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Information Management in the 21st Century

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Leveraging information will continue to fuel business success. But the growth in information volume, velocity, variety and complexity and the new information use cases makes information management infinitely more complex than it has been in the past. In addition to the new sources and the increased demand for multiple context delivery, shareability and reuse, practically all information assets must be available for delivery through varied, multiple and concurrent channels and mobile devices.

To deal with these new demands, the IT organization needs to dramatically modernize its IT systems, transforming outdated data management infrastructure and replacing it with a more up-to-date and superior information environment able to support an entirely new set of requirements.

Key Findings

- Information management challenges must be addressed by understanding how information is utilized across the entire enterprise. Simply adding new storage, applications or databases is no longer sufficient. All information assets must be available for delivery through varied, multiple and concurrent channels and mobile devices.
- Existing tools and techniques can't keep up with the rate at which information is evolving. Modifying existing assets using the old application-centric mind-set is not sufficient to meet 21st century information challenges.

Recommendations

- Identify business outcomes that can be positively affected by additional information sources that previously have not been managed or analyzed.

- Determine which business processes are regularly adding new information sources and/or changing their business process models. Focus on the intersection of dynamic information sources and dynamic business process models.
- Focus on the applications with the data that other applications need the most.
- Inventory existing information management tools and determine their capability to manipulate and manage highly diverse information asset types in the same suite, or even same application engine.
- Use Gartner's Information Capabilities Framework (ICF) to determine the suitability of each component in your inventory of information management (IM) tools and the completeness of your total available IM tools portfolio.
- When new use cases or information sources appear or existing ones change significantly, use Gartner's ICF to determine the appropriate set of information capabilities. Strive to avoid deploying more information capability silos.
- Remember that it's not just about the technology. Information delivery without governance will not be successful.

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What You Need to Know

Current information infrastructure and management capabilities are unable to cope with vastly increased volumes of information, as well as its increased velocity, variety and the proliferation of use cases for information. IT has an opportunity to take a fresh look at its ability to provide business leaders with the appropriate information to help improve business outcomes in a timely manner. To do this, a growing number of IT organizations are attempting to improve enterprise business value by focusing on information capabilities that handle the shifting nature of many information sources and make the information available in an increasing range of use cases and at varying speeds. For this reason, Gartner has defined the information capabilities framework (see Note 1) to bring attention to the many and sometimes co-dependent or competing concepts involved in managing information.

Introduction

For most enterprises their current information management approaches are heterogeneous and complex, often with information silos of data sources, databases and application environments, and legacy data. The current information architecture evolved over decades of technology advancements, and we are now at an impasse — we have surpassed our ability to leverage existing tools for the new challenges of information management.

Innovators understand that the optimal path to adding capacity and capabilities is no longer through the simple addition of storage, applications and databases without consideration of how the information will move throughout the supporting infrastructure. However, through 2015, 85% of enterprises will fail to adapt their information infrastructure to "big data," socially mediated content and new connected devices. This means that all systems, even the largest integration platform in IT (the data warehouse), will be overwhelmed in the next three to four years (see "Does the 21st-Century "Big Data" Warehouse Mean the End of the Enterprise Data Warehouse?").

IT has an opportunity to take a fresh look at its ability to provide business leaders with the appropriate information to improve business outcomes in a timely manner. To do this, a growing number of IT organizations are attempting to define a different approach to managing information in an application or use case and information type agnostic manner. For this reason, Gartner has defined the information capabilities framework to bring attention to the many and sometimes co-dependent or competing concepts involved in managing information.

Importantly, this is not innovation for the sake of innovation. Most organizations have reached a point where information can be used to describe, manage and execute business processes and audit their business — it is no longer a competitive advantage or even a differentiation to do so. Given that modifying existing IT assets is not sufficient, enterprises will need to completely rethink how they leverage information for business value creation. For example, the data warehouse needs to evolve so as to include a fully enabled information-processing platform to handle "big data." This new warehouse forces a complete rethink of how data is manipulated, and where in the architecture each type of processing occurs to support transformation and integration (see "Does the 21st Century "Big Data" Warehouse Mean the End of the Enterprise Data Warehouse?").

What we are ultimately suggesting is that organizations manage information as an asset and that IT has an opportunity to lead this effort. When information is managed as an asset, and made available as a service to processes, and systems, it becomes possible to create entirely new revenue streams and business models. (An example is an airport that is collecting location information from people's Wi-Fi devices — so it can model for better passenger flow and punctuality. Another example is an international supermarket chain that has already started to research how newly available human gesture information might be captured and used in its business.)

