The Information Lifecycle Management Maturity Model

Maturity Model

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The Information Lifecycle Management Maturity Model

Produced By:

Bob Rogers	Chair of the Data Management Forum's ILM Initiative, and CTO, Application Matrix
Paul Field	Data Management Forum Board Member and Independent Consultant
Terry Yoshii	Storage Architect, Intel and Project Lead

Contributors (in Alphabetic Order):

Name	Role	Company
Dale Duckwitz	End User	Hanover Insurance Group
Mikhail Gloukhovtsev	End User	CSC
Shawn Partridge	End User	Rockford Construction
Jackson Shea	End User	Regency Group
Mark Sobatka	End User	US Bank
Edgar St Pierre	DMF/ILMI	EMC
Kurt Wong	End User	VISA
Adam Yang	End User	TD Bank

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Executive Summary

The Data Management Forum's Information Lifecycle Management Initiative (ILMI) and the SNIA End User Council (EUC) began a joint effort in early 2008 to develop an Information Lifecycle Management (ILM) Maturity Model. The work was patterned after the Capability Maturity Model Integration[1] (CMMI) from the Software Engineering Institute at Carnegie Mellon University. The ILM Maturity Model provides a standardized tool for consistent point-in-time assessment of the maturity of ILM capabilities within an organization. There were three objectives for this work effort:

- Provide a standardized tool that would assist organizations determine where they stand relative to best practices in managing their information.

- Help organizations improve their ILM practices to balance their information technology service levels and therefore lower costs.

- Help organizations to set priorities on IT investments, by aligning their costs with the changing value of their information over time.

Information Lifecycle Management is not a product conveniently packaged and delivered in a box. Consider ILM as an ongoing process and as a service management strategy. The Storage Networking Industry Association (SNIA) defines ILM as:

> "The policies, processes, practices, services and tools used to align the business value of information with the most appropriate and cost-effective infrastructure from the time information is created through its final disposition. Information is aligned with business requirements through management policies and service levels associated with applications, metadata and data."

Notice that the SNIA definition of ILM does not mention the word "storage."   Information is the asset to be conserved and protected; storage represents one of the resources that enables ILM, but it is by no means the only resource that is important to the efficient management of information over time.

Another common question is how ILM relates to the Information Technology Infrastructure Library (ITIL)[2]. ITIL is an internationally recognized set of best practices that focus on service management. ILM extends and refines ITIL concepts regarding information management. SNIA strongly recommends that an ILM project begin with a service management strategy based on ITIL, the Control Objectives for Information and related Technology (COBIT)[3], or any one of several other service management frameworks. All of these frameworks begin with an assessment of the business process which is a fundamental step in the information management process. This is where the ILM Maturity Model can help.

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[1] http://www.sei.cmu.edu/cmmi/

[2] http://www.itil-officialsite.com/home/home.asp

[3] http://www.isaca.org/Template.cfm?Section=COBIT6&Template=/TaggedPage/TaggedPageDisplay.cfm&TPLID=55&ContentID=31519

What is a Maturity Model?

The concept of a maturity model dates back to the early '70's when Cyrus F. Gibson and Richard L. Nolan, wrote about the four stages of growth in the Harvard Business Review[4].

Figure 1 below shows the four stages defined by Gibson and Nolan.

Although Nolan's work pre-dated the CMMI model developed by Carnegie Mellon by many years, it is the Carnegie Mellon Software Engineering Institute's CMMI that most people think of when they think of a Maturity Model. The basic concept is the same; it is an appraisal process that can be used to establish a baseline, set performance goals, measure progress, and evaluate the effectiveness of organizational processes. The CMMI has succeeded because it provides a model framework, and a widely used appraisal process that can be applied to software development projects (its original use), and other organizational processes. More information about the CMMI, can be found at http://sei.cmu.edu.

Initiation	IT is introduced and end-users have a « hands-off » approach to systems and applications. IT tends to be viewed as a mysterious group who are difficult to communicate with but nevertheless provide critical services.
Contagion	IT services proliferate and consume increasingly larger proportions of corporate and departmental budgets. This stage is frequently marked by organizations rebelling against centralized IT and building their own applications and systems often without regard for planning and control.
Control	As the cost of IT increases and becomes more apparent, Controls start to be applied and IT begins to shift from managing computers to managing data resources.
Integration	As controls are applied and discipline is established, more economic efficiency is achieved by justifying expenditures and eliminating duplication.

Figure 1. The Four Stages of Growth

Introducing Information Lifecycle Management

ILM is not a piece of hardware or software. Furthermore, ILM is not unique to storage. As stated previously, the word "storage" does not appear anywhere in the SNIA definition. Information lifecycle management is a service management practice applied to information.

The reason SNIA focuses so much effort on Information lifecycle management is that information needs to be managed, preserved, and maintained. The storage industry is well positioned to make sure that information is managed correctly and that digital information doesn't die a premature death.

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[4] Managing the Four Stages of EDP Growth; Cyrus F. Gibson and Richard L. Nolan; Harvard Business Review; January–February 1974

ILM represents a holistic approach to information management: so that five years; ten years; or, whatever number of years from now information continues to be usable. That is just one example of looking at the information lifecycle; there is also the need to understand data protection needs, in terms of recovery time and recovery point objectives. The collaboration process is critical to discovering the services needed by information assets.

Information Lifecycle Management depends on a service management strategy to be meaningful as shown by Figure 2. In the middle layer of Figure 2 are service management policies and service level agreements. Think of it as what information deserves to be preserved (including all the accompanying services accorded critical information), and what information should be used and immediately discarded? Without a set of service management policies and objectives everything has to be managed the same way and that generally translates to "retain everything." That is the issue in many data centers. Without the initial step of collaborating with the business process owners, and other stakeholders in the information management process, there is no way to know and understand the value of the information, what the needs are, or how it should be managed over time. An ILM strategy begins with the process of working with all of the stakeholders.

