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Article

The Importance of Formal Documentation In Enterprise Architectures

By Scott Bernard

Abstract

While Enterprise Architecture (EA) continues to move forward in its recognition as a meta-approach to understanding and documenting enterprises of various types in all dimensions (strategic, business, and technology). This article discusses the elements of a complete approach to EA, focusing on the documentation element. Examples of EA documentation from the EA3 'Cube' approach are presented to show how various types of models and other artifacts are needed to fully cover the associated EA framework. Two new types of composite artifacts are also introduced – the 'storyboard' that shows all aspects of a service or process, and a 'horse blanket' that holistically depicts an enterprise-wide architecture. The article concludes with a call for more standards for EA documentation and more advanced types of EA models.

Keywords

Enterprise Architecture, Documentation, Artifact, Meta-model, Storyboard, Horse Blanket

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INTRODUCTION

This article builds on a previous article on "Using Metamodels to Improve Enterprise Architecture" (Uzzle, 2009). While Enterprise Architecture (EA) continues to move forward in its recognition as a meta-approach to understanding and documenting enterprises of various types in all dimensions - strategic, business, and technology (Bernard, 2005; Ross et al, 2006), there is a relative lack of progress in developing both basic and complex models of the various elements of the architecture (e.g., sub-architectures, segments, workflows, and systems), as well as the entire architecture. These models are one of the forms of documentation (sometimes called "artifacts") that are associated with

John Zachman (1989, 1992) called basic or single-purpose models "primitive" and combinations of primitive models "composites." Zachman emphasized the importance of developing and maintaining the entire set of basic models across all areas of his framework, which documented an enterprise in its entirety using both interrogative descriptors (who, what, where, when, why, and how) and functional descriptors (data, function, network, time, motivation, and organization). Zachman believes, and I agree, that to be able to understand and then engineer or re-engineer an enterprise that models must not only be developed in all functional areas of an architecture framework, but the models must be decomposed to various levels of detail in order for the architecture to be useful for analysis, planning, and decision-making.

Several types of architecture frameworks designate specific types of formal documentation including particular models in various areas of the architecture. These include the Zachman Framework (beginning in 1989), the Department of Defense Architecture Framework (beginning in 1989 as the "C4ISR Framework), the Federal EA Framework (beginning in 1999, uses Zachman artifacts), the EA3 Cube Framework (beginning in 2004) and The Open Group Architecture Framework (beginning in 2006).

Of these approaches, the Department of Defense Architecture Framework (DODAF) has a particularly well integrated set of artifacts, though to date this approach has mostly been used to document system- level architectures.

DOCUMENTATION AND THE OVERALL ARCHITECTURE APPROACH

One of the most important facets in gauging the effectiveness of a particular EA framework is the "completeness" of the overall approach. This includes the presence of integrated elements in the approach for governance, methodology, framework, documentation, repository/tools, associated best practices, and program auditing (Bernard and Grasso, 2009). Figure 1 shows the relationship of these elements.

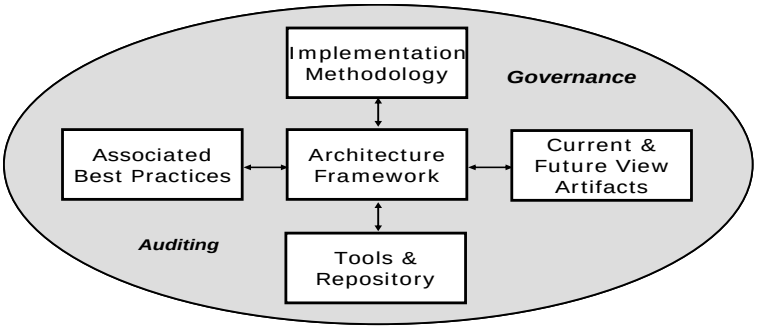


Figure 1. Elements of a Complete Approach to Enterprise Architecture

The documentation element is particularly important, as this is where the various types of artifacts are specified, including reports, charts, spreadsheets, diagrams, matrices, photos, blueprints, various types of models, and other media files. One of the key considerations in ensuring that the architecture documentation fully supports the framework is for the approach to provide all of the types of artifacts that are required to fully cover all of the areas of the architecture at the strategic, business, and technology sub-levels, as well as the ubiquitous areas such as security, standards, and workforce. Figure 3 provides an example of the relationship of the major elements of the EA3 approach.