A strategic approach to information management also demands a strategic combination of information valuation and governance supported by new components and services that together provide timely and semantically consistent access to information across multiple structures and formats residing on different repositories, and providing that access to applications and processes.

Gartner states that through 2015, organizations integrating high-value, diverse, new information types and sources into a coherent information management infrastructure will outperform their industry peers financially by more than 20%. Further, the gap between organizations which are leaders in information management practices and those which are not will widen rapidly. Those failing to adopt these new principles will continue to fall behind. In support of the concept of the ICF, Gartner is finding that many enterprises are beginning to recognize that information management technologies should be approached as a coherent set of capabilities that operate on the enterprise's information assets. In most cases they are just not sure how to create the best practices or select the tools that help in this endeavor.

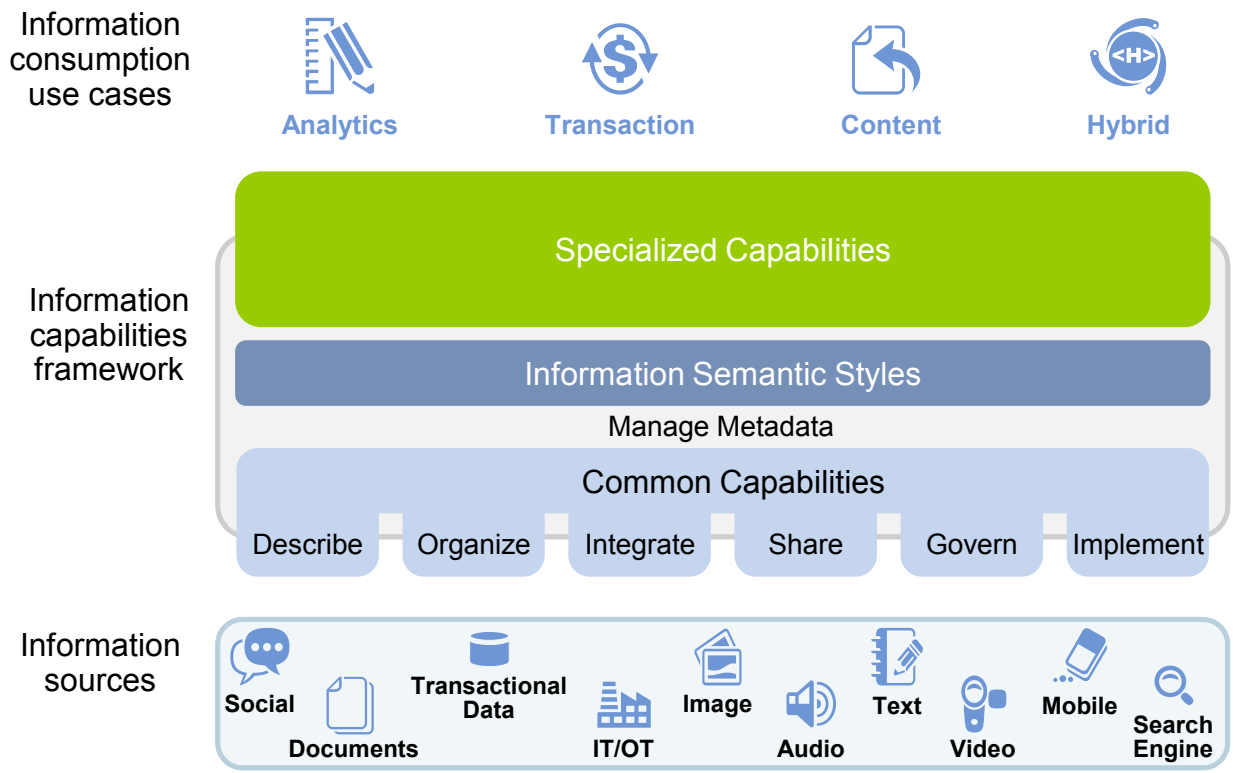
From "Information as a Byproduct" to "Information as an Asset"

The 21st century ICF (see Figure 1) addresses three key transformations:

1. **Use Cases**: Emerging information uses and major changes to existing information uses often represent the greatest new value to the enterprise and require information to be available across use cases rather than being locked into only one use case.
2. **The Information Capabilities Framework**: Moving toward the deployment of application-enabling, information repositories and sources, as well as information infrastructure that handles many data types rather than infrastructure dedicated to data types.
3. **Information Sources**: Leveraging the information continuum with a consistent approach to information management and governance of multiple types and multiple internal/external information sources, and expanding information volume, velocity, variety and complexity.