 Stakeholder identification can be especially challenging when the appointed project manager is a Storage or System Administrator that inherited the job of implementing an ILM program. Technical IT staff people are accustomed to solving technical issues but not necessarily business issues. An executive champion (i.e., somebody fairly highly placed in the organization) can help guide the process, and has the visibility of all the potential users of the affected information. This collaboration will probably be enlightening for everyone involved. Frequently the various people who are participants in

ITSM-ITIL
- Service Mgmt
  - Collaboration
  - Terminology
  - Business Requirements

ILM 2.0
- Service Mgmt
  - Policies
  - SLAs
- Security
- Storage
- Infrastructure
- Metadata

Information Mgmt Methods
- Data Mgmt
- Content Mgmt
- Info-Architecture
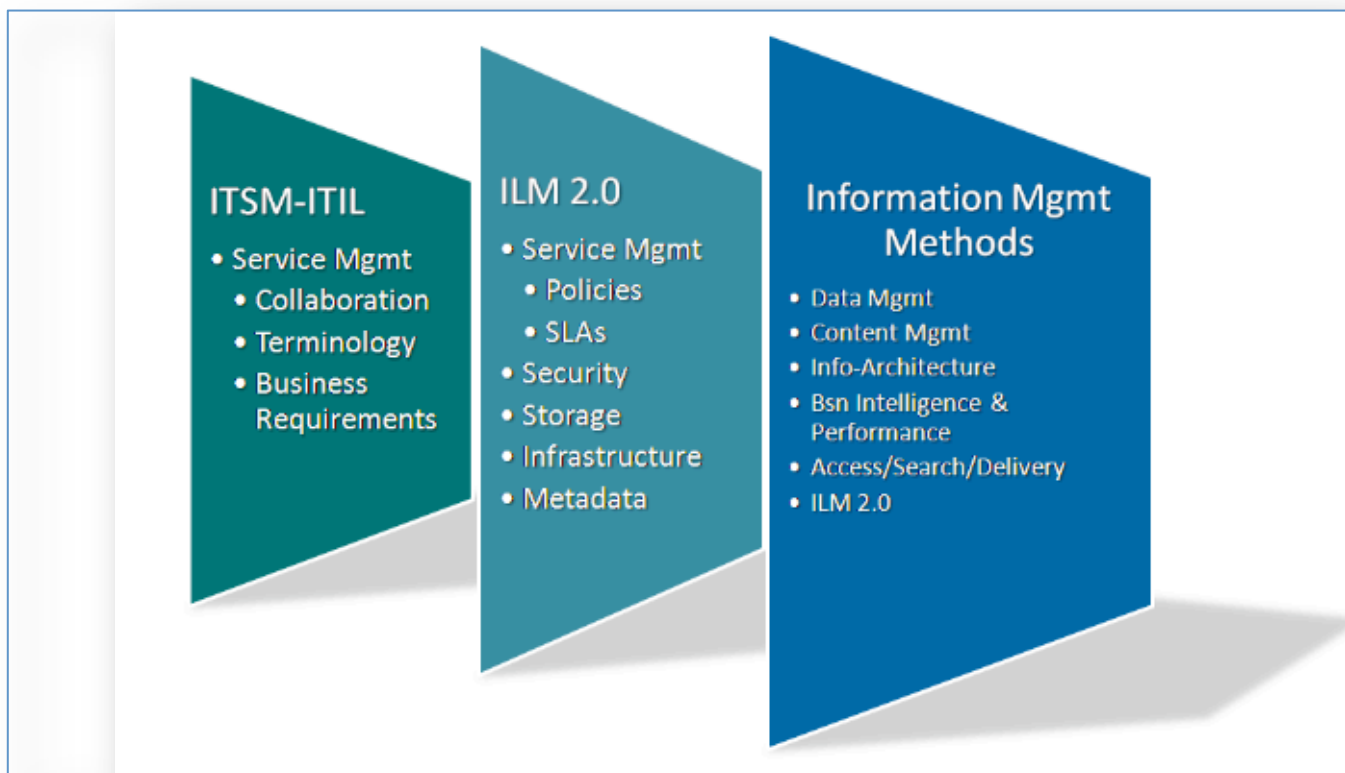- Bsn Intelligence & Performance
- Access/Search/Delivery
- ILM 2.0

Figure 2. Service Management for Information

this process use the same set of words to mean entirely different things. Developing a common terminology surrounding information management is important. In addition, although Service Level Agreements (SLAs) probably exist, it is uncommon for such SLA's to include specifics about how information should be managed. This is often a learning experience for everyone involved.

Finally, once the service management policies and procedures have been developed, things start to get much easier. Information classification becomes a (relatively) simple process of applying rules to information objects for data and content management.

ILM 2.0

When SNIA introduced the concept of Information Lifecycle Management, it was embraced by many only to find that implementation was extraordinarily challenging. Few tools existed, and the processes and procedures needed to interpret the service requirements of information assets were not widely available. The developments of new technologies and social pressures (e.g., eDiscovery and global warming) have accelerated the impetus to apply service management techniques to information.   The processes and procedures associated with ILM have been created or adapted from other related disciplines as exemplified by this Maturity Model.

ILM 2.0 re-introduces the concept of Information Lifecycle Management with accompanying processes and procedures absent from earlier days. Make no mistake; Information Lifecycle Management is still a difficult and challenging proposition, but enough companies have had sufficient experience to relate how to accomplish that objective.

Figure 3 illustrates the comprehensive and cohesive nature of information lifecycle management. Information strategy, architecture, and governance feed into the information management process. For example, the Legal department and others need to be able to find information quickly without slowing down or stopping the whole organization. In other words, there are many different objectives in terms of enterprise information management, and it is important to be prepared to handle the job of ensuring that the information the company needs is there when and where it is needed.

Figure 3 originated with another group of people who have the same goal. Take a look at "MIKE2" – "Method for Integrated Knowledge Environment.[5]"

Information has value, and that value changes over time. Older information doesn't always mean lower value either; in many places, as the age of information increases, so does the value. There is a life cycle for everything though; some information only needs to exist for a short period of time and some has to be retained for longer periods of time.

Consider the processes that are in place today. How is the information used? Why is the information important?   The purpose of an ILM program is to develop an information classification scheme and apply policies so that critical information is treated to the respect and care it deserves. Preservation begins with the creation of information.

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[5] http://mike2.openmethodology.org/wiki/What_is_MIKE2.0

Information is everywhere nowadays. Is it important to ensure that mobile information resources are managed as effectively as in the glass house? In many cases the information generated by people out in the field is even more important because it is irreplaceable. Life was so much easier when the requirement was to just provision more disk storage to store the ever-increasing about of information being created, but that's only a small fraction of what is expected today.