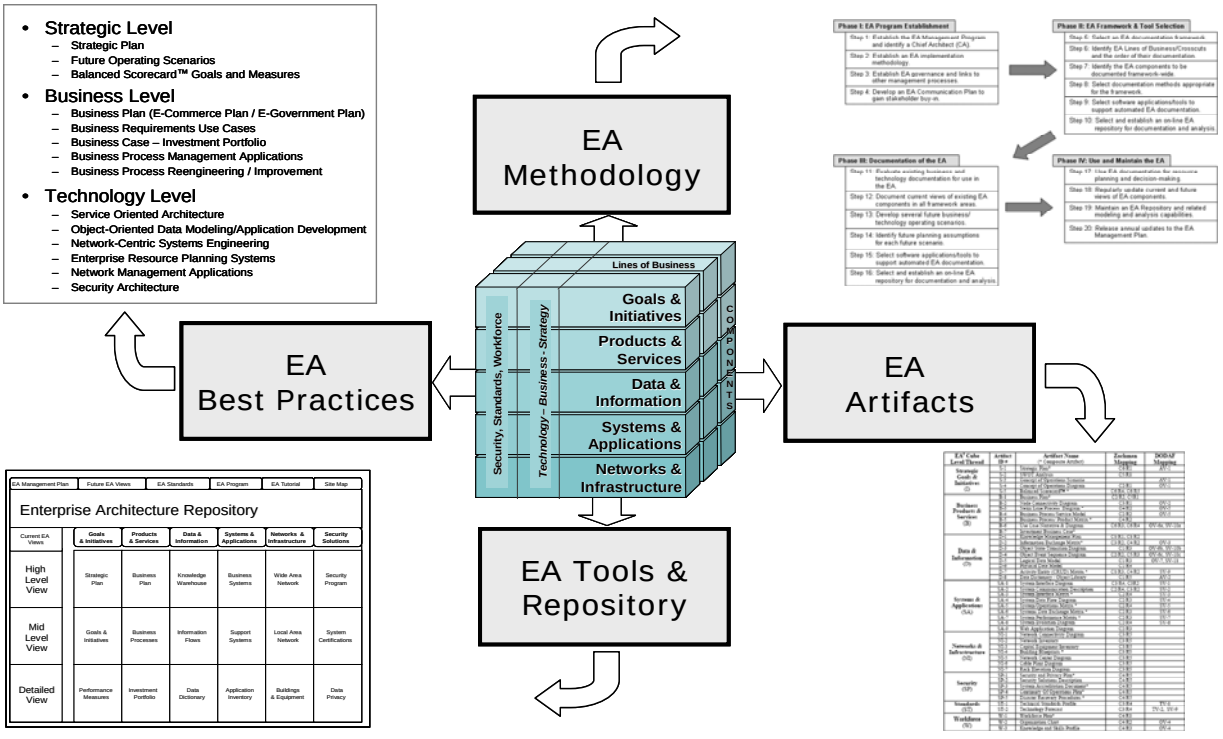


Figure 2. Example of A Complete Approach to Enterprise Architecture

The Role of Metamodels in EA Documentation

In the abstract, a metamodel consists of concepts and their interrelationships. A metamodel, for an actual EA, must specify how the EA concepts and interrelationships are represented. For many organizations, much of the metamodel may be determined by the environment. A framework and one or more tools may already be in place. Defining an explicit metamodel can help to unify an EA program and can provide the benefits outlined previously (Uzzle 2009). The metamodel connects all of the EA artifacts in an approach, an example of which is shown in Figure 3 (Uzzle, 2009).

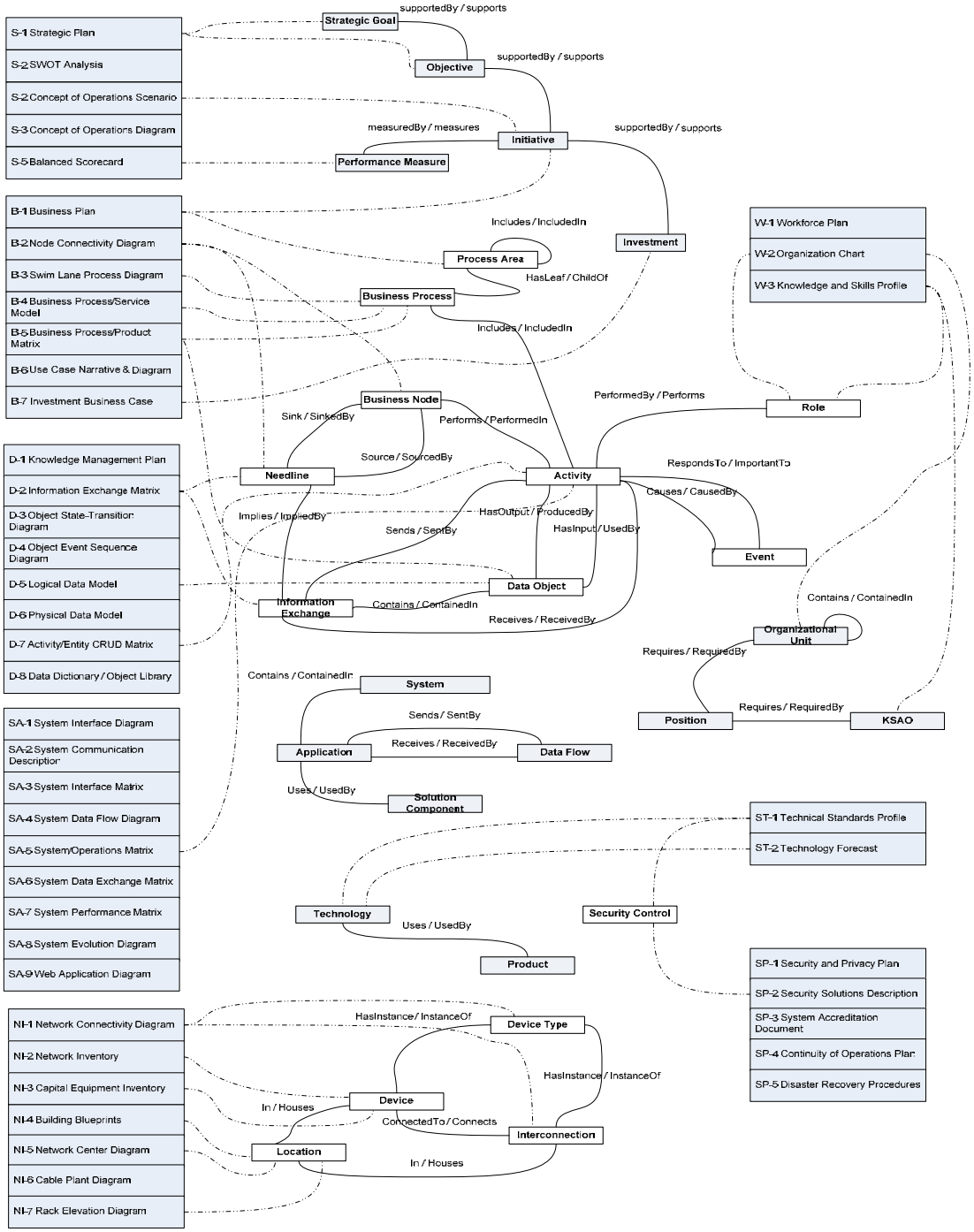
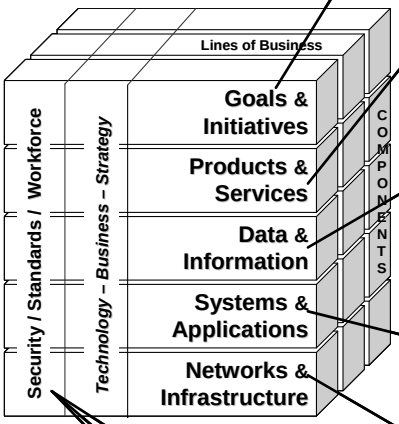