These three transformations demand a profound modernization of current information management infrastructure and will be part of the modernization that many organizations will go through in the next five to 10 years.

Figure 1. Information Management in the 21st Century



Source: Gartner (September 2011)

Information Sources: Sources Must Address the Entire Information Continuum, New Internal/External Sources and Big Data

Most enterprises have a wide variety and numerous internal and external information sources (see Figure 2). These sources take the form of databases, email archives, external data streams, and content repositories/file servers containing text, image, video, audio, and application-specific (for example, Excel or PowerPoint) files. This situation makes it an extremely complex task to deliver any integration of information needed for today's decision making and information sharing needs.

Figure 2. Information Sources and Types Are Proliferating

Source: Gartner (September 2011)

In the past few years the world has also witnessed massive increases in the volume, velocity and variety of information (see "'Big Data' Is Only the Beginning of Extreme Information Management"). Many new types of data and increasing volumes are now coming (and increasingly will come) from outside the enterprise. Increasing amounts of audio, images, video (often captured by mobile devices or security cameras), and telemetry data from IT/OT, location data and social data are being (and will be) captured for business purposes. This has major implications for how the information will be stored and organized. At times, some of the actual data won't be even captured; only the pointers to the external sources and/or the metadata will be stored. Furthermore, many use cases now call for high-speed information analysis and response, so dealing with in-flight and perishable information is becoming an absolute requirement.

End-user organizations now demand that business intelligence provides access to information sources other than the classic data warehouse (DW); namely, access to enterprise content management repositories, XML repositories, streaming data, blogs and more. And there is always a need to integrate data from the DW with other data sources. Also, the DW is used in more end-use cases than business intelligence (as an integration hub, master data support and more). This is evidence of how a complete information continuum (see "Foundations of Enterprise Information Management: The Information Continuum") is used for the full range of enterprise activities, from transactions to collaboration, and from business intelligence to pattern discovery and content analytics.

Additional complexity is added by the requirement that information from these disparate sources be integrated to provide more insightful views of the information — not in a pre-specified manner, but in an increasingly flexible, on-demand manner (see "Case Study: Context-Aware Computing Creates New Products and Access to New Channels"). This scope of end-user demand is extended yet further by the increasing number of end users making demands to access social media and leverage the new sources of information coming from operational systems (see "IT and Operational Technology Alignment Innovation Key Initiative Overview").

Whether or not information is intended to be used for business intelligence/analytic use cases, operational applications integrated with content management, interenterprise data sharing, integration with operational technologies use cases, relevant information located in various repositories should be easy to locate, analyze and manipulate. And this requires format, semantic and structural differences to be resolved. The role of the information capabilities framework is to provide a framework to achieve this goal via metadata-based access, sharing, governance and so on to the entire information continuum.

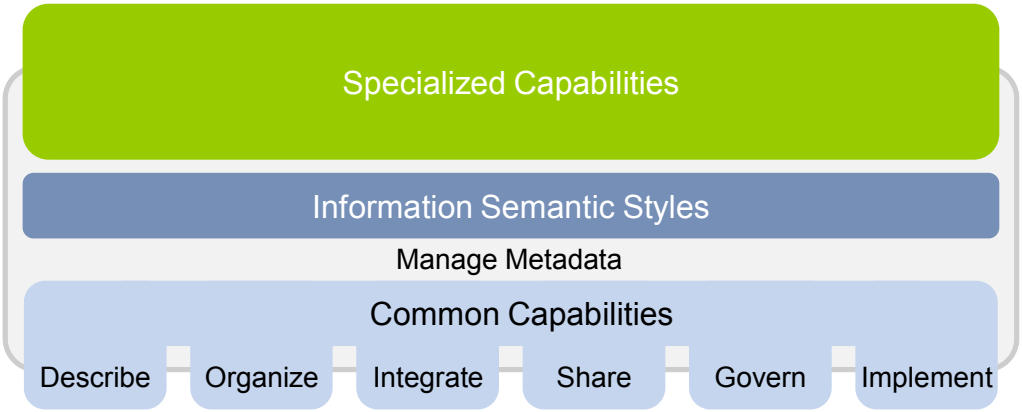
Information Capabilities Framework: Moving to a Cross-Application-Enabling, Adaptive Information Infrastructure

