

Building enterprise architectures with TOGAF 9



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Overview

Enterprise architecture (EA) is an enabling discipline that allows you to intelligently plan for improvements to your organization while understanding the impact and risk associated with changes. EA is often targeted at specific areas of an organization to achieve better planning and a return on investment (ROI) and, after success is achieved, is spread to other areas or concerns. Organizations leverage EA to address business challenges including:

- **Business efficiency**—Improve transparency of your business operations, enhance business operations and support compliance.
- **IT planning and optimization**—Enhance the efficiency of your application portfolio; offer greater return on assets and investments and facilitate reuse; enable a greener organization and reduce costs through server consolidation, and improve business resiliency by implementing an effective disaster recovery plan.
- **Enterprise resource planning (ERP) governance**—Open up the “black box” of your ERP systems to intelligently plan business transformation that relies on those systems.
- **Service architectures**—Map business needs to IT applications and services and determine the optimal software services implementation method.
- **Manage outsourced relationships**—Provide concrete means to ensure that vendors and partners develop designs as per architecture constraints and validate that the delivered applications meet the original requirements and architecture designs.



Your organization can also use EA to improve internal communication and increase efficiency enterprise-wide. In short, EA can help you to run a more effective, efficient organization.

The Open Group Architecture Framework (TOGAF) gives you a detailed guide on how to build and maintain an EA. TOGAF consists of a framework for categorizing what you need to capture about the enterprise and a proven method, called the Architecture Development Method (ADM), to help you develop, implement and maintain the EA. TOGAF guides you through key areas of concern for EA, such as architecture principles, patterns, gap analysis, migration planning, risk management and architecture governance.

IBM® Rational® software provides technologies and tools to help you enable an EA that delivers improved ROI. At the core of the offering is IBM Rational System Architect® software, an EA tool that provides a platform to help you visualize, analyze and communicate your organization's EA. Integrations to other key tools in the Rational product portfolio can help enable you to leverage your effort and more easily harvest and examine existing information in your enterprise, perform trade-off analysis, produce dashboards to provide data that addresses questions about the enterprise, and communicate that information to a wide audience.

This white paper describes how TOGAF and ADM, in conjunction with Rational System Architect software and its integrated IBM Rational tools, can be used to help you successfully capitalize on EA to solve business challenges.

TOGAF: A proven way to develop, maintain and gain value from an EA

TOGAF is a widely accepted framework and method for developing an EA. Created by The Open Group (www.theopengroup.org), TOGAF provides an open framework that is the result of continual contributions from a large number of architecture practitioners in The Open Group's Architecture Forum. On its website, The Open Group freely disseminates and encourages use of the TOGAF specification and all related documentation. Because TOGAF is highly customizable, companies can tailor it to their particular challenges.

TOGAF Version 9 (TOGAF 9) provides a wide-ranging set of revisions to the TOGAF specification that improve its value. Most notably, TOGAF 9 introduces:

- A core content metamodel of information object types to capture.
- The interrelationships between those object types.
- Viewpoints that specify the common models and matrices you should create at each phase of the ADM to help ensure that EA efforts share a common set of views.

TOGAF's two main components

TOGAF has two main components: the framework with its ADM and the Enterprise Continuum. As mentioned previously, the ADM is a detailed, step-by-step method on how to build, maintain and implement an EA. The ADM graphic is a set of circles—which represent the major phases of building and maintaining the EA using ADM—that shows the progression through the phases of the ADM and the architecture models you use and create during the phases of EA development. You navigate the phases iteratively in a cycle.

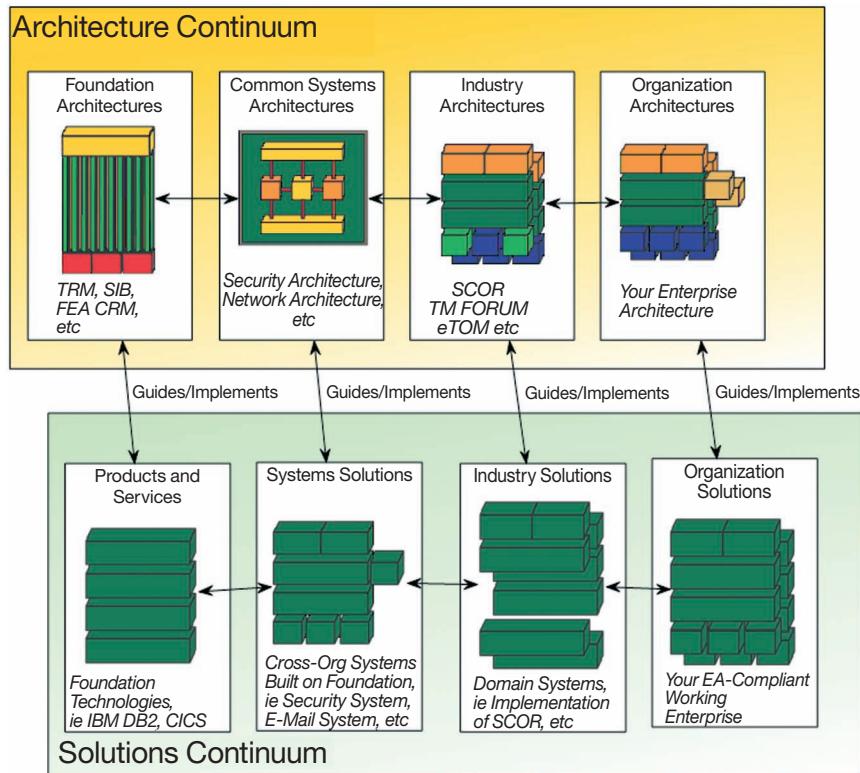


Figure 1: The TOGAF Enterprise Continuum shows the progression that leads to the increasing refinement of the organization-specific architecture