Figure 3. Metamodel of Artifact Relationships in the EA3 Cube Approach

Relating Artifacts to an EA Framework

As has been mentioned, it is important for the documentation/artifact set for an EA approach to fully cover all areas of the approach. This includes all of the artifacts that are needed to document strategic priorities and direction, business activities and workflow, technology solutions, standards, security controls, and knowledge and skill requirements for the workforce throughout the enterprise. To continue with the example approach being used in this article (the EA3 Cube Framework and approach), there are 46 types of artifacts that are called for in this approach, that relate to specific sub-architecture areas, as is shown in Figure 4 below.



EA³ Cube Level/Thread	Artifact ID #	Artifact Name (* Composite Artifact)
Strategic Goals & Initiatives (I)	S-1	Strategic Plan*
	S-2	SWOT Analysis
	S-3	Concept of Operations Scenario
	S-4	Concept of Operations Diagram
	S-5	Balanced Scorecard™ *
Business Products & Services (B)	B-1	Business Plan*
	B-2	Node Connectivity Diagram
	B-3	Swim Lane Process Diagram *
	B-4	Business Process/Service Model
	B-5	Business Process/ Product Matrix *
	B-6	Use Case Narrative & Diagram
	B-7	Investment Business Case*
Data & Information (D)	D-1	Knowledge Management Plan
	D-2	Information Exchange Matrix*
	D-3	Object State-Transition Diagram
	D-4	Object Event Sequence Diagram
	D-5	Logical Data Model
	D-6	Physical Data Model
	D-7	Activity/Entity (CRUD) Matrix *
	D-8	Data Dictionary / Object Library
Systems & Applications (SA)	SA-1	System Interface Diagram
	SA-2	System Communication Description
	SA-3	System Interface Matrix *
	SA-4	System Data Flow Diagram
	SA-5	System/Operations Matrix *
	SA-6	Systems Data Exchange Matrix *
	SA-7	System Performance Matrix *
	SA-8	System Evolution Diagram
	SA-9	Web Application Diagram
Networks & Infrastructure (NI)	NI-1	Network Connectivity Diagram
	NI-2	Network Inventory
	NI-3	Capital Equipment Inventory
	NI-4	Building Blueprints *
	NI-5	Network Center Diagram
	NI-6	Cable Plant Diagram
	NI-7	Rack Elevation Diagram
Security (SP)	SP-1	Security and Privacy Plan*
	SP-2	Security Solutions Description
	SP-3	System Accreditation Document*
	SP-4	Continuity Of Operations Plan*
	SP-5	Disaster Recovery Procedures *
Standards (ST)	ST-1	Technical Standards Profile
	ST-2	Technology Forecast
Workforce (W)	W-1	Workforce Plan*
	W-2	Organization Chart
	W-3	Knowledge and Skills Profile

Figure 4. Relationship Between an EA Framework and Artifact Types

The following are examples of each of these artifacts and are provided to show the variety and types of detail that are needed to properly document an enterprise in all areas and all dimensions (Bernard, 2005).