- ILM 2.0 is a service management style framework for cost-effectively aligning datacenter storage, security, services, applications, and infrastructure with the business requirements for the organization's information

- ILM 2.0 enables service management methodologies to be applied to governance, compliance, risk, and information management

- ILM 2.0 includes adapting to changing requirements throughout the information's lifecycle

ILM 2.0

Database Information Management

Storage, Security, Metadata , Data and Information Services

Datacenter Infrastructure Management

Enterprise Search, and Discovery

Information Strategy, Architecture, Governance

Enterprise Information Management

Enterprise Content Management

Business Intelligence - Performance Management

Enterprise Data Management

Source: Method for Integrated Knowledge Environment, Mike 2.0 and DMF, 2009

Figure 3. ILM 2.0 - The Next

Total Cost of Ownership

The rate of decrease in the cost of managing storage has slowed due to the overwhelming complexity of managing the amount of information created today, and is beginning to increase due to external factors such as regulatory compliance and the barrier that complexity creates. ILM represents the best new opportunity to keep driving costs out.

The Total Cost of Ownership (TCO) includes acquisition, environment, operations, management, service, upgrade, loss of service and residual value, usually compared over a three year period. The annual cost of operations here is based on historical data from Strategic Research Corp and ITCentrix. In 1992 the annual cost of managing storage as originally published by Strategic Research Corp. was $5,000,000/TB. After 12 years time, in 2004, it was down to $22,000/TB or $22/GB, but the erosion rate will disappear due to overwhelming complexity unless a new approach is taken.

Unfortunately concepts such as TCO don't take into account contributions to business productivity, flexibility, or competitiveness. A new metric is needed to fully express the power of ILM and its potential positive impact on the business.

ILM Maturity Model Overview

Now that ILM has been defined, the next step is to introduce the ILM maturity model. The maturity model fulfills two purposes:

1. It defines a common framework and language for discussing ILM maturity. Then it enables a relative comparison for how far along an organization is in terms of implementing good ILM practices. This allows an organization to see how they compare to best practices and to other organizations.

2. It provides information to organizations about ILM best practices that allows them to improve their ILM implementations. In some cases it may provide a basis for an organization to start an ILM implementation. This allows organizations to provide storage service levels appropriate to the value of their information. Often this will reduce costs as organizations start to feel comfortable with providing lower cost service levels for lower value data.

How Do You Use the ILM Maturity Model

The ILM Maturity Model is a template that includes a series of questions that can be used to develop an interview script. Stakeholder identification is best left to the ILM implementation team. This team should be comprised of a multi-disciplinary group of individuals led by an executive at a level high enough to arbitrate any disputes that might arise. Stakeholders are likely to come from the ranks of Records Information Managers (RIM), Compliance, Legal, Security, Applications, Business Owners and others. Conduct interviews with these stakeholders using the questions. Use separate interview sheets for each interview and note who was interviewed. Use the answers to the questions to establish the maturity levels.

Each of the four areas of the model has key processes and a descriptive narrative to assist in the categorization of the level of maturity. Like the CMMI, the ILM Maturity Model has five levels of categorization ranging from Initial or ("Ad Hoc") to Optimizing or ("Continuous Improvement").

Establish a score for each of the four areas (Business Integration, Application and Information Alignment, Data Management, Infrastructure). The score for each area will be the lowest level as determined by the answers to the questions. Consolidate the area scores on a final scorecard for an overall summary of ILM Maturity Levels.

Major Assessment Areas of the Model

Business Integration

The business integration portion of the Maturity Model focuses on the policies, and processes of the business, as well as governance, business process value, and requirements. ILM practices need to be integrated with how the organization conducts its business. This implies that the knowledge of how the business is run is a key part of an ILM strategy. The initial level depicts a reactive (not pro-active) environment in which the ILM team, if it exists, is unaware of business and data governance policies, or of the linkage to business process value.

Application and Information Alignment

The alignment of applications and information moves the analysis of policies, processes, governance, and value deeper into IT by studying the ownership of information, the duplication and dissemination of information, and data models. ILM practices need to be aligned with the organization's applications and information. This implies an understanding of an organization's applications and information. Service quality, security, and data protection all factor into how well applications and information are aligned.

Data Management

The data management section continues to delve into the management techniques of the organization. The creation and maintenance of metadata appears at this stage of the model. Metadata is the basis for ILM decision-making. At the initial stage, there is no concerted retention of metadata, and at the opposite end (Optimizing) metadata are automatically maintained as the environment changes and matures. ILM policies need to be incorporated in an organization's data management practices. This ties the desired service levels to actual service level implementations.

Data management processes build on the metadata inventory to define a continuum ranging from anecdotal knowledge data and location to fully automated policy-based management.

Metrics introduce the concept of key performance indicators (KPIs) that lead to a common taxonomy and automated reporting of data quality.

Infrastructure and Service Management

The final category of infrastructure and service management focuses on criteria such as data protection, connectivity, security, and data migration. ILM policies need to be reflected in the actual IT infrastructure. There should be higher cost infrastructure that supports the higher service levels, and lower cost infrastructure that supports the lower service levels. And there should be mechanisms in place, manual or automated, that move data between service levels at the appropriate time.

Business Integration ◈The extent to which information management is integrated with the organization's policies and processes	**Application and Information Alignment** ◈The extent to which information management is aligned with the organization's applications
Data Management ◈The extent to which information management policies are reflected in the organization's data management practices	**Infrastructure and Service Management** ◈The extent to which information management policies are implemented in the organization's storage infrastructure

Figure 4. Measurement Area Descriptions

Conducting Interviews and Scoring the Maturity Model

The area covered by the Maturity Model is very broad. An iterative approach (probably beginning with the critical business processes) can yield valuable service management information and prepare the assessment team for the other focus areas in the Maturity Model.   Regardless of the starting point, it is important to study the focus areas to identify target areas of opportunity.   It would be very unusual for any of the areas not to be represented by one or more stakeholders whose responsibility is to manage that area.   Sometimes it may be difficult to identify the individual or even the role, so building a network of relationships can be very useful.

Once the target areas, roles, responsibilities, and individuals are identified the next step would be to tailor a set of interview questions. A common difficulty (and one to anticipate) is that the terminology may not be understood (or worse misinterpreted) by the people targeted for interviews. SNIA's Data Management Forum has been working to alleviate this issue and recently published "*Building a*

Terminology Bridge Guidelines for Digital Information Retention and Preservation Practices in the Datacenter[6]" which describes many frequently used terms and how their meaning changes depending on the role of the individual. The "*Terminology Bridge*" was two years in the making and has sparked several active discussions with SNIA. There are many different interviewing techniques (e.g., individually, or as a role-based group). It is a good idea to retain a set of records of each interview to review comments, understand context, or obtain more information during follow-up conversations regardless of how the interviews are conducted,

Scoring the focus area is the hardest part of using the Maturity Model. It requires some subjective evaluation of each of the areas despite efforts to offer objective criteria. Don't be overly concerned about scoring; the Maturity Model is intended to be a learning tool and it is not a "pass/fail" exercise. There are a variety of ways to handle scoring; some users have broken the results into "structured" and "unstructured" categories. Others have broken the results into "open systems" and "mainframe." There are likely to be many other equally valid ways of summarizing and scoring the Maturity Model results.