The Enterprise Continuum

While the ADM specifies a process for building an EA, the Enterprise Continuum (Figure 1) is a philosophy for developing an EA with reusable architecture building blocks (ABBs) and solution building blocks (SBBs) in a continuous, iterative and incremental fashion. A building block is simply a grouping of

functionalities that addresses business needs. An ABB is described with a general level of detail. For example, an ABB might be specified as an online database and the application used to access it. Later on in the ADM, you add information to ABBs to create SBBs, which reflect real solution products.

The Enterprise Continuum is composed of the Architecture Continuum, which provides guidance, direction and support to use the Solutions Continuum (below it) to build your particular technology architecture. You build your architecture by navigating the two continuums, from left to right, top to bottom, so that you are specifying architecture building blocks at each phase and then the solution building blocks that implement them. Next, continuing right, you build on your solution and add increasing detail. The TOGAF ADM guides you through the left-to-right progression from the general architectures and solutions (on the left) to organization-specific ones (on the right).

You base your architecture on a foundation architecture, which specifies the taxonomy of functions and services that your organization supports. You can use TOGAF's Technical Reference Model (TRM), or other industry reference models such as the U.S. Federal Enterprise Architecture (FEA) Reference Models as a guide. You add more precision to that foundation architecture by specifying common systems architectures in use (for example, a generic security architecture) and industry-specific architectures in use (for example, the Supply Chain Council's Supply Chain Operations Reference model (SCOR), the TeleManagement (TM) Forum's Business Process Framework (eTOM) and Information Framework (SID), etc.) to reach the architecture specific to your organization (on the right). The Solutions Continuum defines the solutions that deliver your architecture, which include off-the-shelf solutions and your organization's own custom solutions.

Creating ABBs and SBBs

With Rational System Architect software, ABBs and SBBs are provided as definition types. You can group aspects of the architecture into an ABB, for example, business policies, models representing parts of the architecture (database models, network diagrams and so on), standards, other ABBs and SBBs.

The ADM

The ADM is the TOGAF method. You iterate through phases of the ADM, from phase A (architecture vision) through phase H (managing changes to your EA), and in between, you build your business, information systems and technology architectures—aligning them at all times with your business requirements and goals. During the first four phases of the ADM, you architect the plan on improving your organization so that it is doing the right thing (see Figure 2). During the later phases of the ADM, during which you implement changes to the organization based on the architecture, you are building solution delivery so that your organization does things right.