EA³ Framework Area	Artifact # and Name
	**S-2: SWOT Analysis**

The Strength, Weakness, Opportunity, and Threat (SWOT) Analysis takes a holistic look at the enterprise by identifying internal and external factors which when mapped can reveal areas for improvement and focus.

Example

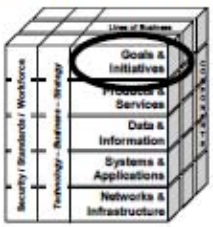
One of the earliest activities the enterprise performs in developing a strategic plan is a 'Strength, Weakness, Opportunity, Threat' (SWOT) Analysis. This analysis looks at internal and external factors to determine areas that the enterprise should focus on to increase its survivability and success, as well as areas that the enterprise should avoid, or decrease its exposure to. The results of the SWOT Analysis should be summarized in the Strategic Plan along with the matrix table illustrated below, and the full SWOT Analysis is archived in the EA Repository as a separate primitive artifact (S-2). The following is an example of a way to summarize a SWOT Analysis.

External Factors / Internal Factors	Internal Strengths (S) **S1.** User Community **S2.** Relationships **S3.** Involved Leadership **S4.** In-house Technology **S5.** Legacy Architecture **S6.** Training Budget **S7.** Culture	Internal Weaknesses (W) **W1.** Policy / Regulations **W2.** Governance Value **W3.** IT Skills – Systems **W4.** Enterprise Architecture **W5.** IT Skills – Process **W6.** Low Usability/Implementation
External Opportunities (O) **O1.** Contracting **O2.** Government **O3.** New Technology **O4.** Partnerships	**SO** **S5/O3:** Legacy Web Portals **S1/O3:** Security	**WO** **W4/O4:** EA Sharing
External Threats (T) **T1.** Funding **T2.** Market Drivers **T3.** Merger **T4.** Advanced Technology **T5.** IT Adoption Rate	**ST** **S1/T2:** FED Requirements **S6/T5:** IT Training **S1/T5:** IT Awareness	**WT** **W4/T1:** Funding Data

From the identification of Internal Strengths (S), Internal Weaknesses (W), External Opportunities (O), and External Threats (T) for the enterprise, a matrix arrangement like the example above can help to reveal internal and external areas to focus on. This SWOT Analysis is also used to help enterprise architects and strategic planners to develop Concept of Operations (CONOPS) scenarios that detail current and future operating environments.

Relationship to Other EA Frameworks

FEAF: Business Level	FEA: PRM, BRM	Zachman: C5/R1	DODAF: None

EA³ Framework Area	Artifact # and Name
	**S-1: Strategic Plan**

A Strategic Plan is a high-level policy and planning document that an enterprise uses to document its direction, competitive strategy, most important goals, and the enabling programs and projects (strategic initiatives). The Strategic Plan covers a future period, usually 3-5 years.

Description

A Strategic Plan is a composite EA artifact that should guide the enterprise's direction over a 3-5 year period in the future by providing the following items, each of which are primitive (basic) EA artifacts. Full versions of abbreviated primitive artifacts are separate artifacts.

- Provide a Mission Statement and a Vision Statement that succinctly captures the purpose and direction of the enterprise.
- Develop a Statement of Strategic Direction that fits the enterprise's purpose, ensures survivability, allows for flexibility, and promotes competitive success. This statement is a detailed description of where the enterprise intends to go.
- Summarize the results of a SWOT Analysis that is based on the statement of strategic direction and which identifies the enterprise's strengths, weaknesses, opportunities, and threats. The full SWOT analysis is artifact S-2.
- Summarize the situation and planning assumptions for several 'Concept of Operations' CONOPS Scenarios that support the enterprise's strategic direction. This summary should include *one current scenario* that describes at a high-level the coordination of ongoing activities in each line of business, as well as *several future scenarios* that account for different combinations of internal and external drivers identified through the SWOT Analysis. The complete scenarios are artifact S-3.
- Develop a CONOPS Diagram that in a single picture captures the essence of and participants in the current operating scenario. This graphic is artifact S-4.
- Develop a General Competitive Strategy for the enterprise that incorporates the current and future CONOPS scenarios and moves the enterprise in the intended strategic direction in a way that and address internal/external drivers such as culture, line of business requirements, market conditions, competitor strategies, and risk.
- Identify Strategic Goals that will accomplish the competitive strategy, and specify the executive sponsors who are responsible for achieving each goal.
- Identify Strategic Initiatives and resource sponsors for the initiatives, which are the ongoing programs or development projects that will accomplish each Strategic Goal.
- Summarize Outcome Measures for each Strategic Goal and Initiative, using the Balanced Scorecard™ or similar approach. The full scorecard is artifact S-5.

