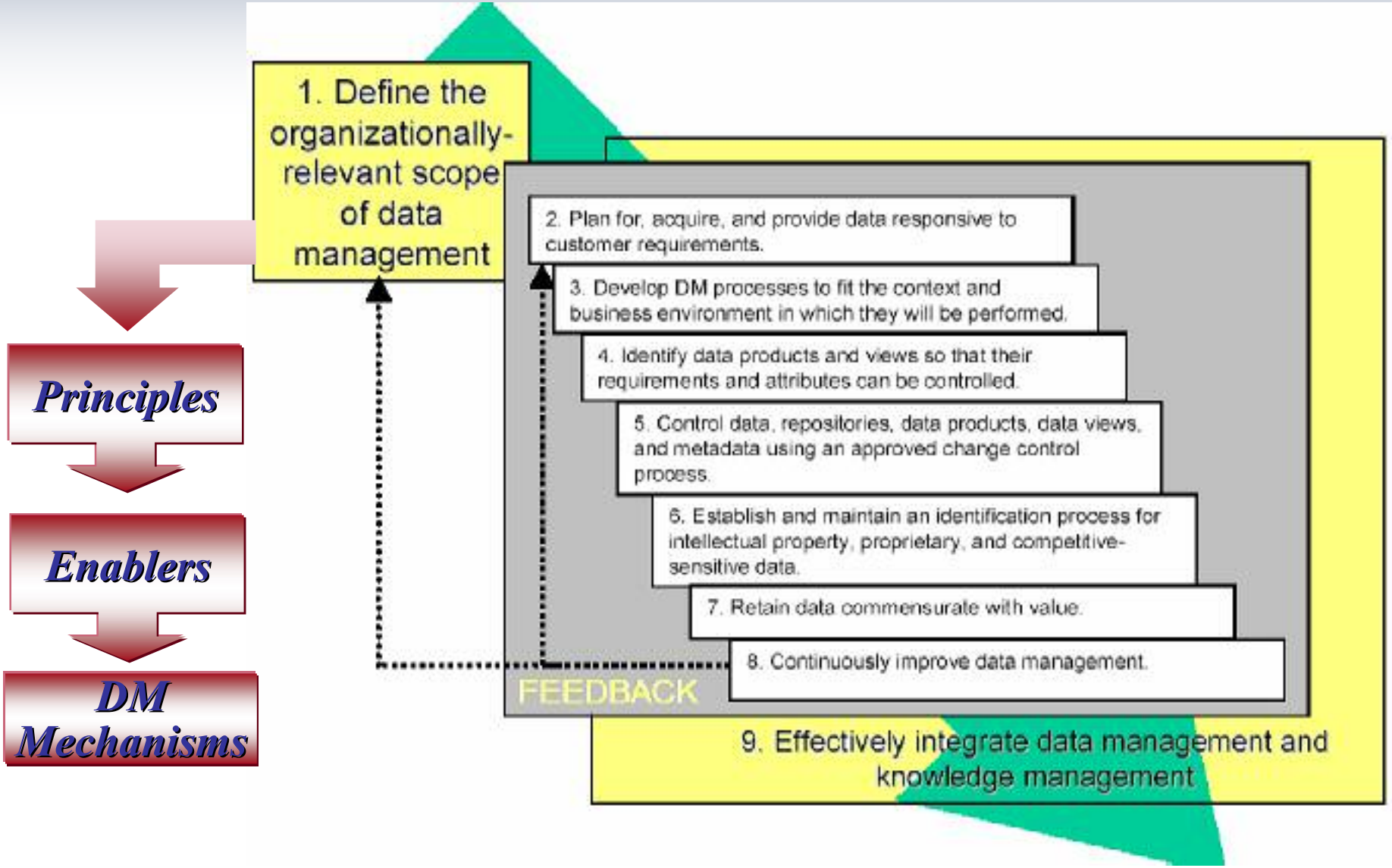
DM in the CMM/CMMI

- Not specifically called out, but strongly implied, described, and implicated
- Deleted from Level 2
  - Not clear why
  - May be that “DM” is considered to be a part of CM
    - That is not the case
    - Unclear inferences and assumptions don’t address challenges
- SEI has accepted a change notice in June, 2004, to redress DM in the CMMI next version

859 Supports CMMI Goals

- Provides clear collection and monitoring of requirements and status
- Supports documentation development and update
- Promotes continuous improvement of data quality and data processes
- Addresses enterprise data as well as product data
- Meets all goals as presented by CMMI objectives
  - PP, PMP, CM support
- Features its own maturity model in order to “catch up” to CMMI goals

Nine Data Management Principles



1.0 Principle: Define the Enterprise
Relevant Scope of Data Management

EIA 859 DM Tasks

- Strategy & Architecture Development
- Process and Infrastructure Design
- Execution
- Process and Infrastructure Maintenance

Traditional DM Tasks

- Identification and Definition
- Acquisition and Preparation
- Control
- Disposition
- Archiving

1.0 Principle: Define the Enterprise
Relevant Scope of Data Management

Strategy & Architecture Development

- ✓ Development of DM strategies
- ✓ Development of DM plans
- ✓ Development of DM policies
- ✓ Development of IP strategies
- ✓ Integration of DM and knowledge management
- ✓ Resourcing of DM requirements

Process & Infrastructure Design

- ✓ Design of data access provisions
- ✓ Development of paper data formats
- ✓ Development of electronic data formats
- ✓ Design of DM processes
- ✓ Design and development of data environments
- ✓ Development of provisions for interoperability and interchange
- ✓ Development of training syllabi and courses
- ✓ Development and management of meta data
- ✓ Design of data products and views

1.0 Principle: Define the Enterprise
Relevant Scope of Data Management

Execution

- ✓Requirements Identification and Definition*
- ✓DM risk assessments
- ✓Implementation of prescribed formats*
- ✓Prioritization of data requirements
- ✓Control of data requirements*
- ✓Control of deliverables received*
- ✓Oversight of data preparation*
- ✓Data marking*
- ✓Import/export control*
- ✓Preparation and maintenance of inventory master lists*
- ✓Conversion from paper to electronic
- ✓Management of data collaboratively developed via IPTs or similar methods
- ✓Administrative management of intellectual property
- ✓Implementation of access provisions
- ✓Data archiving*
- ✓Data disposal*

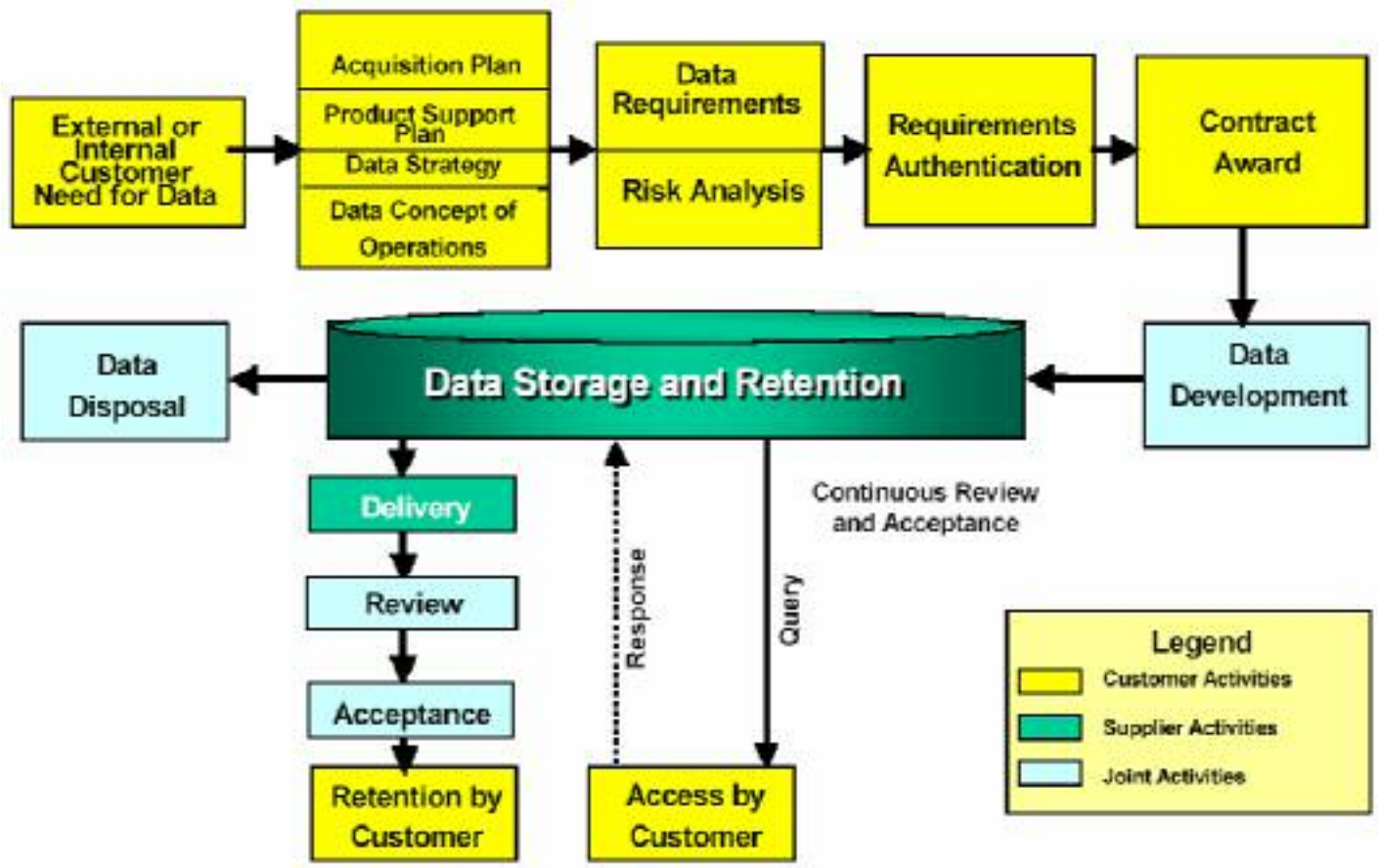
Process & Infrastructure Maintenance

- ✓Recurring DM training
- ✓Management of electronic repositories
- ✓Management of paper repositories