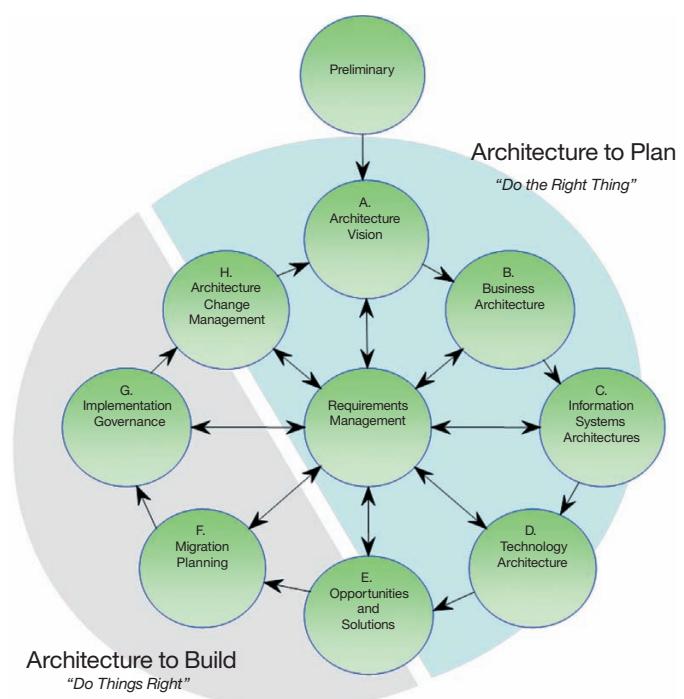


Figure 2: TOGAF ADM

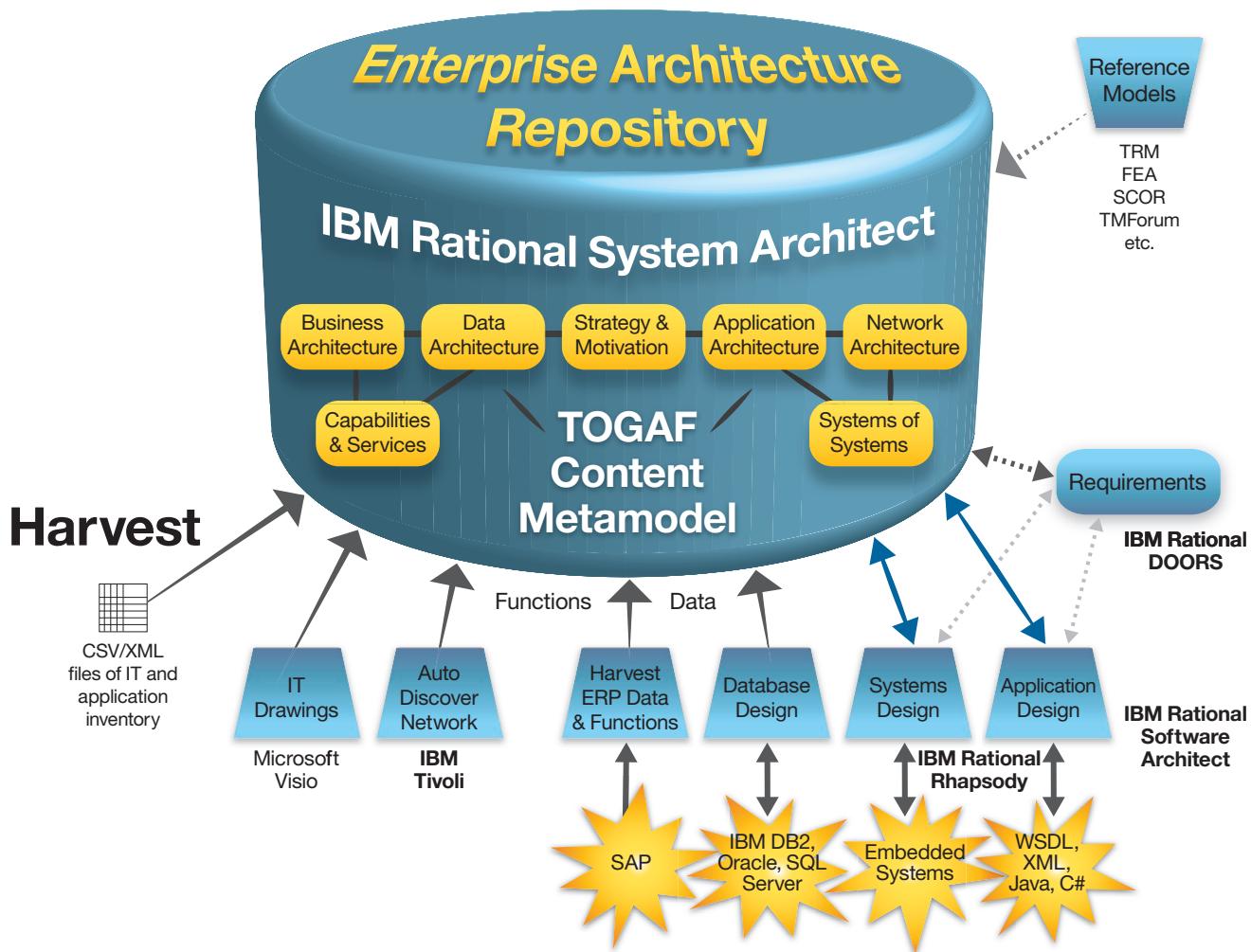


Figure 3: The enterprise architecture repository supports the TOGAF content metamodel as the template for information capture. Information already existing in the organization can be harvested in a variety of ways, and reference models used to jump start the architecture effort. The content metamodel is often customized so that information can “find a home.”

Preliminary framework and principles

In the preliminary phase, TOGAF instructs you to establish the scope of your enterprise architecture effort, to determine how much information you will capture, how you will maintain it, how you will use it, and what kind of management buy-in you

need to secure. Although TOGAF seems to present a top-down approach, in practice organizations implement portions of it through their own prioritized order, which can produce a bottom-up approach—such as tackling application portfolio management first. It's in this phase that the priority and scope of the overall effort is established.

Phase A—Architecture vision

In phase A of the ADM, you add more detail to the work you started in the preliminary phase. To gain formal sponsorship for your architecture effort, you develop a request for architecture work and create a summary view of what the architecture will do. You can create a picture of this with a value chain diagram (a high-level view of the enterprise and how it interacts with the outside world) or a solution concept diagram (a high-level sketch of the architecture solutions that address specific initiatives). During this phase, you begin your investigative work—searching for existing authoritative sources of information to harvest into your architecture—spreadsheets of applications, servers, and databases from your IT department; processes that have been documented; standards in use, and so forth.

Establishing the architecture metamodel

Rational System Architect software helps you to capture the information that TOGAF 9's content metamodel prescribes in a repository, which is a database on Microsoft SQL Server or Oracle. The repository provides robust storage, multiuser access, and SQL reporting, utilized to “question” the architecture by running analytic reports. The interrelated artifact types of the content metamodel help you to describe your business architecture, data architecture, application architecture, network architecture, strategy and motivation, capabilities, services, and systems (see Figure 3).