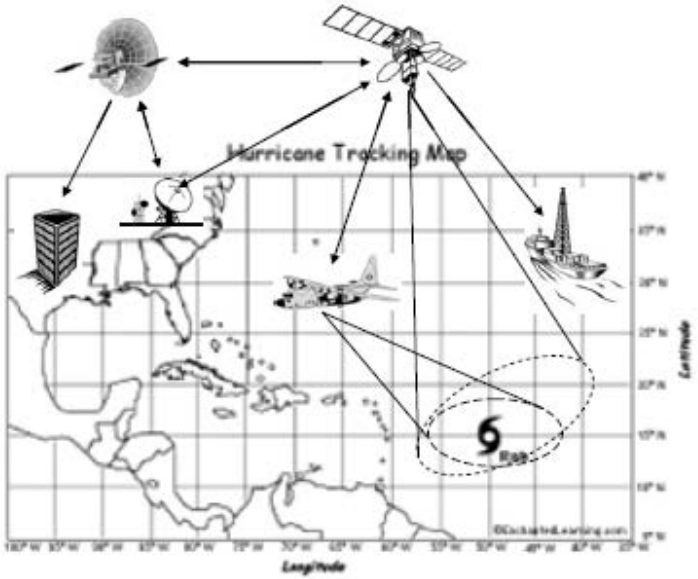
Relationship to Other EA Frameworks

FEAF: Business Level	FEA: PRM	Zachman: C6/R1	DODAF: AV-1

EA³ Framework Area	Artifact # and Name
	**S-4: Concept of Operations Diagram** A Concept of Operations (CONOPS) diagram is a high-level graphical depiction of the how the enterprise functions, either overall, or in a particular area of interest.

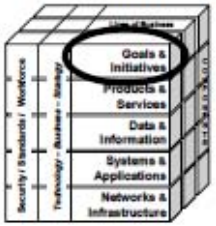
Example Diagram

This CONOPS Diagram shows at a high level how a fictitious system called the 'Hurricane Warning System' would conduct its primary mission of providing a coordinated weather surveillance and reporting capability using land-based, sea-based, airborne, and space-based resources.



Relationship to Other EA Frameworks

FEAF: Business Level	**FEA:** None	**Zachman:** C2/R1	**DODAF:** OV-1

EA³ Framework Area	Artifact # and Name
	**S-3: CONOPS Scenario** A Concept of Operations Scenario is a narrative document that describes how the enterprise operates currently or will operate several years in the future given certain stated internal and external factors identified in the SWOT Analysis. The scenario is footnoted with planning assumptions.

Example

Planning Assumptions

1. New Video Teleconferencing capability.
2. Product roll-outs at National conferences.
3. Need to hold detailed product discussions on short notice, globally.
4. 24x7 work availability.
5. Increased suburban commuting and telecommuting.
6. Tracking of Govt. reports to anticipate product needs.
7. Changing population demographics, driving new product development.
8. Increased cost benefit of solar powered lighting.
9. Additional product features to attract customers
10. Global use of PDAs for employee communication.
11. Integration of sales, marketing, and production information.
12. Accurate customer quotes on the fly.

Jeff Linder, Vice President of Industrial Sales for Danforth Manufacturing Company (DMC) had just finished a presentation at the 2008 National Highway Safety Conference along with Richard Danforth, DMC's CEO, who had teleconferenced in on the big display screen behind the podium.[1] As Jeff was leaving the main conference room, Andrea Newman, Director of Safety and Transportation for the State of Tennessee, asked Jeff if they could talk about the new line of solar-powered highway lights he had just given a presentation on.[2,3]

"Thanks for taking a minute to talk Jeff. I want to tell you about a situation we have in Tennessee and see if your new product line can help" said Andrea as they found a table in the refreshment area.[4] "No problem, thanks for asking" Jeff said. Andrea pulled up a document on her tablet computer and said "Jeff, here is a report that shows an increasing number of serious accidents in rural areas of Tennessee involving passenger cars and agricultural equipment or commercial trucks. We've attributed it to the growth of suburban communities further out in the countryside that then depend on two-lane country roads for commuting into the city.[5] When you put slow tractors and trucks together with cars that are in a hurry at all hours to get somewhere, you have a recipe for disaster." "Isn't this problem being seen in other places around the country?" asked Jeff. "Yes, and one of the contributing factors that is consistently coming out of investigations of the night-time accidents is the lack of good lighting on these country roads.[6] I am thinking that your highway grade solar lighting can help us provide more night visibility on high-risk rural roads without needing electrical infrastructure."[7,8]

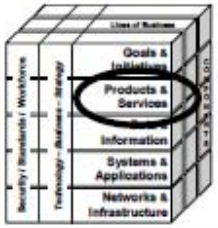
Jeff thought for a minute before responding. "You know, the new line of highway lights has options to incorporate 911 emergency call boxes and Global Positioning System (GPS) equipment that can connect to both State and local level first responders.[9] This might be useful in also improving response times should an accident occur in spite of the improved lighting." Andrea nodded and said, "Yes, I doubt that better lighting will solve the entire problem, but it will help people see each other better, and these other options can improve accident response times. What is the pricing on these units?"

Jeff pulled his Personal Digital Assistant (PDA)[10] out of his pocket and connected to DMC's marketing and sales database at headquarters via a satellite Internet link.[11] "Andrea, these units are $11,300 each, including the GPS and 911 features." Andrea took notes and responded, "If I can get permission to conduct a pilot test in a couple of months can you provide the lights?" Jeff asked "How many miles of road?" "About four miles in the particular area I'm thinking of" said Andrea. "Ok, the suggested density for the new unit is 18 per mile, so that would be 72 units total. I can give you our 10 percent early-adopter discount, so the total would be $732,240. Let me check what the shipping time would be."