During the development of the Maturity Model and discussions of how to score the results, the consensus of opinion was that to maximize the value of the exercise, the lowest (or "weakest") rating in an area should be representative of that whole area. For example, if several interviews produced very high ratings in an area but just one interview suggested a much weaker or less developed structure, then the lowest would be the one used for scoring purposes.

It has been said many times already that there is no one right answer. To elaborate on that statement, there is no one spot in the Maturity Model that is right for every company. What the Maturity Model does is point to places where additional investments might be appropriate.

Maturity Model Checklist

Figure 5 is an example of a Maturity Model Checklist. Having a thorough understanding of the project's objectives is the first, and probably the most important item on the list. For example, expense reduction and litigation preparedness are frequently listed as objectives. Be prepared for conflicting objectives (e.g., litigation preparedness may initially increase expenses by preserving information for longer periods of time). Having a well documented set of objectives with executive approval is likely to expedite the assessment process.

Secondly, determine how much time will be spent on the assessment process and who in the organization might have similar priorities. During Maturity Model discussions, several participants mentioned having spent large amounts of time locating documents and even the right set of stakeholders. Furthermore, there was a significant amount of preparation time required for each

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[6] You can obtain a copy of "Building a Terminology Bridge" from the DMF website at http://www.snia.org/forums/dmf/knowledge/term_bridge/ and you can participate in active discussion about it and other Data Management topics at the DMF Community site, http://community.snia-dmf.org.

interview to ensure that the terminology fit the stakeholder's normal vocabulary. IT-related terminology was not commonly understood by individuals outside the Data Center.

The checklist is an example, some changes may be necessary to fit specific organizational needs. At this point, it is critical to identify the correct stakeholders to interview.

1. Identify goals/objectives in doing the ILM Assessment
2. Identify the amount of time you are willing to invest in performing the ILM assessment
3. Identify primary stakeholders (and alternates) … examples below:
   a. Functional Managers (RIM, Legal, Compliance, HR, Security, etc.)
   b. Business Unit Managers (Operations, Sales, Engineering, Manufacturing, etc.)
   c. Business Process Architect(s)
   d. Application Owners (Key Applications: email, web services, CRM, ERM, Office Productivity)
   e. Application/DB Architects/Engineers/Developers
   f. Storage/Service Operations Manager
   g. Storage/Service Engineering Manager
   h. Storage Engineers/Architects
4. Form an ILM Assessment task force
5. Align stakeholder/alternates to major areas/swim lanes
6. Trim the list down (as needed) with adequate coverage for each swim lane as well as type of data (structured, unstructured, semi-structured)
7. Study the Maturity Model and modify questions as needed to meet the needs of your company.
8. Schedule a 30 minute interview with each stakeholder
9. Provide them with the specific questions that you will be asking them several days prior to the scheduled interview (an update to the calendar item with the list of questions works well).
10. During the interview note the date/time and name/title/dept/function of person being interviewed.
11. State the purpose of the interview and ask if they feel qualified to answer the questions provided.
12. Explain that low ILM maturity levels are not uncommon and this does not reflect how well or poorly individuals are performing their duties
13. Proceed with the interview (even if they are not fully qualified). Use the examples provided in the spreadsheet and create your own examples to help guide them with assessment.
14. Make notes of their responses. There may be some very interesting comments/discussions/observations that will help you define the recommendations or appropriate actions to be taken.
15. Each set of questions/interviews should result in determining the maturity level of ILM practices from each stakeholder's perspective.
16. Multiple perspectives for a specific swim lane/area may require additional validation/interviews.
17. After you are satisfied that you have valid input from the stakeholders, the scores for each swim lane and major areas will need to be consolidated.
18. The lowest score in each area will be used as the indicator of ILM Maturity in that area.
19. The overall levels for the four major areas can then be depicted on the ILM Maturity Dashboard. This dashboard can be used to present an overview of the current state of ILM Practices in your company.
20. The detailed ILM assessment roll-up sheet can be used to define your strategy for improving ILM practices and for identifying key project/investment areas.
21. Perform the ILM Maturity assessment periodically to update progress and identify additional areas for improvement

Figure 5. Checklist for Using the Maturity Model

Set up and conduct interviews using a separate spreadsheet to record answers and results for each interview. The questions provided as examples will often prompt a discussion that will allow you to establish the level of maturity for each area (row). The overall rating will be the <u>lowest</u> level scored for of all of the rows in any given row. There is an example of a score sheet at Figure 15.

There may be a need to look at ILM maturity from various perspectives. When all of the interviews have been conducted, it may be worth categorizing the results into structured and unstructured data environments. The areas with the lowest levels of maturity often point to opportunities where investments should be made. Roll up the results into the ILM Maturity Model Dashboard (Figure 16) for a high level view of where your organization currently stands. This is a point in time assessment that should be repeated periodically to measure an organization's progress towards established goals.

Keep in mind that a low maturity level is NOT necessarily a "bad" thing. This depends on an organization's objectives. It can be much easier to get funding after proving that the chosen areas of investment need the most work.

ILM Maturity Model Details

Here is first major section of the ILM Maturity Model – Measuring Business Integration. Note the columns showing the levels of ILM maturity:

- At the initial, or ad hoc level, there is a very basic implementation of ILM.
- At the repeatable, or documented level, there is some structure to the ILM implementation, but it still remains fairly reactionary and disconnected.
- At the defined and measured, or standardized and correlated level, there is a basic level of organization and structure to the ILM implementation, with a consistent linkage to the needs of the organization. The process improvement is recognized here.
- At the quantitatively managed, or automated ILM level, the ILM implementation is now automated instead of manual. This increases the efficiency of ILM in the organization.
- At the optimizing, or continuous improvement level, the ILM implementation has achieved efficiency, and the ability to increase its efficiency, all while meeting and evolving with the needs of the organization.
- The starting point for an ILM implementation is that it must meet the needs of the organization. To do this, ILM must be able to integrate with the processes and data governance policies of the organization. The implementation also must take into account the varying importance or values of the organization's business processes. To do this, the requirements of the organization's needs must be understood and considered.