Once you have discovered authoritative sources of information to harvest into your architecture, you will need to customize the TOGAF metamodel in the architecture tool, so that the properties and types of information match. You may need to add properties to the information templates (definitions) or create brand new definition templates with interrelationships to capture exactly what you need for your organization. Almost every architecture effort requires metamodel customization near the start of the project to allow for capture of information that is specific to that organization.

CSV or XML files can be imported into the tool, and there are other options for harvesting information in the organization—you might use the tool's ability to reverse engineer database architectures (IBM DB2®, SQL Server, and Oracle supported), use add-on integrations to reverse business process and data architecture information from SAP or other ERP systems, import Microsoft Visio drawings, or use an integration to the IBM Tivoli® Application Dependency Discovery Manager tool to sniff out the network architecture and bring it into the architecture. IBM's other modeling tools—IBM Rational Rhapsody® and IBM Rational Software Architect (RSA) software can be used to reverse engineer applications or industry patterns. Requirements can be captured in the architecture or in a requirements management tool such as IBM Rational DOORS® software, and integrated with the architecture. To build integrations to other best-in-breed tools, users can use Microsoft Visual Basic for Applications, built into Rational System Architect software, with a published application programming interface (API), or the tool's Representational State Transfer (REST) interface. In all cases it is important to establish what the source of record will be and how often the enterprise architecture is refreshed from that source.

Reference Models can be used to establish the foundation architecture. The FEA reference model add-in for Rational System Architect software can be used to import the latest FEA Reference models into the repository, populating it with the standard business functions, services, data, technologies and standards that government agencies in the United States must adhere to. This reference model is popularly used by commercial companies as well.

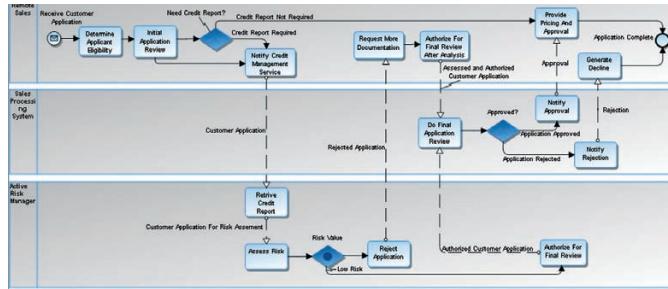


Figure 4: A sample BPMN diagram shows process flow in swim lanes, which represent the part of the organization that performs a process. Sequence flows are drawn between processes in a lane; dashed message flows that are drawn between processes in different lanes carry data.

Phase B—Business architecture

Phase B guides you on establishing your business architecture. On the first iteration through this phase, you describe the baseline business architecture to the extent necessary to support the target business architecture. According to TOGAF, it is unnecessary to go into unwarranted detail about the as-is architecture if it will not form the basis of the future architecture.

From this phase forward, information is added to the repository by EA teams on the network, and you can engage a larger audience to contribute to the EA through a web-based, thin-browser interface to the repository called SA/XT (for eXtended Team).

The business architecture captures the following:

- **Business processes**—Leverage Business Process Modeling Notation (BPMN) to outline workflow processes (Figure 4).
- **Organizational structure**—Use organizational charts and correlate *who* does *what* with swimlanes on BPMN diagrams. Capture lines of command, employee roles and responsibilities, and skill sets.
- **Business goals and objectives**—Align the goals and objectives of your organization to the rest of the architecture to capture *why* you are doing what you’re doing. The industry standard Business Motivation Model (BMM) of the Object Management Group (OMG) helps you use a common language to realize the ends and the means of business strategy.
- **Business functions**—Use functional decomposition to specify your organization’s basic business functions, such as marketing and product development, and align that to *how* things get done via business processes.
- **Business services**—Outline the services that your business provides to external and internal customers.

Later, as you iterate through the TOGAF phases again to build your to-be architecture, you build the business architecture that supports your future needs. By comparing as-is and to-be business architectures and performing a gap analysis, you can determine where the architecture falls short of stakeholder concerns.