Jeff sent a high priority email to Bob Green, Vice President of Manufacturing. Bob was in the factory when he received Jeff's email on his PDA, and after checking the DMC Production Scheduling System, responded two minutes later that a special order for 72 units could be completed and shipped 35 days from when the order is received. Jim relayed this information to Andrea, who said, "Wow, that's fast. I have all the information I need to propose the project, I'll get back to you next week"[12]

Relationship to Other EA Frameworks

FEAF: Business Level	**FEA:** None	**Zachman:** None	**DODAF:** None

EA³ Framework Area	Artifact # and Name
	**B-1: Business Plan** The Business Plan provides a high-level description of the key line of business functions, and financial strategy that will accomplish the strategic goals and initiatives.

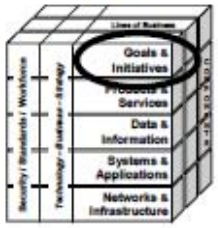
Description

The following items are often found in a Business Plan:

1. Business Overview
2. Executive Team Profile
3. Relationship of Business Activities to Strategic Goals
4. Organizational Structure
5. Market Outlook and Competitive Strategy
6. Business Cycles
7. Capitalization Summary
8. Financial Strategy
9. Current Financial Status Summary
10. Business Partnerships and Alliances

Relationship to Other EA Frameworks

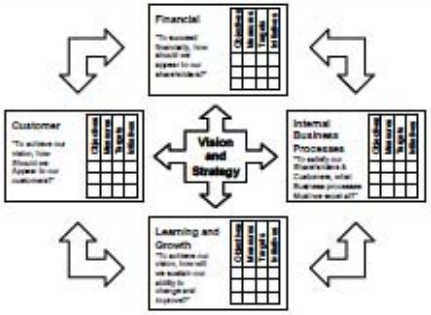
FEAF: Business Level	**FEA:** None	**Zachman:** C2/R2, C5/R1	**DODAF:** None

EA³ Framework Area	Artifact # and Name
	**S-5: Balanced Scorecard™** The Balanced Scorecard™ goes beyond financial measures of success for an enterprise and establishes goals and measures in four key business views: *Customer;, Financial; Internal Business Processes; and Learning and Growth.*

Description

"The Balanced Scorecard™ suggests that people should view the enterprise from four perspectives, (not just a money perspective) and should develop metrics, collect data, and analyze the enterprise relative to each of these perspectives, as is shown in the figure to the right."

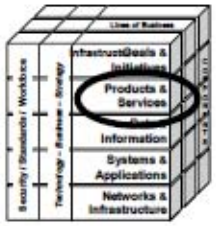
"The Balanced Scorecard™ is a management and measurement system that enables enterprises to clarify their vision and strategy and translate them into action. The scorecard provides feedback around both the internal business processes and external outcomes in order to continuously improve strategic performance and results. When fully deployed, the balanced scorecard transforms strategic planning from an academic exercise into the nerve center of an enterprise."[1]



[1]Balanced Scorecard Institute

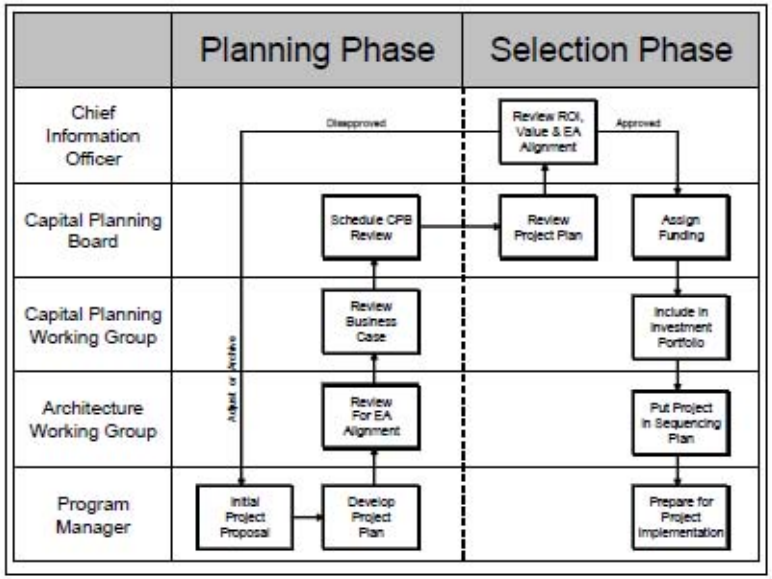
Relationship to Other EA Frameworks

FEAF: Business Level	**FEA:** PRM	**Zachman:** C6/R4 & R5	**DODAF:** None

EA³ Framework Area	Artifact # and Name
	**B-3: Swim Lane Process Diagram**

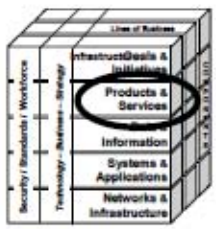
A Stakeholder Activity Diagram shows which stakeholders (those with a vested interest in the enterprise) are involved with line of business processes, and the timing of that interaction. The diagram uses the format of 'swim lanes' to arrange stakeholders by row, and timeframes by column, then overlaying activities with flowchart symbology.