* Previously Existing Tasks

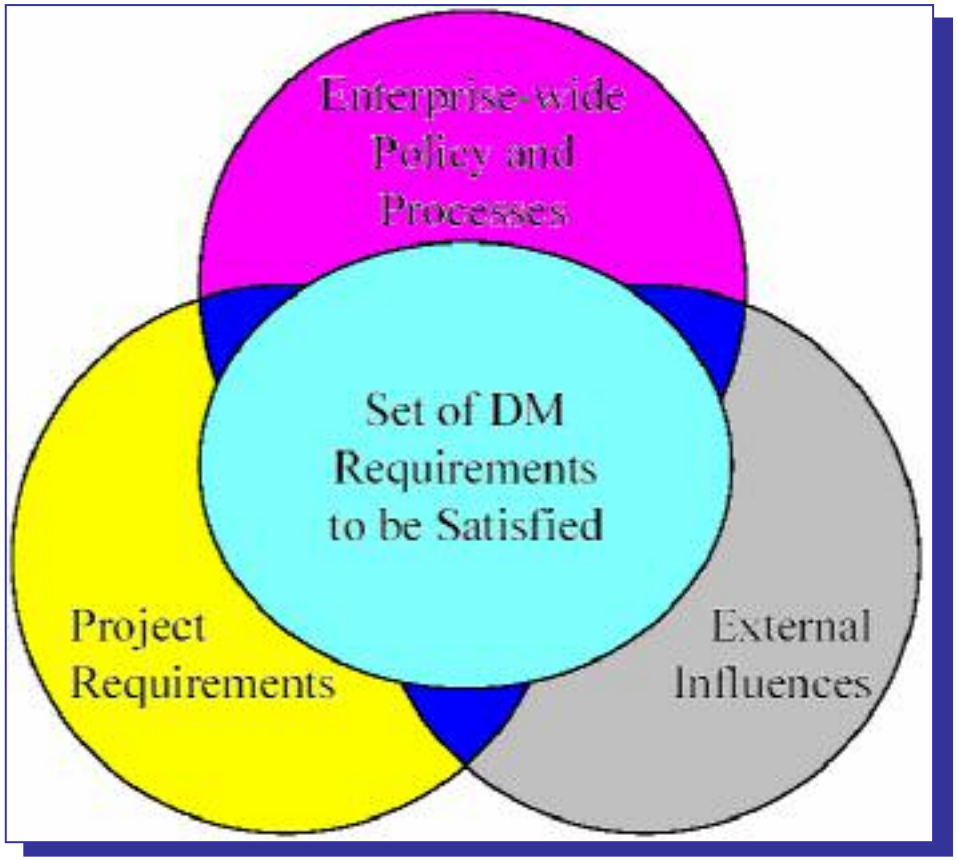
2.0 Principle: Plan for, Acquire, and Provide Data Responsive to Customer Requirements

"This principle address the steps in the model beginning with product need and ending with contract award."



3.0 Principle: Develop DM Processes to Fit the Context and Business Environment in Which They Will be Performed

"To be effective, DM solutions, processes, and practices should supported by a realistic analysis and understanding of the business context and environment in which they will be performed."



4.0 Principle: Identify Data Products and Views so That Their Requirements and Attributes can be Controlled

"Data is of value to the enterprise when it can be located or accessed by users. Metadata, or data about data, is essential for data managers and others to identify, catalog, store, search for, locate, and retrieve data."

4.1 Develop consistent methods for describing data.

4.1.1 Ensure data interoperability between team members.

4.1.2 Apply processes to characterize data and data products to ensure adequacy and consistency.

4.2 Establish relevant attributes to refer to and define data.

4.3 Assign identifying information to distinguish similar or related data products from each other.

5.0 Principle: Control Data, Data Products, Data Views, and Metadata Using Approved Change Control Processes

"This principle provides guidance that will ensure the integrity and timeliness of data, data elements, data structures, and data views by applying the principles of configuration management."

5.1 Control the integrity of data, data elements, data structures, and data views

5.1.1 Establish a change control process that imposes the appropriate level of review and approval

5.1.2 Provide a systematic review of proposed changes within the change process

5.1.3 Determine the impact of change to include associated products, data, data elements, data structures, and data views

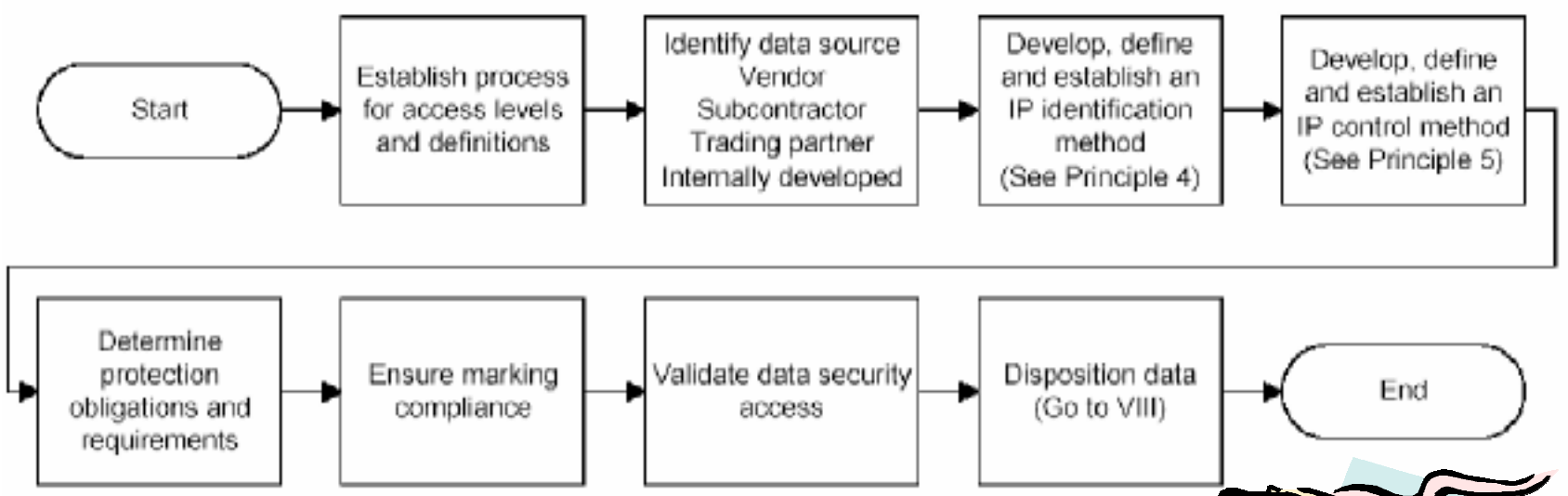
5.1.4 Gain approval or disapproval of changes to data, data elements, data structures, and data views (data products) by a designated approval authority

5.2 Establish and maintain a status accounting process, reporting tool and mechanism.

5.3 Establish and Maintain an Internal Validation Mechanism

6.0 Principle: Establish and Maintain an Identification Process for Intellectual Property, Proprietary, and Competition-sensitive Data

"Intellectual property (IP) is a term used to describe real but intangible assets, embodied in such items as patents, copyrights, trademarks, and trade secrets."



7.0 Principle: Retain Data Commensurate With Value

"The purpose of this principle is to delineate methods for ensuring adequate retention and preservation of data assets that are of value to the enterprise and effectively disposing of data assets that are no longer of value."

7.1 Plan to ensure data is available when later needed

7.2 Maintain data assets and an index of enterprise data assets

7.3 Assess the current and potential future value of the enterprises' data holdings

7.4 Disposition data

8.0 Principle: Continuously Improve Data Management

"The purpose of this principle is to provide a basis for implementing a process for data quality improvement."