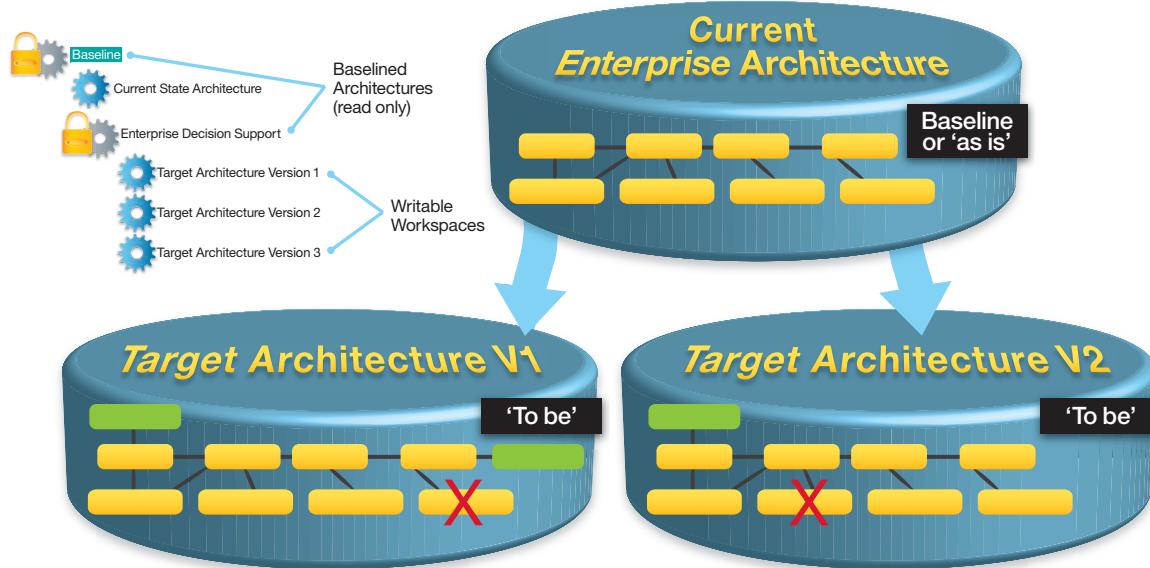


Figure 5: Upon opening a repository in Rational System Architect software, you choose in what workspace to work; each workspace provides a versioned layer of the architecture.

Workspaces for as-is and to-be modeling

Rational System Architect software provides workspaces as an enabling technology of current and future state architectures. With workspaces, you can create versioned layers of your architecture in the repository and work in any of those alternate versions. You can make a workspace a baseline at any point, which makes it read only and enables you to create one or more target, writable versions as side-by-side layers on top of it. As you work in a target version, you can access the entire baselined architecture, which you can edit, add to, and delete from. At some point you may create a new baseline from a target architecture. You can compare baseline to target architectures or target architectures against one another. TOGAF identifies three basic types of architectures: baseline, transitional and target. Workspaces enable you to follow TOGAF guidance to move from baseline to target via transitional (or scenario) architectures, making comparisons between those transitional architectures to determine the optimal choice for your target architecture.

Phase C—Information systems architectures

In Phase C, TOGAF describes detailed steps for defining your data and application architecture. Application architecture includes your application portfolio and the applications in place that can process the data and support your business.

TOGAF suggests a range of models to establish viewpoints of phase C—for data architecture these include classic relational data models, data dissemination diagrams (within which you show the relationships between data entities, business services and application components), data security diagrams (which show who in the organization has access to data), and data migration diagrams (which illustrate the flow of data between applications). Application architecture includes your application portfolio catalog and various application landscape diagrams, providing a global picture of functions, the applications that provide them, the technologies they use, their locations, and who uses them).

Rational System Architect software provides cause-effect Explorer diagrams, which automatically visualize relationships between architecture artifacts. Underneath the covers, a SQL report query is run; it can show direct relationships and indirect relationships—so if a function is provided by an application on a server at a location, you can visualize just the functions and their locations, or you can visualize the full cause-effect chain.

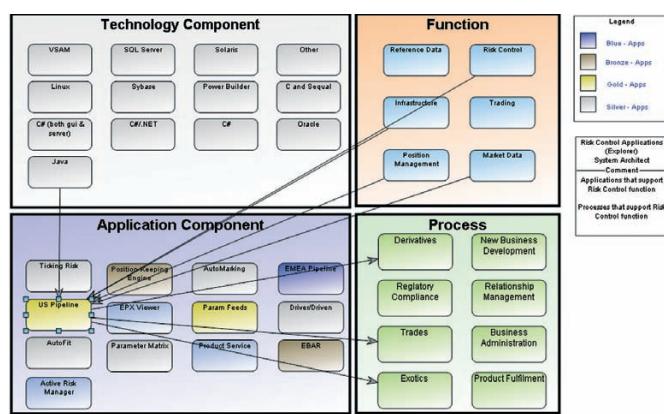


Figure 6: Cause-effect “Explorer” diagram enables you to click on a symbol and see what’s related to it—in this case the technology components, functions, and processes associated with an application. In this case, if a change in technology is mandated, you can see what applications use that technology, and what business impact it might have.

Phase D—Technology architecture

This phase is represented by its mini framework and details how to architect the technology underpinnings of your organization. This includes networked computing and hardware views, communications views, processing views, cost views and standards views. You can select the services that each ABB provides and refine the ABBs, choosing the standards and specifications to which your technology must adhere, wherein they become SBBs.

Viewpoints of phase D

At phase D you capture your technology standards, application and technology portfolios, and network architecture in models such as the environments and locations diagram (which shows the technologies used and locations of hosted applications) and the platform decomposition diagram. Automation can help you capture the current network architecture—use automated discovery tools to query the network and find what servers exist where and bring that information into the EA repository where you can align it with the applications, business processes, services, data and other aspects of the EA.



Figure 7: Landscape-style “Explorer” diagram is auto built to show locations, servers, and applications hosted. An analytic is run against applications to show if a Disaster Recovery (DR) plan is in place—autocoloring the app to show the status of its DR plan, from red (no plan) to green (plan in place and fully tested). Such a diagram is often called a heatmap.

Phase E—Opportunities and solutions

In this phase, you examine the baseline versus target architectures to determine any opportunities for improvement within your organization. You plan projects using the ABB that will help you realize your target architecture and specify whether

your projects require reuse of an existing system, new development or a purchase. Additionally, you ask questions such as the following:

- What are the business priorities?
- What business/technology assets do you have?
- What is unnecessary, redundant or obsolete?
- Where can you cut costs?
- Which business processes work well?