Example



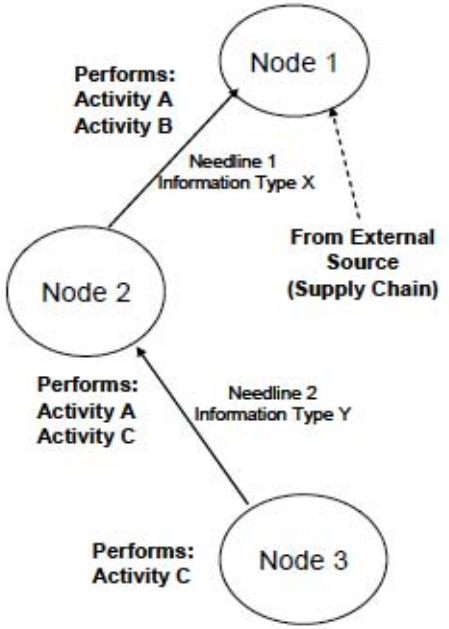
Relationship to Other EA Frameworks

FEAF: Business Level	**FEA**: BRM	**Zachman**: C4/R2	**DODAF**: OV-5

EA³ Framework Area	Artifact # and Name
	**B-2: Node Connectivity Diagram**

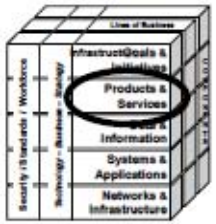
The Node Connectivity Diagram shows the operational nodes, activities performed at each node, node-to-node relationships, and information exchanges. The purpose of this diagram is to show, at a high level, who are the operating groups in the enterprise (lines of business) and how they share information.

Example



Relationship to Other EA Frameworks

FEAF: Business Level	**FEA**: BRM	**Zachman**: C3/R1	**DODAF**: OV-2

EA³ Framework Area	Artifact # and Name
	**B-5: Activity/Product Matrix**

The Business Activity & Product Matrix maps the lifecycle of revenue-producing products to various lines of business throughout the enterprise. This matrix highlights who owns business processes and products, as well as the extent of supply chains.

Example

The Activity/Product Matrix maps the lifecycle of each revenue-producing product that the enterprise produces to the line(s) of business that support one or more phases of the product lifecycle. This matrix allows the enterprise to see where the vertical and horizontal (cross-cutting) business product activities are located, as well as to help define ownership of those processes. The B-5 Activity/Product Matrix can then be used with various Data & Information level artifacts (e.g. D-7 Activity/Entity Matrix) to further map the product lifecycle to requirements for data across the enterprise.

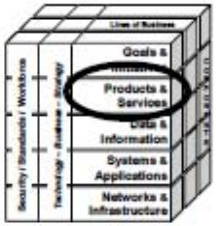
	Line of Business A	Line of Business B	Line of Business C	Line of Business D	Line of Business E	Line of Business F	Line of Business G	Remarks
Business Product								
Product 1	R					F	L	
Product 2		M	W	D	S	F	L	
Product 3		M	W	D	S	F	L	
Product 4	R					F	L	
Product 5		M				F	L	
Product 6		M	W	D	S	F		

R = Research & Develop W = Warehouse S = Service L = Legal
M = Manufacture D = Distribute F = Financials

The product lifecycle illustrated in this example has five sequential stages (research and development, manufacturing, warehouse storage, sales/distribution, and servicing) and two parallel administrative functions (financials and legal). Product lifecycles are different within most enterprises, and adjustments to the B-5 matrix should be made accordingly.

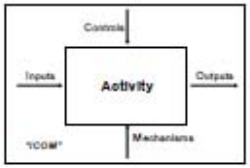
Relationship to Other EA Frameworks

FEAF: Business Level	FEA: BRM	Zachman: C4/R2	DODAF: None

EA³ Framework Area	Artifact # and Name
	**B-4: Business Process Diagram**

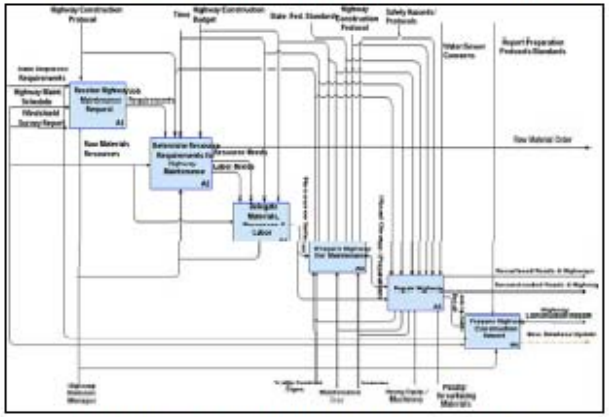
A Business Process Diagram shows a detailed breakdown of an activity, including how each step in the activity relates to the others. The B-4 diagram follows the IDEF-0 modeling technique to show what the inputs, controls, outputs, and mechanisms are for each step in the process.