Measuring Business Integration

In this section, for each row, map the organization against the requirements for each ILM level. For example, under processes and policies, determine whether the organization has an ILM implementation that is reactive to or conflicting with the needs of the organization, whether ILM is automated with a feedback loop, or something in between.

	Initial (Ad Hoc)	Repeatable (Documented)	Defined & Measured (Standardized & Correlated)	Quantitatively Managed (Automated ILM)	Optimizing (Continuous Improvement)
Processes/ Policies	Reactive to conflicts with business processes/polici es when noticed	Follows business processes/policies inconsistently	Follows business processes and policies consistently.	Automated ILM consistent with business processes/policies	Feedback loop for continuous improvement of ILM alignment with business processes and policies.
Governance (of processes, policies, data)	Unaware of business data governance practices	Aware of business data governance practices but followed inconsistently	Follows business data governance practices consistently	Automated ILM consistent with business data governance practices	Feedback loop for continuous improvement of ILM alignment with business data governance practices
Business Process Value	Not linked explicitly to business process value No differentiation of business processes	Basic linkage with business process value	Consistent linkage with business process importance. Key Business Performance Indicators for assessment and ILM process improvement.	Automated ILM consistent with business process importance	Feedback loop for continuous alignment of ILM with business process importance
Requirements	No stated ILM requirements	Documented ILM requirements	Documented and uniform ILM requirements	Automation of requirements	Feedback loop for continuous input of ILM improvements

Figure 6. Measuring Business Integration

Processes	These are the processes and policies used by the business for its operations. ILM should be implemented within or complementary to these processes.
	Example: The business has process/policies where customer information is captured in a Customer Relationship Management application. The ILM policies should include one that is appropriate for the storage needs of this information.
	Question: How are your business processes/policies aligned and integrated with your ILM policies?
Governance	These are the data governance policies used by the business to set the retention and protection policies of its information. ILM should be implemented to reflect the data governance policies.
	Example: The business has a Customer Relationship Management application. The data governance policy states that the customer opportunity information that is captured by this application must be kept for three years. This information also must be encrypted. After three years the information must be deleted. The data storage structure for the CRM information should enact this policy.
	Question: How are your business data governance practices aligned and integrated with your ILM policies?
Business Process Value	This is the importance set by the business for its business processes. ILM should be implemented to reflect the varying levels of importance of the business processes and Key Performance Indicators established to determine effectiveness of ILM.
	Example: The business has a Customer Relationship Management application. This application is deemed critical to the operational well-being of the business, with minimal downtime allowed. The data storage structure for the CRM information should reflect this availability expectation and this expectation may be a KPI for the business process.
	Question: How do you align and link your business process values with your ILM policies and what are your key performance indicators?
Requirements	These are the requirements defined by the business for its ILM policies. ILM should be implemented to reflect these requirements.
	Example: The business has defined six ILM policies with varying levels of data activity, response time and retention expectations. Each of these policies should be reflected in a permutation of the data storage structure.
	Question: How do you determine your ILM requirements and make improvements to your ILM policies?

Figure 7. Business Integration Definitions

Measuring Application and Information Alignment

Applications are how businesses automate their business processes and store/retrieve information that is needed. The manner in which applications behave models the processes and policies established by business and other information governance stakeholders. At this layer, Application Owners will need to comprehend a wide range of requirements and understand the value of the information that is being generated, processed, stored, and deleted.

	Initial (Ad Hoc)	Repeatable (Documented)	Defined & Measured (Standardized & Correlated)	Quantitatively Managed (Automated ILM)	Optimizing (Continuous Improvement)
Processes	Unclear ownership of information	Applications/Groups own information	Business level ownership Linkage to Business Metrics	Enterprise owns information	Same as Previous
Policies	Backup Only	Documented business Requirements Backup as an Archive	Aligned to service offerings w/static allocation Recovery-Based	Automated/dynamic allocation of services Electronically-stored Information (ESI) as a resource	Data Preservation applied per policy
Governance	DB schema	Enterprise Architecture/Data Model	Enterprise Taxonomy	Same as previous	Same as Previous
Alignment Dynamics	Duplication of information Inconsistent copies of information	Increase in information sharing Reduced unnecessary duplication	Quality metrics are established	Information stored is based on business requirements	Information lifecycle is based on changing business requirements
Value	No information value is determined. All information objects treated as equal.	Business value of some information is periodically assessed with inconsistent results	Business value of information consistently assessed. Metrics for measuring information business value are defined.	Information storage and protection criteria are regularly re-assessed based on the business value.	Continuous assessment of information value with consistent results.
Access/ Availability	Limited sharing Incorrect Security	Information sharing policies are set.	Information sharing with established security controls.	Information access/sharing policies are regularly reviewed on all managed information objects	Same as Previous

Figure 8. Measuring Application and Information Alignment

Key points for this measurement area:
1. The organization owns the information
2. Information is stored based on business requirements
3. The business value of information changes over time and value is re-assessed on a regular basis
4. Information storage requirements are understood, communicated and reviewed periodically

Processes	see Business Integration Definitions
Policies	see Business Integration Definitions
Governance	see Business Integration Definitions
Alignment Dynamics	Quality of storage services introduces classes of service allowing customers to align their storage with application requirements based upon Quality-of-Service metrics Example. Quality of Service (QoS) in Fabric Channel switching enables traffic differentiation and prioritization, allowing latency-sensitive applications such as online transaction processing (OLTP) to share storage resources alongside throughput-intensive applications such as data warehousing. Question: To what extent are the classes of services determined by the business data value dynamics?
Value	Value of storage services for business is to provide a combination of processes, tools, methods, and metrics to achieve business goals. Example - Establishing a process for linking business value of the applications with information life management metrics. Question: Do you have a data value re-assessment process to align the storage service level with business values?
Access/Availability	Access control and information availability address data security and include accountability, traceability, risk management, information retention and sanitization. Example: establishing a security policy enforceable with security tools and sanctions. Question: Do you have established authentication, authorization, and accounting policies controlling data access and management?

Figure 9. Application and Information Alignment Definitions

Measuring Data Management

The data management topic sparked many discussions during the development of the Maturity Model. Data Management is our next focus area in the Maturity Model. For example, should a Configuration Management Data Base (CMDB) be a required element of the Metadata focus area? What about Master Data Management (MDM)? In both cases the decision was that they should not be required. What was required was a source of metadata that would be the basis for measurement, information for key performance indicators and service level objectives, and classifying information. Metadata is critical to understanding information lifecycle management.