Enabling technologies for phase E

Bringing the enterprise architecture information into a business intelligence tool enables you to marry that information with non-architectural information such as costing, and use the BI tool's reporting functions to produce dashboards that executives can analyze. IBM Cognos® Business Intelligence software is

bundled with Rational System Architect software to enable you to query across workspaces and produce dashboards that detail how versions of architecture differ across the aspects that you wish to measure. The EA information becomes something that senior management can easily digest and use to develop high-level implementation plans.

Phase F—Migration planning

During migration planning, you take a harder look at the priority order of potential projects to transition to your target architecture, taking into account nonarchitectural, real-world implications such as short-term payoff (to create impetus for proceeding), technical issues, organizational behavior implications, and so on. You may perform cost–benefit analysis that weighs user importance against cost, development times and available resources, or build-versus-buy risk analysis. The output of this phase is a detailed implementation/migration plan.

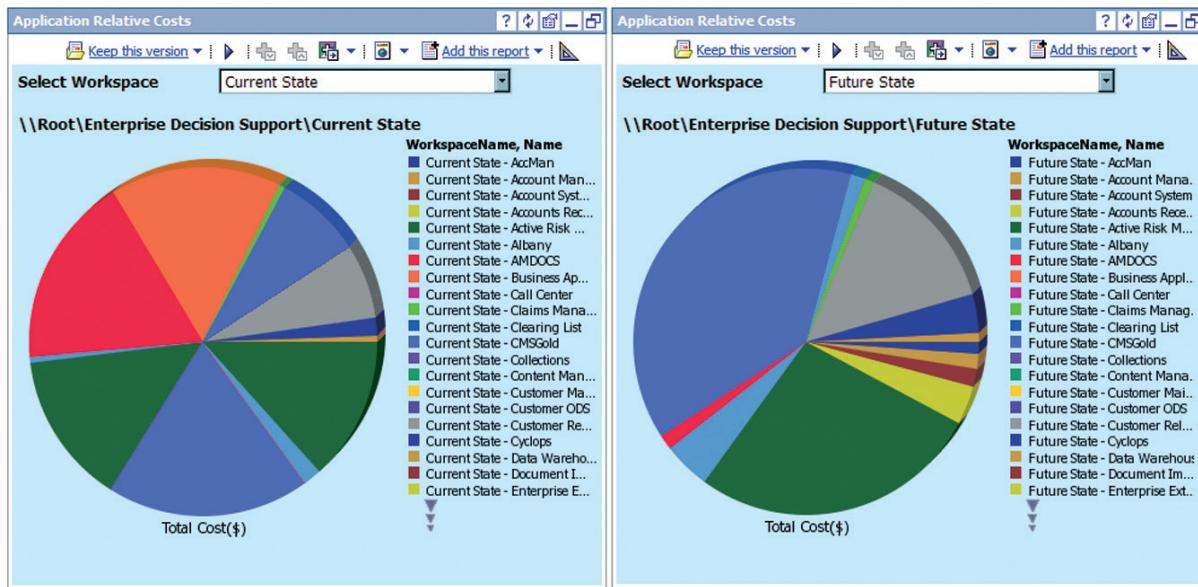


Figure 8: Marrying the EA information with costs in IBM Cognos Business Intelligence software allows you to analyze costs of applications in the current and future-state architecture.

Portfolio management and road mapping

BI and portfolio management tools complement EA information to help you examine architecture elements from nonarchitectural perspectives and prioritize and plan changes accordingly. Rational System Architect software offers tight, bidirectional integration with IBM Rational Focal Point™ software. The resulting capabilities help you to put your architecture information into Rational Focal Point software and add nonarchitectural information to it (such as risk, cost, development times, resources available, user preferences for function, performance scores of existing applications and so on).

This information can come from other sources of record, or you can harvest it from the workforce using Rational Focal Point software as an information-gathering tool—for example, you can enable users to share feedback about their preferences or opinions on the applications that they use. This helps increase bidirectional communication with your users (as they see that their feedback is being taken into account) and provides you with valuable information on the real workings of the organization.

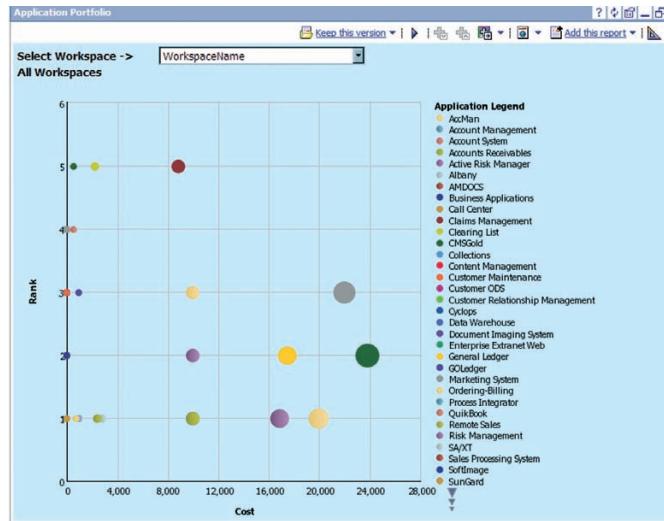


Figure 9: Bubble-chart in IBM Cognos Business Intelligence software (also available in Rational Focal Point software) shows architecture data married with nonarchitectural data, in this case applications' strategic rank plotted vs. cost, with size of bubble indicating number of users.