We define the ICF (see Note 1) as the collection of capabilities required to create business value from information assets. The ICF is a conceptual model developed to help IT leaders think holistically about the capabilities that they need to create value from enterprise information assets. It does not pre-suppose a particular use case or information source, and does not rely on or advocate any particular technology or architectural style. Rather, it is intended as a way of looking at new use cases, new information sources, or major changes to existing ones in a way that leads to information capabilities that do not lock data into a specific use case. In enabling information to become more independent from the application, data and content are prevented from being locked away or hardwired to only one or a few limited applications. Today, when information needs to be available to many applications, the integration effort tends to be high. An ICF approach will reduce integration complexity as well. Particularly for information that is consumed in multiple use cases, independence between such information and associated applications enables such information to be reused or repurposed without extensive rework of specific applications.

The ICF is a conceptual framework and doesn't imply or require a specific architectural approach, implementation tactics, or tools or technologies. It does, however, recognize that the capabilities described within are interdependent and that extreme data challenges ("Does the 21st Century "Big Data" Warehouse Mean the End of the Enterprise Data Warehouse?") require a more holistic approach than has been traditionally practiced. But it's not only for extreme information challenges. Any organization would benefit from this, even if they have no dimensions of "extreme." Just evolving existing capabilities in a consistent, application-independent manner has huge value. It enables the organization to treat information as a strategic asset, equal in importance to applications and business processes.

Typically, capabilities required for information management were developed independently by project, application or information type. This approach has led to fragmented, disjointed silos of information that are not easily joined together and cannot readily support new information types and use cases. It also has generated siloed approaches to managing information — each application or project taking its own approaches to the "verbs" in the platform. This creates redundancies (higher cost), inconsistencies (higher risk and cost), complexity (lack of agility), and lack of transparency (impossible to know how the data is really being managed). To meet the new information challenges described above, a new approach is required: the information capabilities framework (see Figure 3).

Figure 3. The Information Capabilities Framework



Source: Gartner (September 2011)

The ICF is composed of a range of capabilities that address critical components of information management, from assisting organizations in understanding the meaning and value of information assets, to exposing and sharing them in a variety of formats and contexts, all with appropriate conformance to policies. We present the ICF in three main layers: Common Capabilities, Information Semantic Styles and Specialized Capabilities. Underpinning all the capabilities is the metadata management capability.

ICF: Manage Metadata

Underpinning the ICF is a set of capabilities that are able to take all the metadata defined within the ICF and manage it, including providing that metadata to each of the components of the ICF, in terms of the contexts in which those information assets are used.

It is possible to manage information using siloed and redundant versions of the information assets in non-integrated tools. However, as a best practice organizations should try to achieve standardization, unification and integration of the metadata about the information assets across the various components in the ICF. In this way the assets become more understandable, reusable and valuable to the organization. Arguably, a failure to successfully integrate and manage the metadata can lead to a failure of the entire information management program.