What data management processes are in place today. Are they documented? Could someone else come in and take over without assistance? Are those policies automated, and if so, what drives the processes? Are the policies responsive to changing requirements?

Some of the data management processes can be easily tested. A good Disaster Recovery exercise is unannounced and requires the local IT staff to watch as the "survivors" follow the recovery procedures.

Finally, think about the metrics for assessing data and service quality. Moreover, is there a common vocabulary so that management, staff, and end-users all have agreement on what constitutes key performance indicators?

	Initial (Ad Hoc)	Repeatable (Documented)	Defined & Measured (Standardized & Correlated)	Quantitatively Managed (Automated ILM)	Optimizing (Continuous Improvement)
Metadata	No Extended Metadata	Multiple Isolated Repositories. Inconsistent use of metadata across environments.	Multiple Isolated Repository Consistent strategies and data model/architecture defined Self describing data	Federated Metadata Repository Metadata Management	Automated change/data mgmt. Changes reflected across metadata repository automatically.
Data Mgmt. Processes	Requires human knowledge of data and location. Management processes are manual.	Management processes are Documented & Manual	DM Policies enforced based on correlated metadata. Manual processes still required for management of data based on business metrics	Automated Policy Based Mgmt. Manual feedback and correction. Data management processes based on storage and business metadata.	Automated DM as a closed loop system (no human intervention required)
Data Protection Operational and Disaster Recovery	Recovery timing predictions are not possible or a guess Best effort basis.	RTO/RPO can be estimated but may not be accurate, due to lack of testing. Standard Tool Set BC Plan Documented with Business Impact Analysis. Standard back-up and recovery processes applied manually across the organization	RTO/RPO Classification Standard Service Levels offered Staged DR testing Standard back-up and recovery processes applied automatically based on defined data criteria RTO/RPO is predictable, reliable and process is tested periodically	RT/RP monitored against objectives. Processes tested periodically, & real-time predictive capabilities. Audited and fully tested recovery plans Standard back-up and recovery processes based on org. policy when allocated	RTO/RPO is managed automatically based on policy Automated and dynamic risk mitigation Dynamic backup/recovery processes based on policy and changes to metadata
Metrics	No Metrics	Metrics Available - Inconsistent terminology across environments DM metrics stored for ad hoc reporting	Common definition for metrics. Collected and maintained DM metrics (tied to KPIs) are collected and maintained, basic automated reporting	Automated reporting Data Quality Metric DM metrics (tied to KPIs) are available in real time, automated reporting of exceptions based on organizational policy	Managed based on Policy Self-describing data DM metrics (tied to KPIs) are automatically based on policy

Figure 10. Measuring Data Management

Metadata is	... constructed ... (Metadata is wholly artificial, created by human beings.)
	... for a purpose ... (There is no universal metadata. For metadata to be useful it has to serve a purpose.)
	... to facilitate an activity ... (There's something that you do with metadata.)[7]
	The business has processes that are critical to its operation and existence. The set of rules used to identify those processes and the information used in the execution of those processes would constitute metadata. These metadata rules not only need to be constructed, but are also used for a variety of processes and serves to facilitate the company's operation; as such, these metadata belong in a repository (or repositories), subject to management policies, and used to administer information.
	Example: Metadata for unstructured files (.doc) would be the file characteristics such as file size, owner, date of creations, etc. As maturity level increases additional metadata are required to manage information in accordance with the characteristics and ILM policies. Further along in maturity, metadata definitions are further expanded to include other attributes such as retention and expiration, physical data location, etc. Metadata across the enterprise will be consistently defined and retained in a federated repository in the Quantitatively Managed state.
	Question: What are the constructs that identify this key information? Constructs might be keywords, process names, department names, etc that can be associated with digital objects within the enterprise. Where is metadata stored? Is metadata administered as a corporate resource?
Processes	A large part of data management is understanding what information assets exist within the enterprise and how this information is integrated into corporate processes. The common term for this is "portfolio management." The level of collaboration necessary to implement a portfolio management program is substantially beyond the scope of storage administration and requires the active participation of executive level management. However, once "C-level" management has participated in this process, Storage Administrators should to be able to implement standardized information management policies into automated data management processes.
	Question: Does the enterprise have a well-known and understood set of processes, policies and objectives for its business critical applications such that information assets can be identified, located, protected, preserved and deleted?
Data Protection (Disaster Recovery "DR" and Operational Recovery "OR")	These are the processes and policies set by the business for the protection and continuance of its on-going operations. ILM should be implemented with consideration for these processes and policies. ILM policies define backup data categorization and their retention periods.

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[7] "*Metadata: Data With a Purpose*" a talk given by Karen Coyle at the California Library Association Meeting, November, 2004, http://kcoyle.net/meta_purpose.html

	Examples: ** Data Recovery Processes defined and documented with business priorities and service objectives communicated to storage administrators ** When data loss occurs where will the required data be ... this should be based on ILM retention and deletion policies that are in effect. ** Data is deleted in backups based on ILM retention and deletion policies that are in effect. Question: If a failure occurs within the IT environment, can its effect on the business be assessed and remedied based on recovery time objectives?
Metrics	Measurement of quality of service in the managed data environment. A common taxonomy is constructed to ensure consistent identification and tracking of information assets across the enterprise regardless of physical location or condition. Storage service level objectives will exist (e.g. 99.999% availability) as part of an overall ITSM plan Example: OR/DR capability has been defined and implemented at the infrastructure level. Data RTO/RPO are reported consistently and used as KPIs for Storage Services Question: Do you have consistent metrics established for each class of storage service and how do you measure and report out on these?

Figure 11. Data Management Definitions

Measuring Infrastructure and Service Management

Shared storage infrastructures are generally very complex. Establishing a storage service and offering standardized services will greatly simplify service management.   At the heart of the storage service is a Storage Service Catalog that provides for better alignment of application/business needs to the information objects being managed at the infrastructure layer. The challenge of providing the appropriate levels of protection and retention continues to rise, driven by increasing data capacity, regulatory compliance, security, litigation support, and the fact that IT is constantly pressured to do more with a flat or decreasing budget.