Taking this approach, you can examine architecture elements in relation to these other perspectives. To determine priority order, you can plot projects against one another and weight them based on cost, bandwidth needed or importance. You can do the same for other architectural elements, including applications, functions, processes, goals and objectives; bring priority rankings back into the architecture in the EA repository; and display them by automatically coloring or applying informational icons to the architecture elements. You might also create roadmaps of projects or applications over time, comparing the cost of implementing a project with its long-term payoff. You might also create roadmaps of projects or applications over time, comparing the cost of implementing a project with its long-term payoff (see Figure 10).

Phase G—Implementation governance

In phase G, you implement and govern the projects that you have prioritized and approved to deliver solutions. Implementation governance is a subset of ongoing governance of changes to the overall architecture, described in phase H below.

Phase H—Architecture change management

One of the most important factors in creating a thriving, well-used EA is to make sure it reflects the current business, even though that business is constantly evolving, whether in the form of business change (mergers and acquisitions, reorganizations, new policies and procedures) or technological change. If your architecture reflects yesterday's organization, then no one will trust it or use it. The ADM provides strategies and suggestions for this ongoing phase, including recommending a governance process for change so that your architecture provides detail at a level sufficient enough to provide business value, and you avoid creeping elegance—too much detail that makes the architecture harder to maintain.

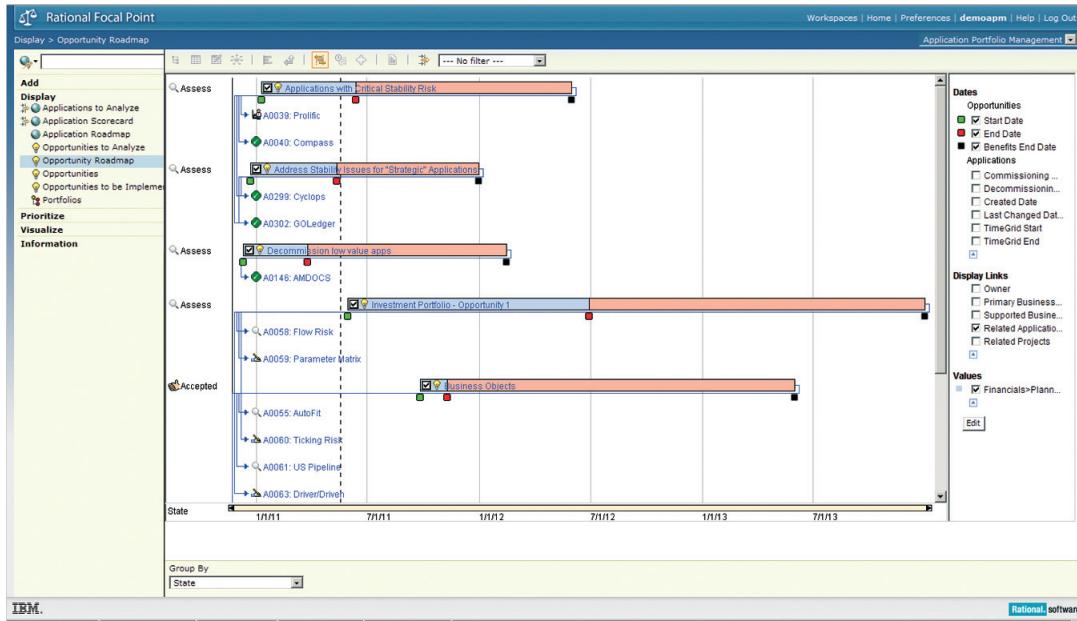


Figure 10: Architectural information married with nonarchitectural information in Rational Focal Point software: roadmap of projects plotted against time, from start date to end date; the blue indicates cost to develop; the red how long benefits will be garnered from the project.

Governing EA together with asset management

Ensuring that individual assets and projects *comply* with the enterprise architecture, and that the EA references the latest versions of those assets, is an essential aspect of architecture governance. One powerful technique used to address this challenge is an asset management strategy. Using IBM Rational Asset Manager software, you can create a definitive asset library that allows you to manage and govern those assets. You can specify compliance levels of the relationship between the architecture and the implementation—for example, irrelevant, consistent, compliant, conformant, fully conformant and

nonconformant—and then use governance features in Rational Asset Manager software to institute an architecture compliance review process on both the EA artifacts and the related assets. The governance process can consist of life-cycle workflows, reviews, approvals, policies and audit trails. Because the assets in the library can be searched, rated and discussed, all stakeholders can provide input into the decision-making process for an asset. Rational Asset Manager software policies can also discover and automatically notify Rational System Architect software about newly added assets that are not connected to EA assets, and you can update the EA accordingly.