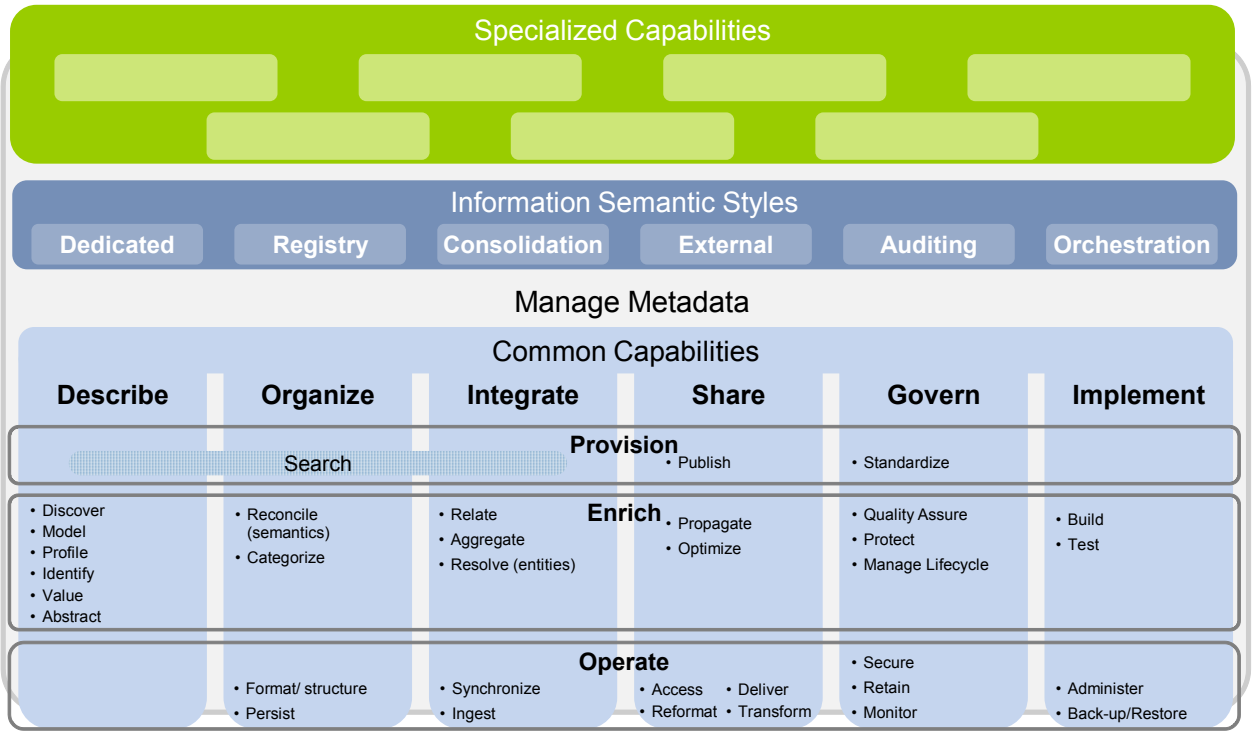
This is not to suggest that the entire enterprise needs to be integrated to one "metadata repository." There are various issues and approaches to managing metadata across the ICF (see "Defining the Scope of Metadata Management for the Information Capabilities Framework").

ICF: Common Capabilities

The ICF common capabilities layer is presented as a matrix (see Figure 4) with six major categories of common capabilities focused on describing, organizing, integrating, sharing and governing the information, and the capabilities required to implement information services. In addition, we have identified three "horizontal" categories: "operate," which includes capabilities that interact directly

with physical data stores; "provision," which includes capabilities concerned with preparing information for consumption; and "enrich," which includes capabilities that increase the value of the information by making it more easily used and found and by providing context. (See "The Information Capabilities Framework: An Aligned Vision for Information Infrastructure.")

Figure 4. ICF: Common Capabilities Matrix



Source: Gartner (September 2011)

ICF: Information Semantic Styles

Semantic styles or categories will emerge to enable different applications to negotiate how they will reuse components of the enterprise information architecture as opposed to randomly choosing to write dedicated application to data interfaces, services in some places and mixtures of tightly and loosely coupled architectures. The ICF lists the capabilities required to deliver a valid information architecture, but the EIM strategy and approach designates the options and choices that will be used to deliver the ICF.

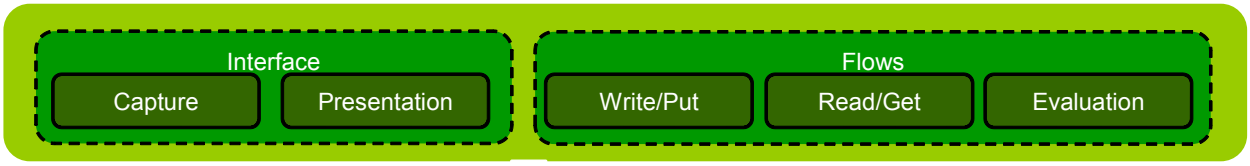
A modern information management architecture will continue to evolve toward information governance practices that are increasingly independent from application architecture. At the same time, services enablement will become common, even in packaged applications. Such packaged applications will evolve to become composite services networks, and custom applications will want to utilize information services in common with those packaged applications (see "Information Management in the 21st Century Is About All Kinds of Semantics").