	Initial (Ad Hoc)	Repeatable (Documented)	Defined & Measured (Standardized & Correlated)	Quantitatively Managed (Automated ILM)	Optimizing (Continuous Improvement)
Storage Service	No Storage Service Strategy No Service Lifecycle process No Service Levels No Service Metrics	Introduction of Service Design Processes and Functions. Event/Fault Monitoring Configuration Mgmt is manual (Excel) Some reporting capability	Storage Service Catalog, Service Transition Capacity Management ILM Reporting against KPIs	Storage Service Portfolio and Catalog. Configuration & Asset Management. Tools/Processes/CMDB All Storage CIs CMDB	Highly automated CMDB processes and support
Storage	No Standardized Tiering	Storage tiers defined at basic level	Storage pools established	Shared storage pools	Self-healing
Connectivity	Direct	Networked	Virtualized	Adaptive (internal & cloud?)	Same as Previous
Data Preservation & Retention	Backups only	Data retention based on SLO	Data Retention & Deletion based on SLO aligned to policies	Automated policy application to class of service and audit	Dynamic protection based on evolving business needs
Security	Physical Only	Network/Array/Device Level	Application and LUN Level	Data Encryption	Same as Previous
	User	Network/Array Level (RBAC)	Active Monitoring/Alerting	Audit (external)	Same as Previous
Movement	None	Manual - some documented policies/processes	Policy Based Movement	Automated PBDM	Same as Previous

Figure 12. Measuring Infrastructure and Service Management

Key points for this measurement area:
1. Alignment with IT Service Management framework can be very useful
2. Service Level Objectives are well defined, understood, measured, and reported
3. Automation of routine tasks that are labor intensive will need to be deployed
4. Risk mitigation from a security and compliance perspective cannot be overlooked
5. Managing storage and storage services goes well beyond managing disks and tapes

Infrastructure and Service Management Definitions

Storage Service	Describes the availability and capability of the services being delivered by a storage service organization and their alignment with ITIL based service management practices
	Example: Storage services are offered to customers based on infrastructure capabilities such as Disaster Recovery with RTO and RPO
	Question: What is the process you use to map customer needs to service capabilities and how do you measure service performance?
Storage	Describes the design and implementation of storage devices in support of efficient storage tiering in an ILM environment
	Example: Storage "devices" (block and/or file) are implemented and differentiated (tiered) by performance, availability and protection capabilities as well as cost
	Question: How many tiers of storage have you implemented and describe the capabilities (technologies/automation) of your shared storage resource pools
Connectivity	Describes the efficiency of design and integration across multiple tiers and types of storage within the storage environment
	Example: The storage to host interconnect type (Local, Direct Attached, Storage Area Network, Network Attached Storage, Virtualized) determines the degree of agility within your storage environment
	Question: What type(s) of storage and percentage(s) have been deployed within your storage environment? Is it virtualized?
Data Preservation & Retention	Describe the ability to retain, preserve and delete data over its full life cycle.
	Example: Business requirements define the retention of financial data and the deletion of records that are no longer required. This capability will be provided as a service with specific classes. Retention financial records for 7 years, immutable, with deletion after 7 years.
	Question: Do you have records management policies that dictate retention and how do they tie into your classes of service?
Security	Describes the method of security implemented to protect information assets within the storage environment
	Example: Security can range from "none" to password protection on devices to encryption of data at rest or in flight and should be aligned to corporate policies. Includes physical and logical security (AAA)
	Question: How do you ensure appropriate security within your storage environment?

Movement	Describes the method and degree of consistency and automation/efficiency for movement of data within the storage environment
	Example: Manual intervention is often required to migrate data when a storage array is decommissioned or when data needs to be placed on less expensive infrastructure. This process can be automated to limit manual intervention and should be aligned with data migration policies.
	Question: What types of data migration do you perform and what is your process and tools for alignment with data movement policies?

Figure 13. Infrastructure and Service Management Definitions

ILM Service

Implementation of ILM as a service includes the development of a storage service strategy, service design, service transition, service operation, and continual service improvement. Storage service design provides guidance for the storage service catalog and storage service management processes (for example, service level management, storage service capacity management, storage security management). Storage Services Catalog as part of the Service Portfolio will provide alignment of business requirements to the new and existing storage services. The development and evolution of the storage services catalog involves the dynamic alignment of business needs to the provision of storage services. It is a business requirements-driven approach and is not constrained by specific types of hardware or software.   The primary purpose of the continual ILM service improvement is to address the maturity of enabling IT processes for continual alignment and realignment of storage service with the current and future business needs.

	Initial (Ad Hoc)	Repeatable (Documented)	Defined & Measured (Standardized & Correlated)	Quantitatively Managed (Automated ILM)	Optimizing (Cont. Improvement)
Spans all domains: Business Application Information Data Storage	No Storage Service Strategy No Service Lifecycle process No Service Levels No Service Metrics	Introduction of Service Design Processes and Functions. Event/Fault Monitoring Configuration Mgmt is manual (Excel) Some reporting capability	Storage Service Catalog, Service Transition Capacity Management ILM Reporting	Storage Service Portfolio and Catalog. Configuration & Asset Management. Tools/Processes/CMDB All Storage CIs CMDB	Highly automated CMDB processes and support
Service Lifecycle	Strategy Defined	Design of Process & Functions	Transition of Services	Service Operation	Full Service Lifecycle with continuous service improvement.

Figure 14. ILM Service

ILM Maturity Model Usage Examples

Two companies interested in ILM used this Maturity Model and conducted of their IT staff and line of business owners. Their observations are summarized below:

CASE 1: The first company is a medium sized insurance company with about 5,000 employees, 120 TB of user data and an additional 80 TB of remotely replicated data. Sixty percent of the user data was database resident structured information.

The questions asked in the interview were:
1. What are the constructs that identify this key information? Constructs might be keywords, process names, department names, etc that can be associated with digital objects within the enterprise. Where is the store of metadata? Is the metadata administered as a corporate resource?
2. Does the enterprise have a well-known and understood set of processes, policies and objectives for its business critical applications such that information assets can be identified, located, protected, preserved and deleted?
3. If a failure occurs within the IT environment, can its effect on the business be assessed and remedied based on recovery time objectives?
4. Do you have consistent metrics established for each class of storage service and how do you measure and report out on these?

Observations from the first interview:
1. Engagement with the appropriate stakeholders can be difficult without a major program or initiative to drive it with management support.
2. There is a disconnect between written policies and execution.   There is no process to follow through on enforcement or auditing.
3. Key business drivers for ILM need to be clear and embraced by management and stakeholders.

CASE 2: The second company is a large financial institution with about 75,000 employees. This company has about 1.3 petabytes of user data distributed as 23% structured, 10% semi-structured, and 77% unstructured data.