8.1 Recognize the need to continuously improve the quality of data

8.2 Establish and maintain a metric process and reporting strategy

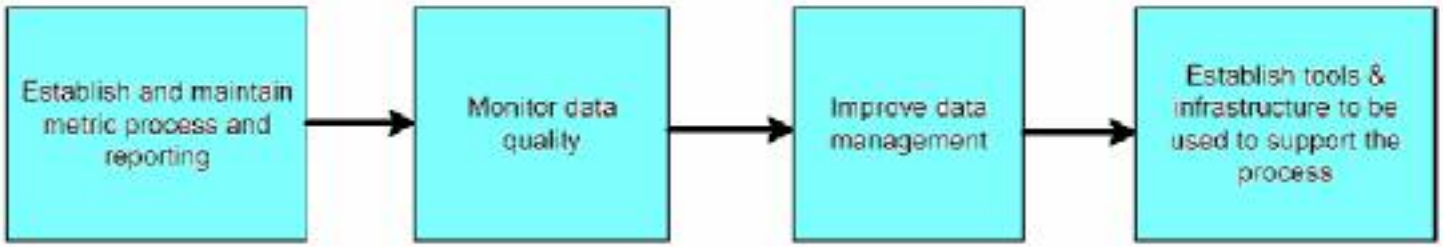
8.3 Monitor the quality of data to improve data and processes

8.4 Improve data management through a systematic and self-diagnostic process

8.5 Establish the necessary tools and infrastructure to support the process and assess the results

8.0 Principle: Continuously Improve Data Management

"Metrics vary from enterprise to enterprise and from project to project. These process measurements should be simple and accurate indicators of performance, yet provide sufficient data to allow analysis."



Example of DM Metrics

Metric Name	Definition	Suggested Reporting Frequency
Data Schedule Status	Summarizes delivery status, contains number delivered early, on-time and late by month	Monthly
Electronic Delivery Status	Summarizes progress towards electronic delivery; contains the percentage of deliverables made electronically for each month	Monthly
Project Data Report	Summarizes the project data traffic; identifies the number of correspondence items transmitted between prime trading partners each month.	Monthly
Data Acceptance Rate	Percentage of submittals approved and disapproved by customer on first submission	Monthly

9.0 Principle: Effectively Integrate Data Management and Knowledge Management

"This principle describes the interdependent relationship between DM and knowledge management (KM).

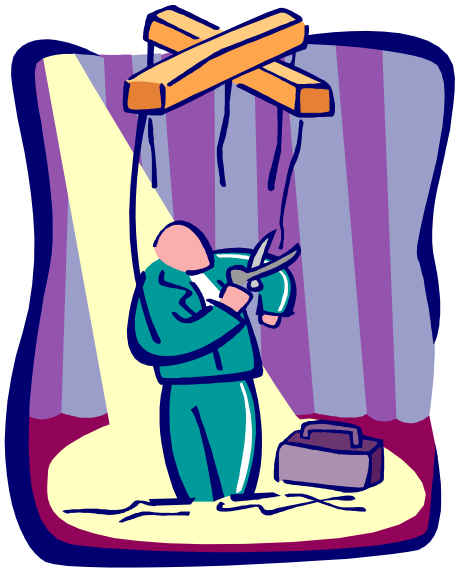
Since knowledge management and data management are naturally interdependent, the objective of this principle is to distinguish the roles of each so that, in practice, KM and DM efforts are complementary."

9.1 Establish the relationship between data management and knowledge management.

9.2 Cooperate with knowledge management where DM and KM intersect as KM methods develop.

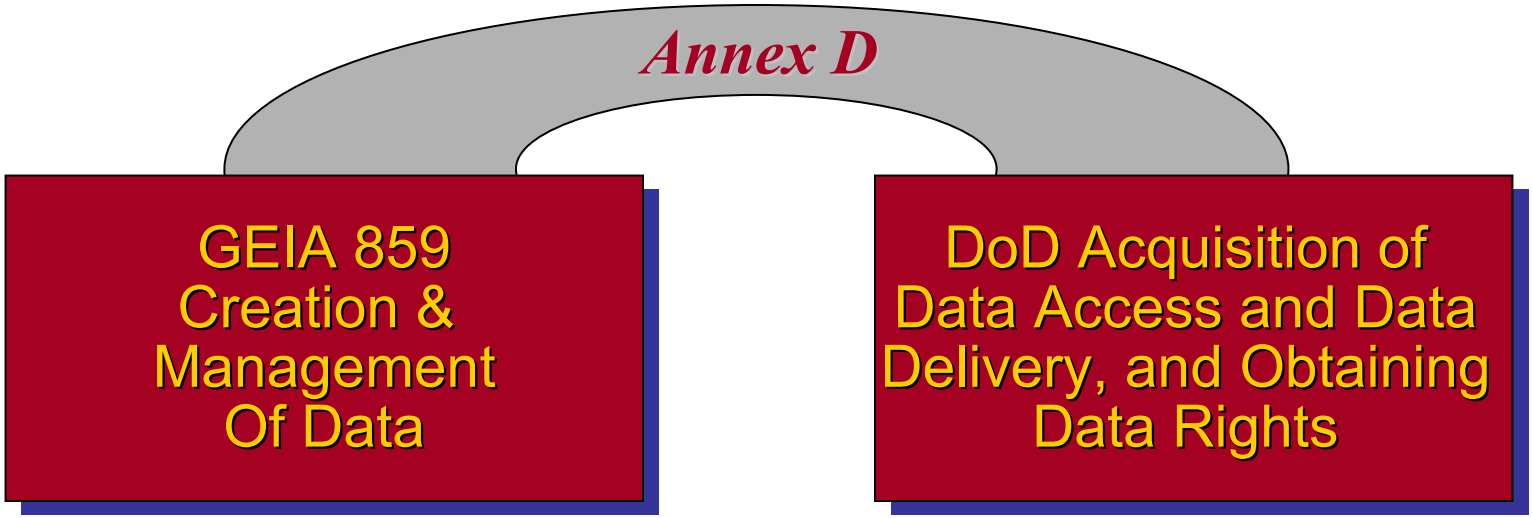
9.2.1 Understand state of KM in the enterprise.

9.2.2 Coordinate DM and KM efforts.



Annex D – Non-commercial Practices for Data Management

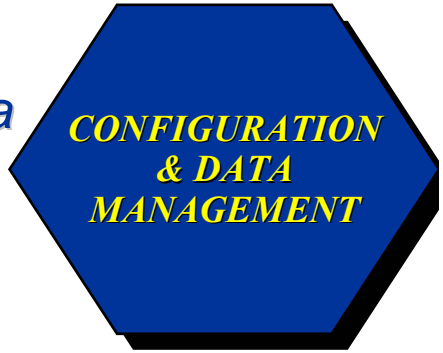
This Annex is to identify Department of Defense (DoD) DM procedures and relate the existing practices to GEIA 859, where applicable.