ICF: Specialized Capabilities

The information semantic styles layer provides connection points for the specific use case applications/tools and processes. Applications are intended at their core to support an information use case. Information use cases vary from data entry and transaction processing (such as entering customer data, capturing an order, or looking up the status of a service request) to analytics and business intelligence to content management. The mechanical nature of an application is to document information specific to a business need or provide access to previously captured documentation. At the same time, applications provide a digital rendering of both formal and informal business processes. In order to develop a reuse model for application design, modular development has given way to services that are orchestrated into composite applications.

Application services that can best utilize a specialized capabilities create two large classes of services — the interface and the logic flows. Figure 5 defines these common types of specialized capabilities.

Figure 5. ICF: Specialized Capabilities



Source: Gartner (September 2011)

From an interfacing perspective, applications support two main functions:

1. Capture services provide for an interface capability to input information. Some capture services are keyboard driven (like fields in a screen form), while others are conversion interfaces (like video capture into editing software). Regardless of the final intended read requirements of any information asset, it must first be captured in order to begin information management.
2. Presentation services provide for a method of accessing previously stored information. Some presentation services merely present information in the native structure and form — and actually represent characteristics from the repository where the information is stored. This is common in operational technology and traditional IT systems. Other presentation services render information into a new visual or document medium (for example, a dashboard renders a picture of data instead of numbers or words, or a text mining tool renders the aggregate analysis of search and affinity algorithms from a logical process).

Applications also consist of logical processing flows that are not inherently deployed for human consumption, but rather instruct the computing environment on how to manipulate information assets.

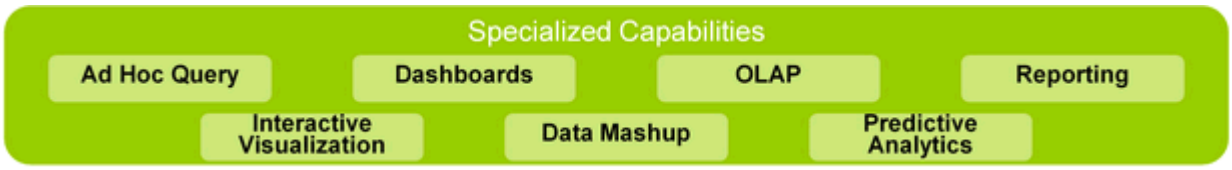
- **Write/put flows** in an application are concerned with assuring that information from a capture service is written to a repository, a temporary object or even a document or string. Write/put

also addresses a level of assurance that metadata describing the documented information is available to subsequent user cases.

- **Read/get flows** describe the types and nature of information desired, which are then supplied to presentation or evaluation services. Red/get is also concerned with the qualification of information and its suitability to purpose. These services pass parameters regarding data quality desired, fidelity of the information and more to the common capabilities services and match the metadata description of the request with the metadata descriptions of the information assets provided, and in this manner create a form of contract.
- **Evaluation flows** form the heart of an application. Capture, presentation, write and read all feed into evaluation services, which determine the outcome of how information will be formally processed. Some evaluation flows infer new data points or create summaries and aggregates. Other evaluation services actually direct the interface services toward their next action (get more data, present data, and so on). Evaluation services are the location for business process logic in operational applications and the home for query and analysis construction in analytics applications.

Figures 6 and 7 detail the specialized services for the BI and transactional use cases. Future research notes will go into these in detail.

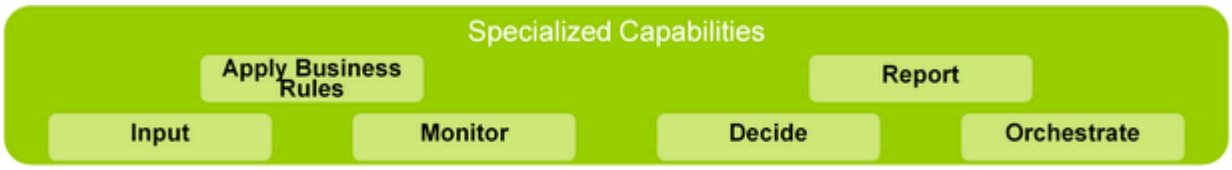
Figure 6. ICF: Specialized Capabilities for Structured Analytics Use Cases



OLAP = online analytical processing

Source: Gartner (September 2011)

Figure 7. ICF Specialized Capabilities for Transactional Use Cases



Source: Gartner (September 2011)

Information Use Cases

As information volume, velocity, variety and complexity increases, the ability to use information to support various use cases grows increasingly complex. Traditionally, information was produced and consumed by transaction-centric and content-centric business applications in the course of a business process. When necessary, information resided within the applications, and when necessary, a copy was extracted, transformed and loaded into a data warehouse for reporting and analysis or in a point-to-point fashion for application integration support. In the case of content-centric information, the content was stored in a content repository. In both cases, the information was not considered an asset in its own right — but rather a byproduct of the business process, owned by the application.