The questions asked in this second interview were:
1. What is the process you use to map customer needs to service capabilities and how do you measure service performance?
2. How many tiers of storage have you implemented? Describe the capabilities (technologies/automation) of your shared storage resource pools.
3. What type(s) of storage and percentage(s) have been deployed within your storage environment? Is it virtualized?
4. Do you have records management policies that dictate retention and how do they tie into your classes of service?
5. How do you ensure appropriate security within your storage environment?

6. What types of data migration do you perform and what is your process and tools for alignment with data movement policies?

Observations from the second interview:
1. The mainframe side is more mature than the open systems side.
2. Data management policies are not implemented or consistently applied company wide. Data centers are better managed than remote offices.
3. Structured data scored higher than unstructured data. Ownership is not clear for unstructured data.
4. Business process value is difficult to quantify, and is the most difficult question. Additional probing here may be required.
5. Is "Optimizing State" a real goal or is this a state of "Enabled Capabilities"? This depends on the risks to the company.
6. The interviewee could relate to the questions and was very pleased with the results.
7. The results could be used as a benchmark to understand where the company is compared to other companies in the same industry.

Figure 15 shows an example of a form that can be used to record the results of a specific area and an associated set of interviews. Examples of specific areas include email, CRM, engineering, finance, manufacturing, sales and marketing, etc.

In this example, Infrastructure and Service Management were at a much higher level of maturity than Business Integration. What level of maturity are these companies at? The lowest grade in each row was used for form an assessment of the maturity level.

		Initial	Repeatable	Defined and Measured	Quantitatively Managed	Optimizing
Business Integration	**Processes**		X			
	Policies			X		
	Governance	X				
	Process Value		X			
	Requirements		X			
Application and Information Alignment	**Processes**			X		
	Policies		X			
	Governance		X			
	Alignment			X		
	Value	X				
	Access		X			
Data Management	**Metadata**			X		
	Processes		X			
	Data Protection		X			
	Metrics		X			
Infrastructure and Service Management	**Storage Service**			X		
	Storage			X		
	Connectivity			X		
	Security			X		
	Movement			X		

Figure 15. Sample Maturity Model Results Summary

Figure 16 shows an example of mapping the lowest score among all the spreadsheets onto an ILM Maturity Model Dashboard.   Many of the participants on the Development Team thought it was important to provide a quick visualization of the overall maturity level of each given area. It isn't necessary to break this into different areas or categories but it may help when it's time to identify where investment should be made. Keep in mind that these are all templates and each organization probably ought to modify them to meet their specific needs. Another option is to use different color codes to indicate that some progress is being made in specific areas or where investments have already been identified. This may be acceptable but could get confusing if the dashboard gets too "colorful".

ILM Maturity Scorecard for **Structured Data**	Initial (Ad Hoc)	Repeatable (Documented)	Defined & Measured (Standardized & Correlated)	Quantitatively Managed (Automated ILM)	Optimizing (Continuous Improvement)
Business Integration	🟩				
Application & Information Alignment	🟩				
Data Management	🟩	🟩			
Infrastructure & Service Mgmt.	🟩	🟩	🟩		
ILM Maturity Scorecard for **Unstructured Data**	Initial (Ad Hoc)	Repeatable (Documented)	Defined & Measured (Standardized & Correlated)	Quantitatively Managed (Automated ILM)	Optimizing (Continuous Improvement)
Business Integration	🟩				
Application & Information Alignment	🟩				
Data Management	🟩				
Infrastructure & Service Mgmt.	🟩	🟩			

Figure 16. Maturity Model Dashboard

Recommendations

The purpose of the ILM Maturity Model was twofold:

1. Define a common framework and language for discussing ILM maturity; and,

2. Provide information about ILM best practices that allows them to improve their ILM implementations.

Although the results of only two installations that used the Maturity Model are summarized in this white paper, everyone on who participated in the development of the Maturity Model expressed the opinion that the discussions and the thought provoked by the work was beneficial to them. The effort of mapping each of the maturity levels helped to clarify the actions they needed to take or recommend to management.

Everyone who participated in the development of the Maturity Model emerged from the exercise with the recognition that an ILM project would be a long-term commitment that required executive involvement and active participation. Finally, the Maturity Model proved that ILM is a corporate exercise. What matters is the type of service and level of cost appropriate to the environment.

One of the particularly useful outcomes of the work is the score sheet shows investment opportunities. Gaps are identified through the assessment process, and in most cases it the solutions were obvious. The results of the assessment were instructive of what to do, where to invest, and even what to expect from an investment. This can help management understand value, understand governance, and understand how IT can be run as a service.

Most enterprises today are experiencing very rapid growth in their information assets. Information Lifecycle Management offers the opportunity to apply business rules to control the rate of growth and ensure that valuable information is properly protected. While there is no certainty that the rate of spending on storage resources will plateau or even decline, the experience of most enterprises that have piloted ILM programs has yielded very significant cost savings.

ILM delivers on the promise of aligning IT to business needs. The Maturity Model is one of a series of steps that helps to achieve that goal. The Maturity Model's self-assessment process should demonstrate to your organization the progression and value of improving the information management process.

Call to Action

The SNIA is one of several organizations that continue promoting and developing tools, standards, and methods to allow ILM 2.0 to evolve into its full potential. You can participate in the work in many ways by visiting the SNIA websites or you can participate in active discussion around the ILM Maturity Model at the DMF Community site, http://community.snia-dmf.org or at the StorTOC site, http://stortoc.org.

StorTOC is a community of IT professionals working on sharing experiences on programs such as ILM-based practices. Your participation and feedback are welcomed and encouraged.

About the DMF

The SNIA Data Management Forum is a cooperative initiative of IT professionals, vendors, integrators, and service providers working together to conduct market education, develop best practices and promote standardization activities that help organizations become Information-Centric Enterprises. Areas of focus include the technologies and services that support information lifecycle management, data protection, and information retention, and preservation. For more information, visit www.snia.org/forums/dmf or participate in our open online community http://community.snia-dmf.org

About the Storage Networking Industry Association:

The Storage Networking Industry Association (SNIA) is a not-for-profit global organization, made up of some 400 member companies spanning virtually the entire storage industry. SNIA's mission is to lead the storage industry worldwide in developing and promoting standards, technologies, and educational services to empower organizations in the management of information. To this end, the SNIA is uniquely committed to delivering standards, education, and services that will propel open storage networking solutions into the broader market. For additional information, visit the SNIA web site at www.snia.org.