C&DM Standards & References to Consider – Government or Others

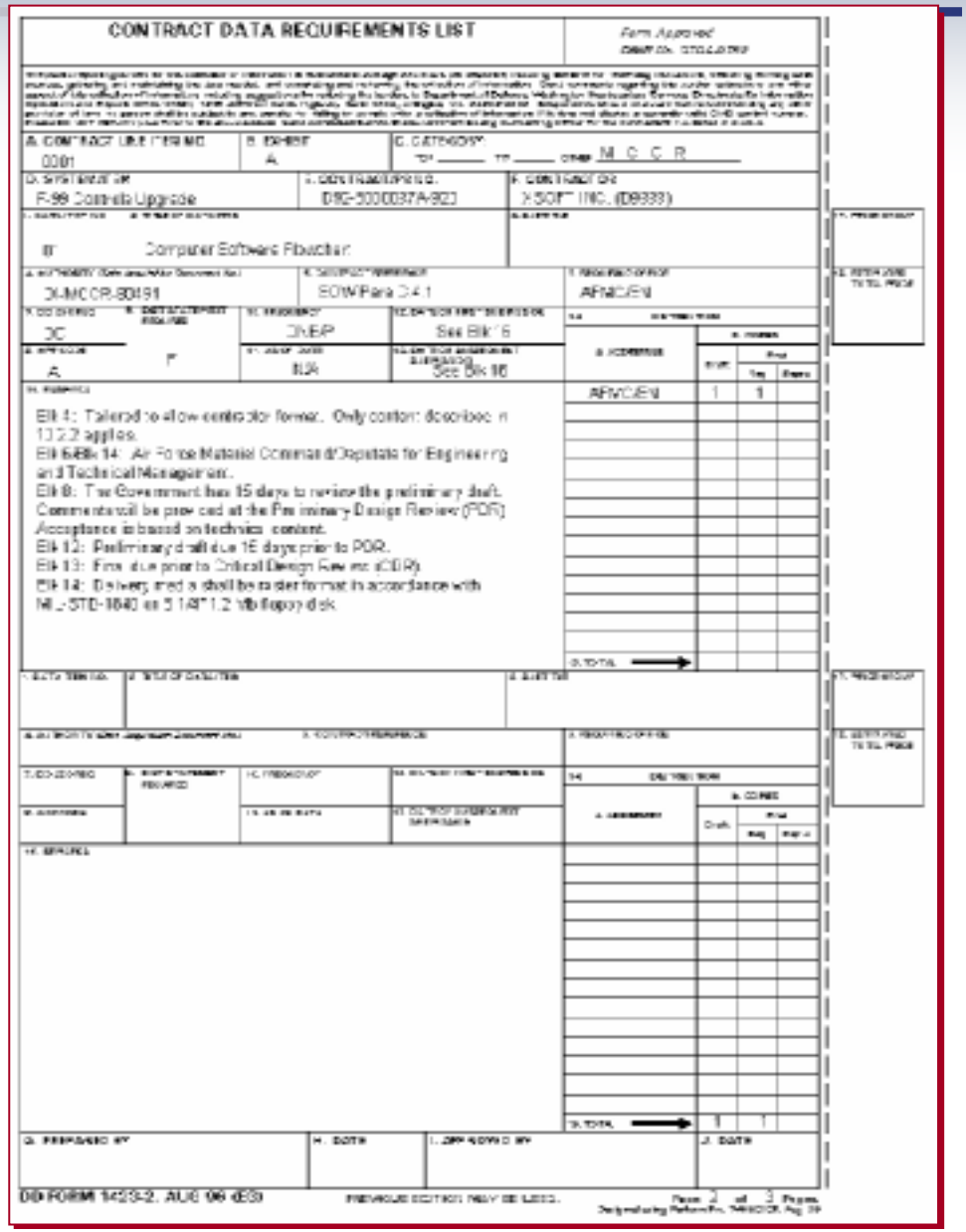
INPUTS

- Mil HDBK 61A – CM Guidance for DoD
- ISO 9001:2000 – Quality Management Systems
- DoD 5010.12M - Procedures for the Acquisition & Mgmt of Technical Data (CDRL)
- Mil-Std-963D (Notice 1) – Data Item Description
- DFARS 252.227-7027 – Deferred Ordering Of Data
- DFARS 252.227-7028 – Deferred Delivery Of Data
- DFARS 252.227-7030 – Withholding of Payments
- DFARS 252.227-7036 – Certification of Technical Data



Contract Data Requirement List

DoD-5010.12M
(CDRL, DD Form 1423)



CONTRACT DATA REQUIREMENTS LIST

Form Approved
OMB No. 0704-0188

A. CONTRACT LINE ITEM NO.: 0001
B. EXHIBIT: A
C. CATEGORY: TDP ____ TM ____ other: M C C R
D. SYSTEM/ITEM: F-99 Comms Upgrade
E. CONTRACT/PR NO.: DSC-3000037A-902
F. CONTRACTOR: XSOFT Inc. (09333)
1. DATA ITEM NO.: 8
2. DESCRIPTION/PURPOSE: Computer Software Flowchart
3. SUBTITLE:
4. AUTHORITY (Data Acquisition Document No.): DI-MCCR-80191
5. CONTRACT REFERENCE: SOW Para 3.4.1
6. REQUIRING OFFICE: ARMCOM
7. DD GIVEN: 3C
8. DATA ACCESSION REQUIRED: F
9. FREQUENCY: ONEP
10. DATE OF FIRST SUBMISSION: See Blk 16
11. AS OF DATE: N/A
12. DATE OF SUBSEQUENT SUBMISSION: See Blk 16
13. DISTRIBUTION: A
14. TRANSMITTAL: ARMCOM
15. TOTAL COPIES: Draft 1, Final 1, Reprod —
16. REMARKS:
Blk 4: Tailored to allow contractor format. Only content described in 10.3.2 applies.
Blks 6&8&14: Air Force Material Command Deputate for Engineering and Technical Management.
Blk 8: The Government has 15 days to review the preliminary draft. Comments will be provided at the Preliminary Design Review (PDR). Acceptance is based on technical content.
Blk 12: Preliminary draft due 15 days prior to PDR.
Blk 13: Final due prior to Critical Design Review (CDR).
Blk 14: Delivery and shall be in ster format in accordance with MIL-STD-1840 on 5 1/4" 1.2 Mb floppy disk.
16a. TOTAL: 1 1
17. PREPARED BY:
18. DATE:
19. APPROVED BY:
20. DATE:
DD FORM 1423-2, AUG 99 (ES)
PREVIOUS EDITION MAY BE USED.
Page 2 of 3 Pages
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Annex D – Practices/Enablers

Practice/Enablers 1—Certify and Qualify Data Managers

Practice/Enablers 2—Plan Data Requirements

Practice/Enablers 2.1—Determine risk, maturity of systems, and life-cycle phase

Practice/Enablers 2.1.1—Acquire minimum essential data

Practice/Enablers 2.1.2—Generate Data Requirements from the work tasks

Practice/Enablers 2.2—Identify Data Requirements from Data Calls

Practice/Enablers 2.3—Review, select, and consolidate Data Requirements

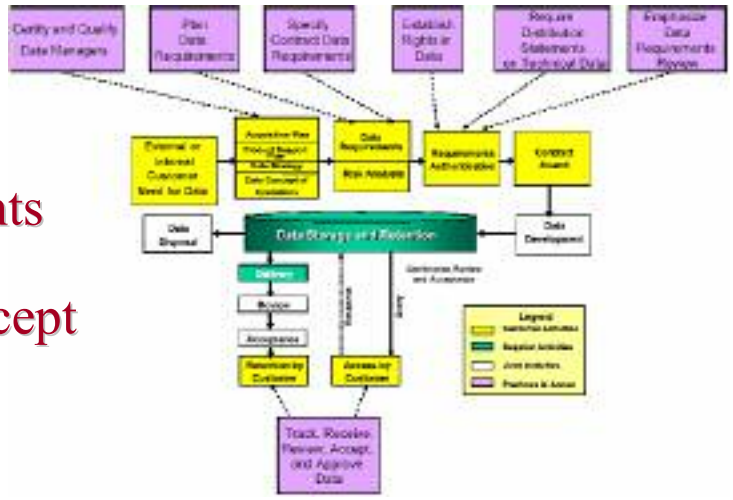
Practice/Enablers 3—Specify Contract Data Requirements

Practice/Enablers 4—Establish Rights in Data

Practice/Enablers 5—Require Distribution Statements on Technical Data

Practice/Enablers 6—Emphasize Data Requirements Review

Practice/Enablers 7—Track, Receive, Review, Accept and Approve Data



Status - Handbook 859

- ✓ Activities underway since January 2004
- ✓ First rough draft of section outlines are complete
- ✓ First integrated draft of sections is next and target completion is June 2004
- ✓ Handbook 859 is complete in draft as of September 2004
- ✓ Red Team comments are indicating two busy months in October and November

Establishing Value
Step One: Metrics

Key: Establishing & calculating worth for effort and assets expended, saved, re-used

- *Cost* - acquisition and life cycle *(investment potential)*
- *Price* - against risk and investment *(return)*
- *Re-use* - with metadata and characterization *(leverage factor)*
- *Measurable consistency* - from project to project *(data integrity)*
- *Evolving* - quality decision data *(KM or collaborative quality, use, and outcome)*

Establishing Value

Step Two: Maturity Model

The three essential macro states of maturity

Initial	*Transitional*	*Excellence*
Manual, inconsistent methods that are not repeatable (Asset Ignorance)	Course corrections that are applied in certain cases, over time Methods improve and gain consistency with understanding & use (Asset Recognition)	Improvements are predictable, proven, and intentionally created Repeatable methods create opportunities for efficiencies & economies of scale (Asset Use)

TIME, TECHNOLOGY, UNDERSTANDING & QUALITY

Value Determination Factors

Model Level	Value Determination Characteristics
5 Fully Optimized	Obvious value for services received; risk reduced, unnecessary costs avoided, clear best practices & sector leadership
4 Predictable Risk	Lower ROI in investments in DM are accepted in exchange for reduced risks
3 Corporate Competency	Measurable, able to recognize costs and benefits, perform cost/benefits analyses, maximize ROI, good results faster, better trained workforce
2 Managed	Anecdotal, based on individual performers' capabilities and specific memorable events
1 Baseline	Subjective, gut feel for performance, benefit, costs, and value received

Gains: Consistency, Repeatability, Cost & Business Model Awareness

Building the Business Case

Structuring an Approach:

Assumption – DM brings value to the organization and the project

- *Why and how is management of data/assets important within the hundred of millions of dollars spent on national defense and national security?*
  - *Competitive contracting*
  - *System operation and maintenance*
  - *Development/pursuit of best practices*
  - *Cost avoidance*
  - *Risk reduction or mitigation*
- *Spending just 1-3% of the [data acquisition, engineering, defense, project] budget on data improvements & quality can be an insurance policy for not only project success, but the ROI on the sum invested.*
  - *What are we currently spending on DM? Calculate it! Show losses and gains.*
  - *What end state (savings, efficiencies, benefits) are we proposing to create for the project in question?*
- *Begin by defining "data" as an asset instead of an expense*
- *Calculate the costs (1-3%) on the total budget to perform DM*
- *Define what end-state or beneficial outcomes will be achieved*