This attitude toward information is no longer tenable. First, much of it (for example, social networking information) is not produced within the confines of the enterprise. Second, consumption happens outside of traditional application boundaries. For example, the business wants analytics on mobile devices so that associates in the field have up-to-date information at their fingertips, and line managers want to perform real-time analysis on operational data on their media tablets. Third, enterprises increasingly want to expose and share their own information with partners and suppliers in order to drive value from external insights and to link their information with other sources that they might not readily have discovered on their own. Organizations such as the Environmental Protection Agency (EPA), for example, routinely make raw data on air quality and emissions available to the public at large — in the hopes that the EPA will benefit from analyses performed on the data by unaffiliated scientists and academics. Obviously, this creates additional concerns around privacy and security. And finally, there's a need to mash up information from different sources — for example, data from blogs and streaming social sources like Twitter with order history and customer information.

As a result, information in the 21st century will be consumed, sourced and produced in a variety and growing number of different use cases that leverage structured information, content-specific or hybrid (see Figure 8).

Figure 8. Categories of Information Consumption Use Cases

Source: Gartner (September 2011)

On the structured information side, use cases include improving supply-chain processes, managing master data and so on. Managing corporate performance is also an important analytical use case. On the content information side, the most recent interest includes optimizing online channel customer interactions, social content analysis, improving case management and so on. New emerging analytical use cases include pattern seeking and discovery, and rich content analytics. A combination of hybrid use cases leveraging structured information and content are also emerging;

for example, where need is improving customer loyalty and intimacy of the mobile user by offering contextual services based on location, time and preferences, and social content.

Bottom Line

The benefits of this new approach to information management based on the information capabilities framework are multiple; some examples are as follows:

- Enable business growth by:
  - Improving the timeliness and quality of decision making through access to a more comprehensive set of information sources.
  - Improving the agility of enterprise processes for new context-aware products/service introduction.
  - Improving the ability to predict new opportunities or challenges through pattern seeking, matching and discovery.
- Reduce/manage risk by:
  - Improving enterprise compliance with regulations and policies through improved information quality and governance.
- Reduce cost by:
  - Reducing the cost of storing, locating and mashing information through the information continuum.

Recommended Reading

"Defining the Scope of Metadata Management for the Information Capabilities Framework"

"The Information Capabilities Framework: An Aligned Vision for Information Infrastructure"

"Information Management in the 21st Century Is About All Kinds of Semantics"

"How to Use (And Not Use) Gartner's Information Capabilities Framework"

"Does the 21st-Century "Big Data" Warehouse Mean the End of the Enterprise Data Warehouse?"

"Organizing for Information Governance"

Note 1 Gartner's ICF Definitions

Gartner's **information capabilities framework (ICF)** is the collection of technical capabilities required to create business value from information assets. It is a conceptual model that is people, process and technology independent and allows IT leaders to think holistically about the capabilities

required to describe, organize, integrate, share and govern information in an application-independent manner. It is independent of use case and information source and does not rely on, nor advocate, any technology or architectural style. However, it does take into account the specifics of use cases.

An **"information capability"** is a representation of the actions needed for the information to be used, treated, organized or developed for the general management of, and for specific purposes throughout, the organization.

An **"information use case"** represents the usage of information throughout the organization to create business value.

The ICF's **common capabilities layer** provides the range of functionalities used to describe, organize, integrate, share and govern the information, and the capabilities required to interact with physical data stores (operate), to prepare the information for consumption (provision) and to increase the value of the information by making it more easily used and found, and by providing context (enrich).

The ICF's **information semantic styles layer** provides the specific entry or "gate" into information management functions or capabilities. These services follow styles or approaches that support specific assumptions on how an application interacts with the data it uses.

The ICF's **specialized capabilities layer** deals with the range of functionalities used to support use-case-specific requirements.

This is part of three sets of related research. See the following for an overview:

- Roundup of Master Data Management and Related Research, 4Q11
- Information and the Nexus of Forces: Delivering and Analyzing Data
- Information Innovation: The Art of the Possible

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