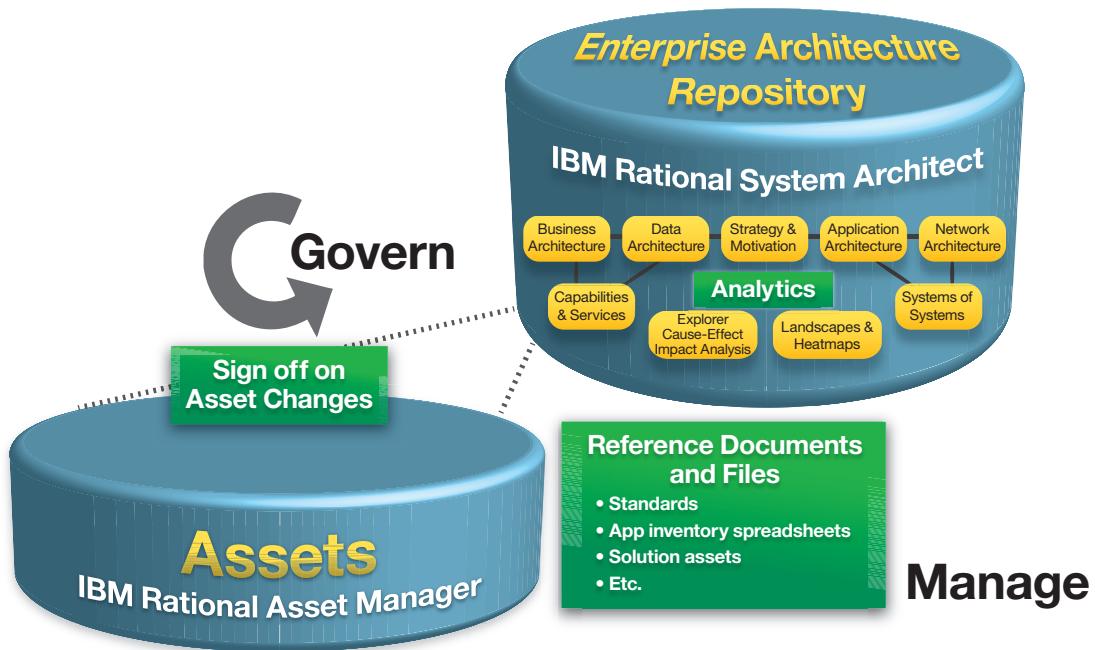


Figure 11: IBM Rational Asset Manager (RAM) software is used to identify solution assets, reference them to/from the EA, govern those assets, and alert the EA when there are changes to the state of those assets.

TOGAF: Key to a competitive advantage

Enterprise architecture is an effective tool to help you address business challenges including business efficiency and transformation, IT planning, consolidation of servers and application portfolios, ERP governance, service architectures, outsourcing management, and system-of-systems architectures. TOGAF 9 is a proven framework and method that guides you in building and maintaining an EA.

A number of technology enablers bring TOGAF 9 to life, such as repository-based EA tooling integrated with an ecosystem of tools to help you automatically capture, process and communicate architecture information. This tool-and-methodology combination can enable your organization to use EA to plan and transition to a more efficient and competitive organization and to make better decisions about technology investments and business process improvements.

Why IBM?

The Rational software portfolio includes tools that can help you manage the development life cycle—from defining and managing requirements; enterprise architecture, systems architecture and software architectures; to software configuration and change management, software build management, and quality management. You can benefit from the wide range of software and systems development capabilities available through the Rational software portfolio as well as from the support of the Rational software professional services team and the IBM Global Services organization. IBM Rational offers unique training options including a combination tool and methodology course for using Rational System Architect software with TOGAF 9. IBM and IBM Rational tools include:

- *IBM Rational System Architect* software and suite of add-ons for EA. This includes Rational System Architect XT software, Rational System Architect Publisher Add On software, and other add-ons for ERP governance and simulation.
- *IBM Cognos* software for business intelligence reporting
- *IBM Rational Focal Point* software for product portfolio management
- *IBM Rational Asset Manager* software for asset management
- *IBM Rational Software Architect* software for solutions architecture development
- *IBM Rational Rhapsody* software for embedded systems design
- *IBM Rational DOORS* and *IBM Rational RequisitePro®* software for requirements management
- *IBM Rational Change* and *IBM Rational ClearQuest®* software for configuration management
- *IBM Rational Publishing Engine* software for cross-product reporting
- *IBM Rational Insight®* software for cross-product business intelligence reporting
- *IBM Tivoli* software for network autodiscovery and management
- *IBM WebSphere®* and *IBM WebSphere Business Modeler* software for business process execution
- *IBM Jazz™ technology*, a platform for collaborative software delivery that is designed to transform how people work together to build software, making software delivery more collaborative, productive and transparent.

Notes

For more information

To evaluate Rational System Architect software and its TOGAF support, contact your IBM sales representative or IBM Business Partner, or visit:
ibm.com/developerworks/downloads/r/systemarchitect/learn.html

To download the latest version of TOGAF, visit:
www.opengroup.org/architecture/togaf9-doc/arch

Additionally, financing solutions from IBM Global Financing can enable effective cash management, protection from technology obsolescence, improved total cost of ownership and return on investment. Also, our Global Asset Recovery Services help address environmental concerns with new, more energy-efficient solutions. For more information on IBM Global Financing, visit: ibm.com/financing



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