Measuring - an Example Task

Identify documents sufficiently to permit retrieval of the desired data products

DM Model	I Initial	II Transition	III Advanced (Consensus standards-based)
Description	May be identified at time of creation. No indexing system available to aid retrieval or record inventory	Identification sufficient to permit retrieval within some local settings.	Data are routinely identified for retrieval; easily retrievable across trading partner interfaces
Representative retrieval success rate (in xx hours)	18%	30-50%	99%

Creating a DM Capability Model

DM Model	I Initial	II Transition	III Advanced (Consensus Standards-based)
Description	May be identified at time of creation. No indexing system available to aid retrieval or record inventory	Identification sufficient to permit retrieval within some local settings.	Data are routinely identified for retrieval; easily retrievable across trading partner interfaces
Representative retrieval success rate (in xx hours)	20%	30-50%	99%

- Will need similar description triads for each enabler/sub-enabler
- When complete, amounts to DM capability model
- Associated success rates are inputs to analysis

Behavior Has Economic Consequences

Principles
Enablers

- Data products and views are identified so that their requirements and attributes can be controlled.
  - Assign unique identifiers to distinguish items from similar or related data products.
    - Identify documents sufficiently to permit retrieval of the desired data product.
- . . .

- Principles themselves do not determine economic return on data management
- Behaviors, extent to which they are consistent with enablers, determine economic consequences
- Hence, will measure effects of DM behaviors

Overview

- Purpose -- state business case for investing in data management standard
- Assumptions
  - Technology is a given
  - Motivations for having a standard
    - Articulate effective and efficient c
      current and "near future" environment
    - Reap scale effects from multiple trading partner adoption
  - Business case needs to address both motivations

Today's presentation addresses preliminary model related to this motivation.

Assumptions & Caveats

- Assuming 500K worth of data
  - The actual figure/value of logistics data on a circa 1980s major defense fighter aircraft
  - Actually a very low figure for “data”, but one that was documented, well-understood, and acknowledged as correct
- Assuming a 2% loss rate for each of 4 common phenomena
  - Data loss, data obsolescence, metadata degradation, data irretrievability

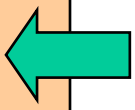
Business Case

- Purpose – understand return on investment in data management standard(s)
- Assumptions
  - Technology is a given
  - Motivations for having standard(s) are
    - Articulate effective and efficient data management behaviors in current and “near future” environment
    - Reap scale effects from multiple trading partner adoption
  - Business case needs to address both motivations

Observation

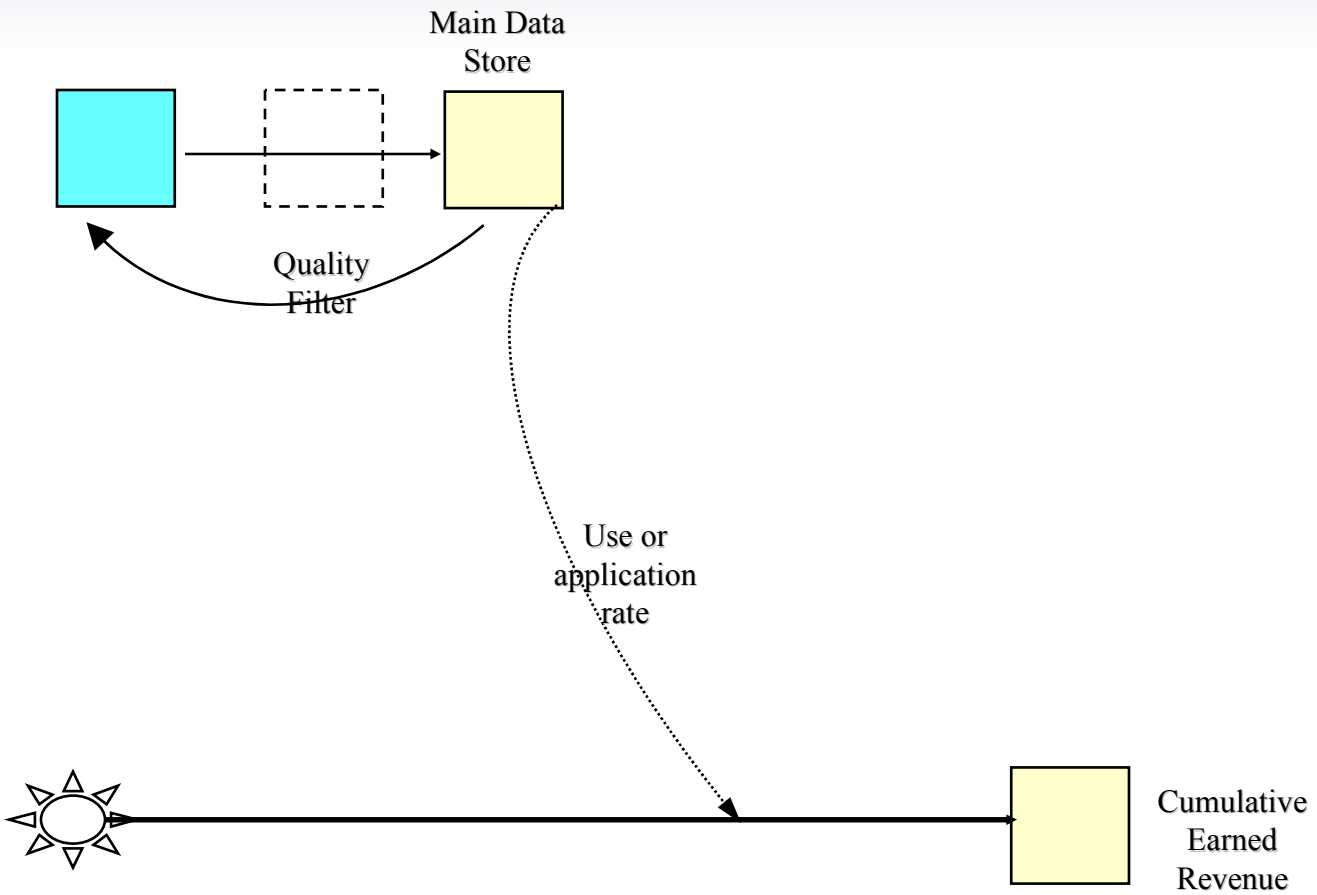
Principles

- Data is a valuable and costly corporate asset for any enterprise.
- The effectiveness of an enterprise increases with improved quality and use of data.
- DM includes the management of data, data products, and data views.
- . . .

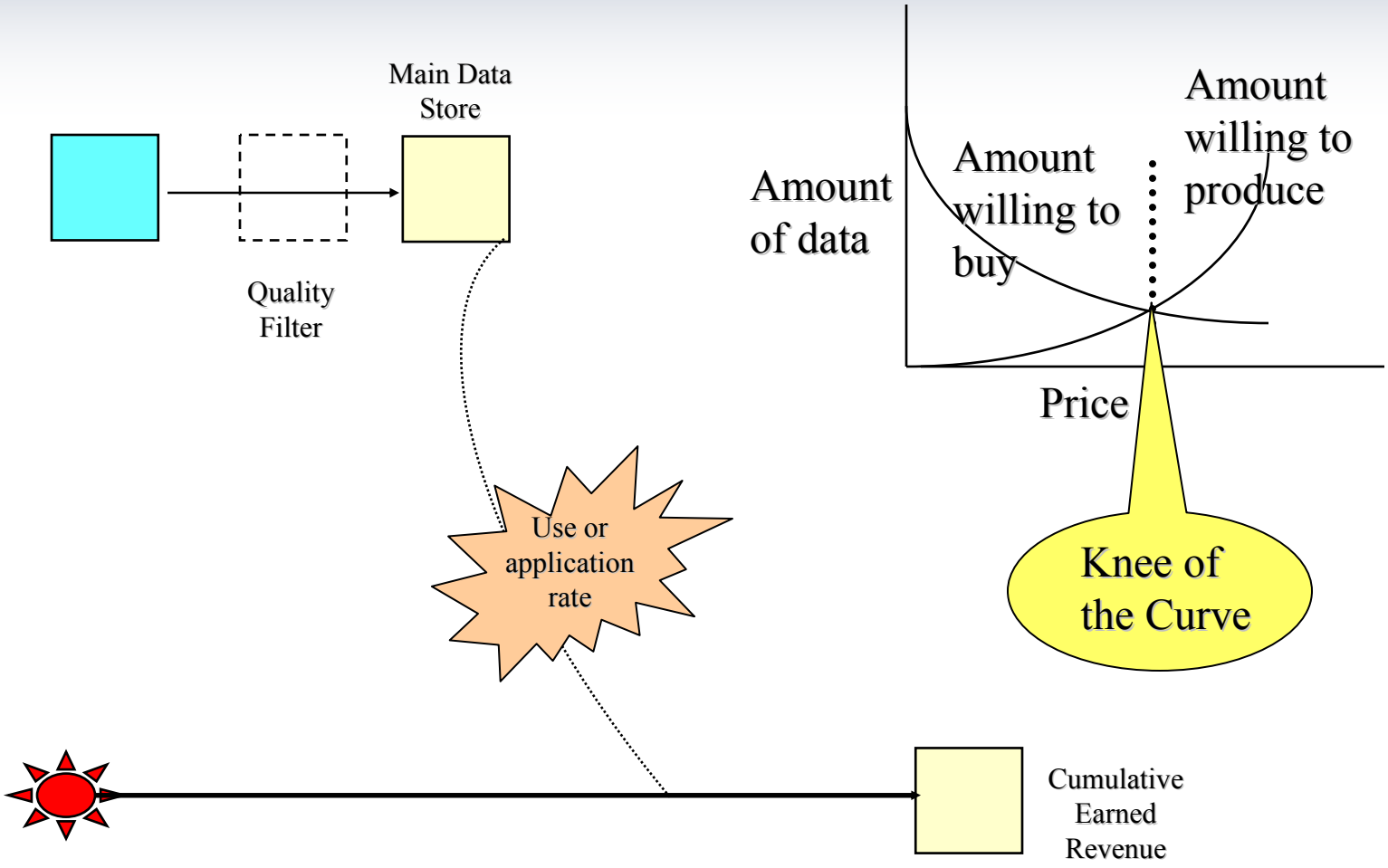


Principles themselves do not determine economic return on data management

Basic Concept



Basic Concept



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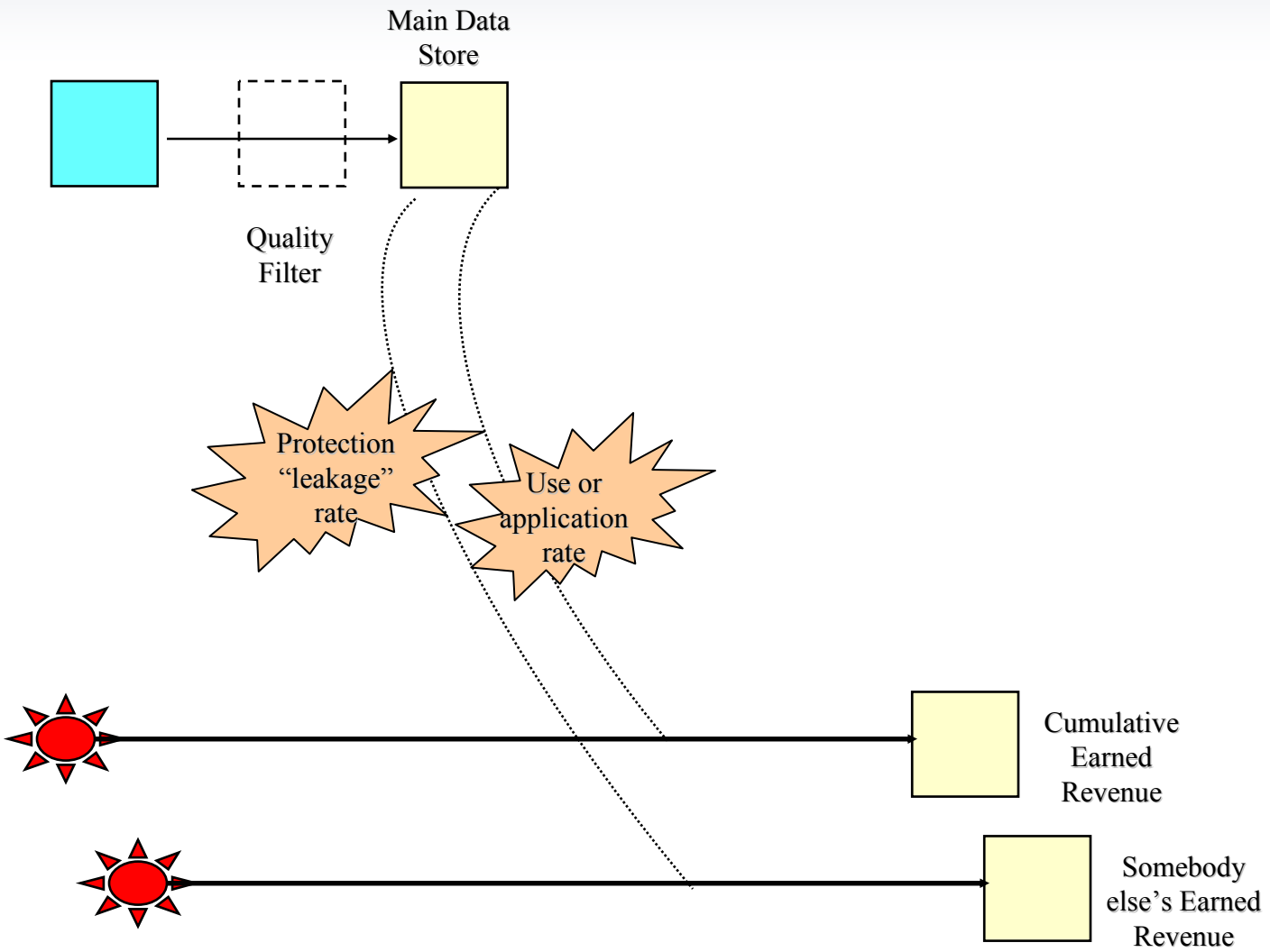
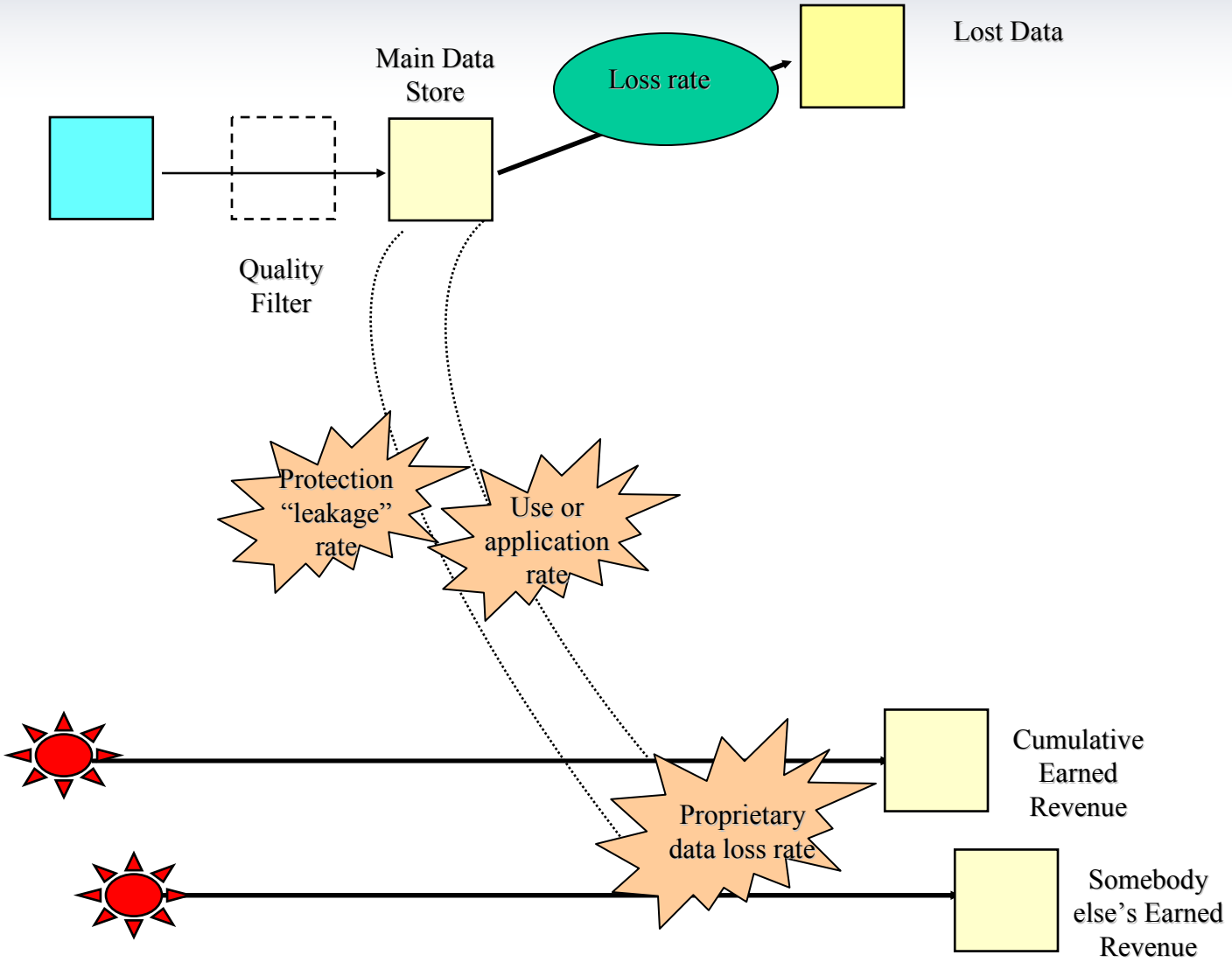
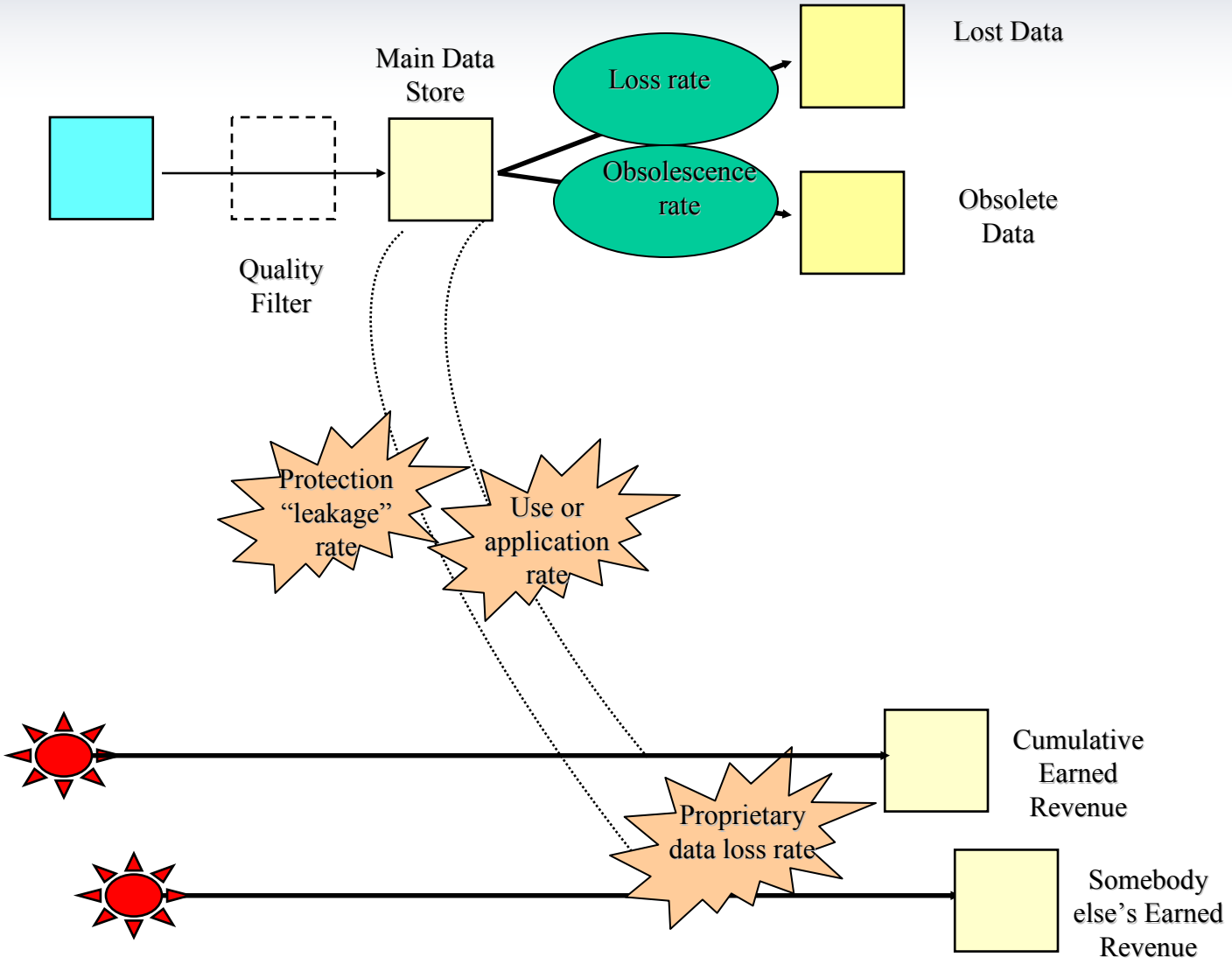


Basic Concept



Basic Concept



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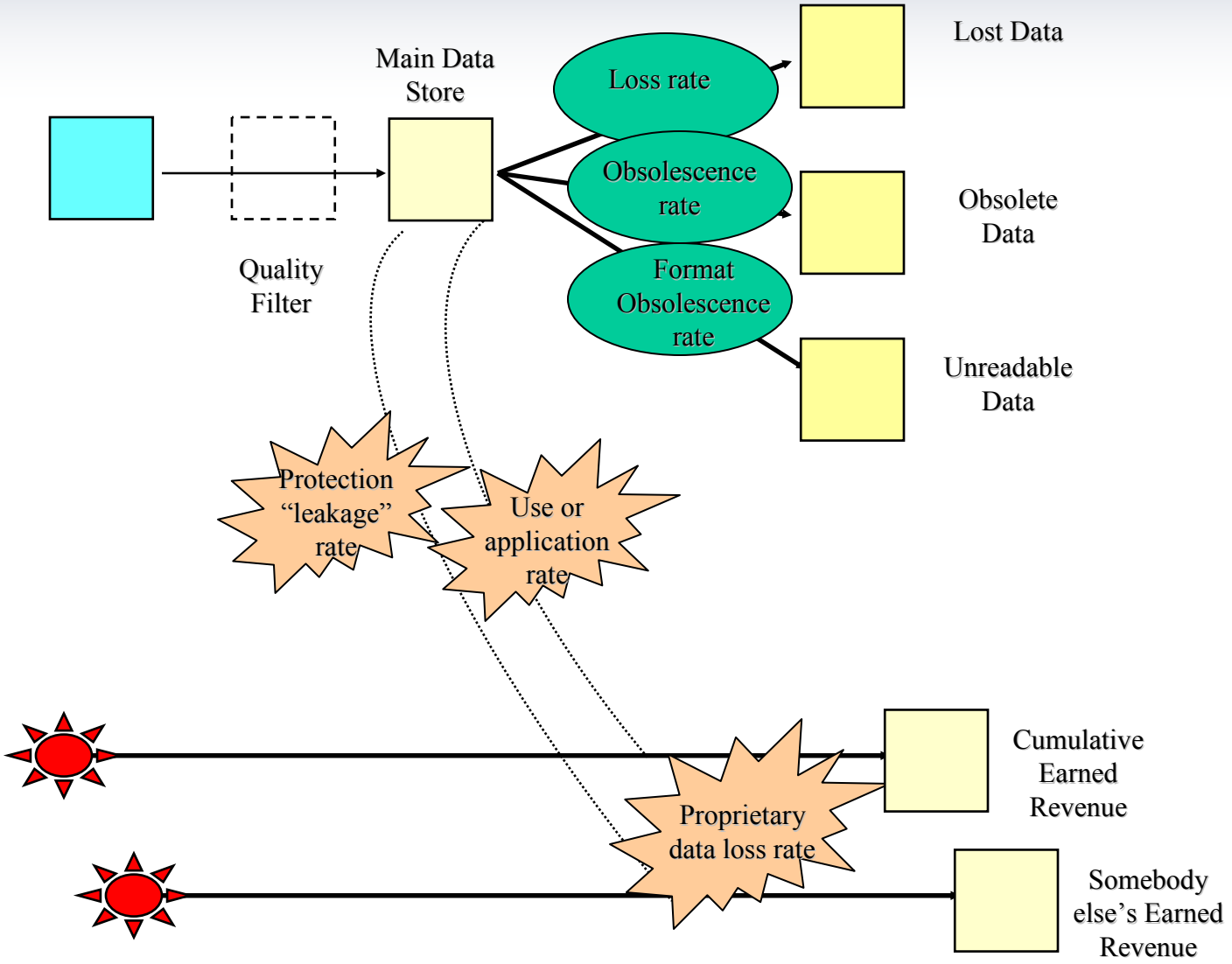

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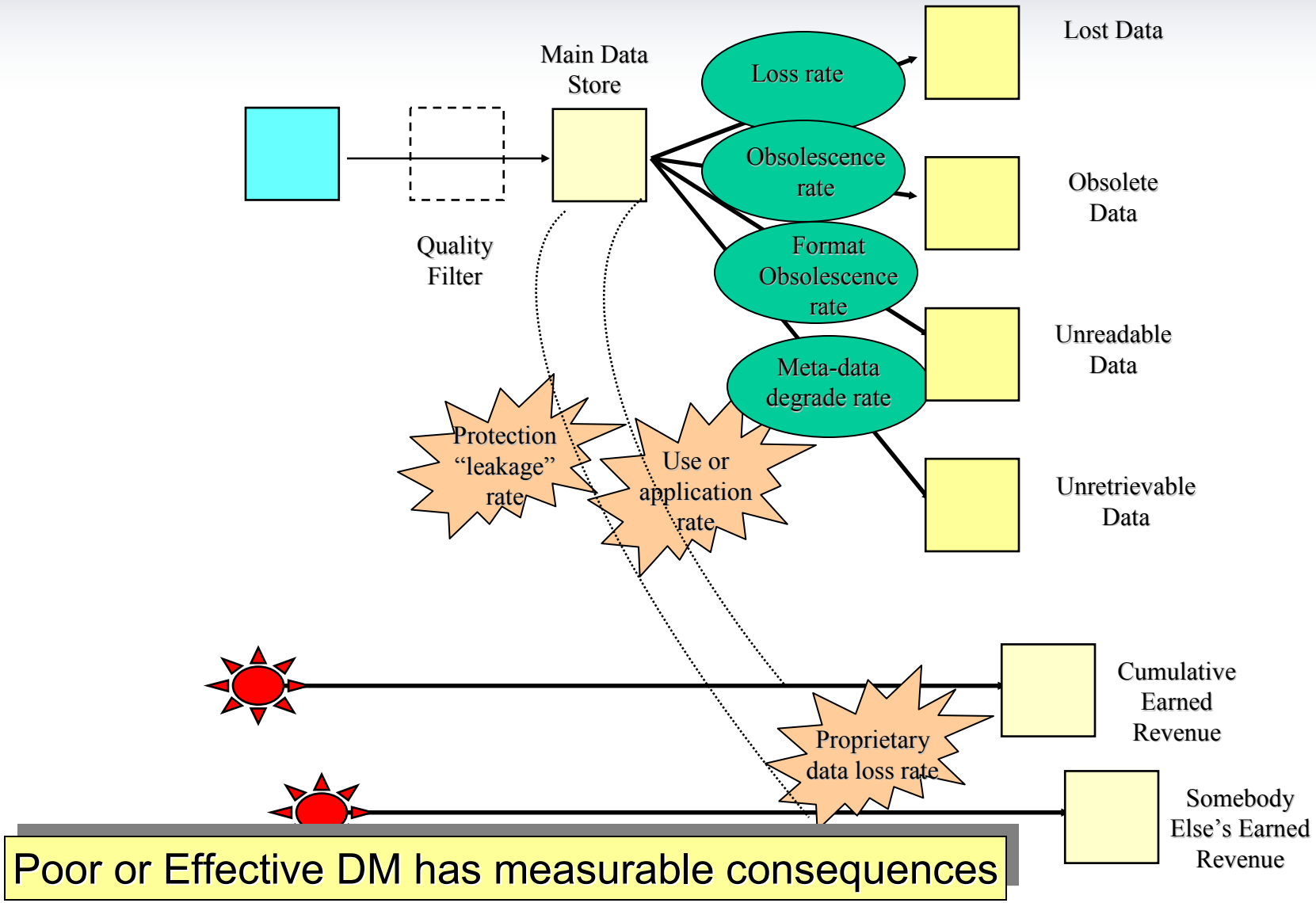
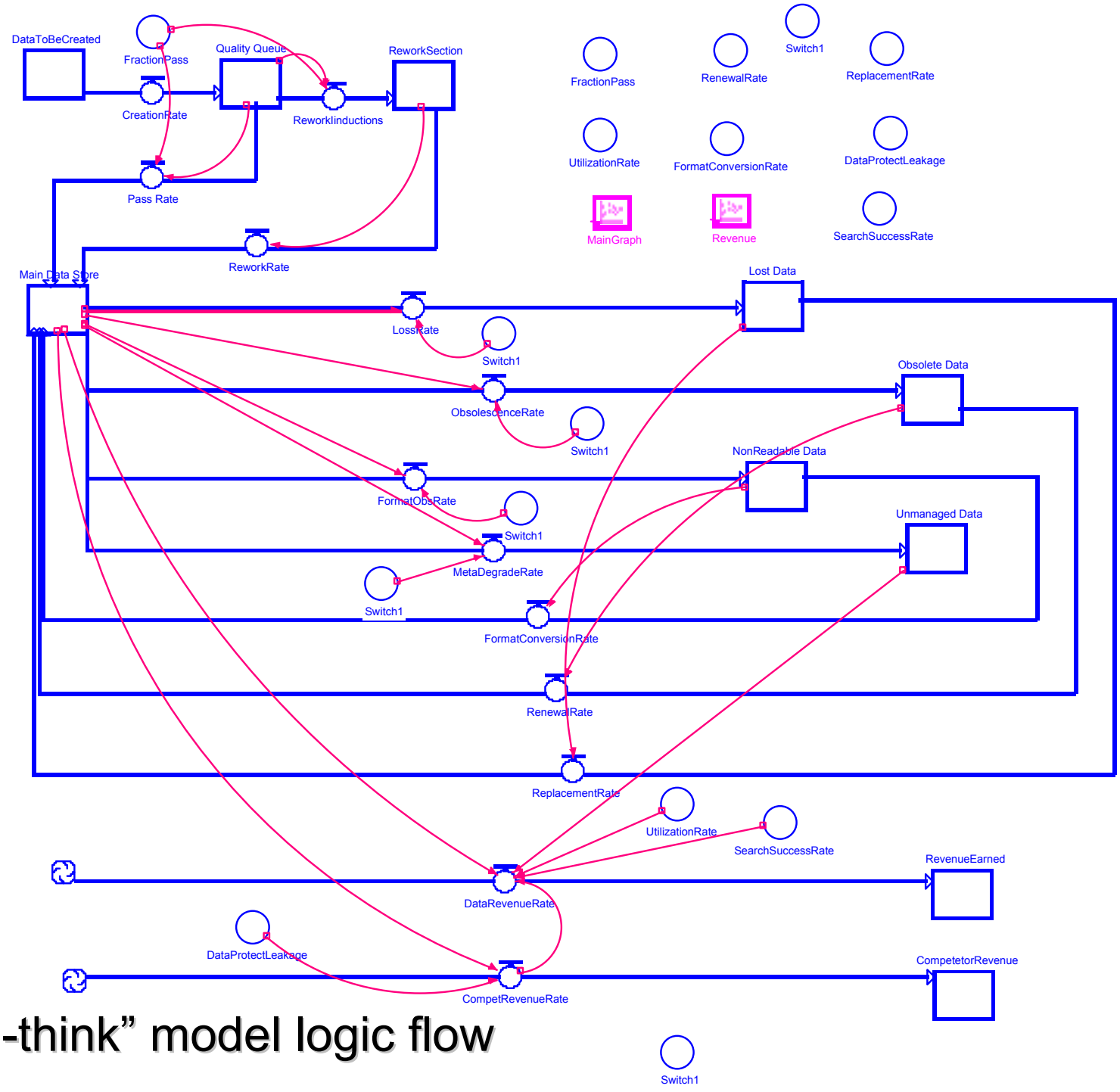


Poor or Effective DM has measurable consequences



“I-think” model logic flow

Data Management in CMMI-SE/SW/IPPD/SS v1.1

- Project Planning (PP)
  - SP 2.3-1 Plan for Data Management
  - SP 2.7-1 Establish Project Plan
    - *Sample includes Data Management Plan*
  - GP 2.5 – Train People
    - *Sample training topic is Data Management*
  - GP 2.6 – Manage Configuration
    - *Sample work product = Data Management Plan*
  - GP 2.7 – Identify & Involve Stakeholders
    - *Sample Activity = Review Data Management Plan*
  - GP 2.9 – Objectively Evaluate Adherence
    - *Example work products reviewed = Data Management Plan*
- Project Monitoring & Control (PMC)
  - SP 1.4-1 Monitor Data Management
  - GP 2.5 Train People
    - *Sample training topic is Data Management*
  - GP 2.7 Identify & Involve Stakeholders
    - *Sample Activity = Review Data Management Plan*
- Configuration Management (CM)
  - GP 2.3 Provide Resources
    - *Example = Data Management Tools*

Data Management Correction Request

- Cindy Hauer has submitted a CR to SEI as an organizational CR for the Data Management Community
  - Requests an update to the definition of Data Management
  - Suggests coordination with the Data Management Community on ensuring the next revision of the CMMI is in synchronism with the GEIA-859
- The SEI configuration management team has received the CR and is considering incorporation
  - The SEI's CMMI V 1.2 Project Manager indicated that his initial review indicates that the CR can be accommodated
  - There still may be implications in the examples and details that will have to be investigated.

Status - DM Way Forward

- ✓ DM community of practice maturity
- ✓ Training and institutionalization
- ✓ Linkage to EIA-836 Configuration Management Data Exchange DM business objects
- ✓ Assessment and integration of government and industry model, taxonomy, and enterprise efforts
- ✓ Body of Knowledge development
- ✓ Revision updates cycle
- ✓ New re-integration with CM in the future
- ✓ Redressing of DM in the CMMI – fulfilling DM's potential