Description and Example



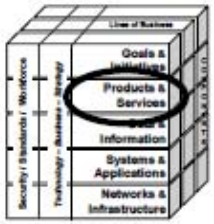
Inputs: Items that initiate/trigger the activity and are transformed, consumed, or become part.
Controls: Guide or regulate the activity; usually indicate when/ how a process will be performed.
Outputs: The results produced by the activity; the reason for which the process was performed.
Mechanisms: Systems, people, and equipment used to perform the activity.

IDEF-0 activity modeling is suitable for business process documentation in that it provides both high level context views, and more detailed views of each step in the activity in a format that can be further decomposed and interrelated with other processes to show linkages. This type of diagram is useful in showing linkages between steps and internal/external influences, but may not indicate a time sequence.



Relationship to Other EA Frameworks

FEAF: Business Level	FEA: BRM	Zachman: C2/R2	DODAF: OV-5

EA³ Framework Area	Artifact # and Name
	**B-7: Investment Business Case**

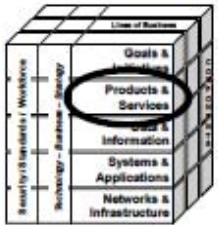
An Investment Business Case uses a standard format to describe the value, risk, and return on investments made in technology and other resources. The Business Case also contains an alternatives analysis, program performance tracking metrics, architecture information, and security status information.

Example

1. **New Requirement**. A new requirement for resource(s) or support is identified in a line of business (LOB), which is brought to the EA and capital planning teams for evaluation.
2. **Existing Solution Check**. The EA and capital planning teams determine that an existing EA component cannot meet the requirement.
3. **New Solution Business Case**. The sponsoring LOB determines that the requirement is of sufficient importance to merit the cost of developing a business case:
   - Business Need. Describe the requirement in terms of the gap in operational or administrative performance it represents to the LOB and the enterprise.
   - Impact if Not Resolved. Describe the impact to the enterprise if the performance gap is not resolved, including strategic, business, and technology impact.
   - Alternatives Analysis. Identify 3 or more viable alternative solutions (if 3 exist).
   - Cost-Benefit Analysis. Quantify the direct and indirect costs and benefits for each alternative on a lifecycle basis, including qualitative items.
   - Return on Investment. Do a ROI calculation for each alternative.
   - Net Present Value Adjustment. Do a NPV adjustment for each ROI calculation to account for anticipated cost increases over the investment's lifecycle.
4. **Business Case Evaluation**. The business case's alternatives are evaluated by the Architecture Working Group (AWG) for the correctness of the analysis, and alignment with the EA at each level of the framework. The Capital Planning Working Group (CPWG) then reviews the business case for the correctness of the financial analysis. A coordinated recommendation is made to the executive-level Capital Planning Board (CPB) as to whether the business case should be approved or disapproved.
5. **Business Case Approval**. The CPB reviews and approves/disapproves the business case in the context of the enterprise's overall investment portfolio using criteria that identify value from a strategic, business, and technology perspective:
6. **Implementation**. If the business case is "selected" (approved) for funding by the CPB, the proposed solution becomes an implementation project that is managed by the sponsoring LOB. The project is reviewed by the CPB at key milestones and/or periodically as part of the capital planning process' oversight of all projects.

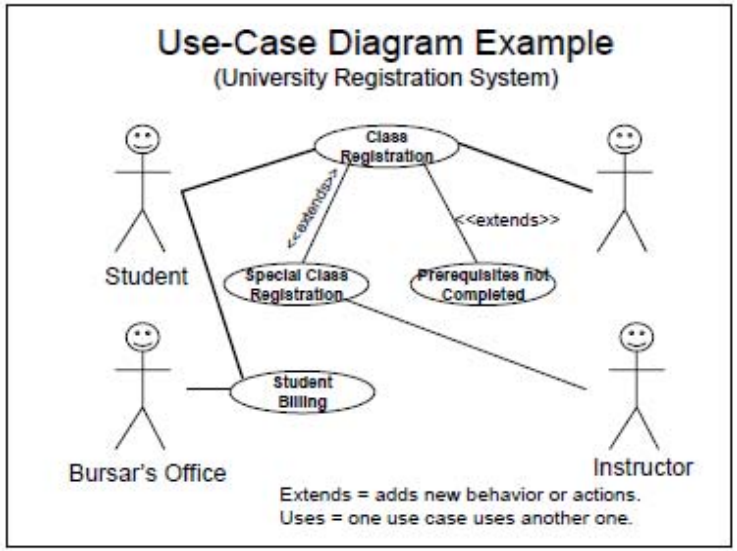
Relationship to Other EA Frameworks

FEAF: None	FEA: Exhibit 300	Zachman: None	DODAF: None

EA³ Framework Area	Artifact # and Name
	**B-6: Use Case Narrative & Diagram**

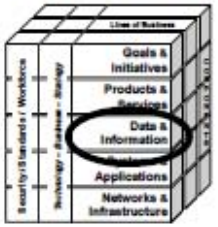
A Use Case narrative follows the Unified Modeling Language (UML) format for identifying business requirements, their context, stakeholders (actors), and business rules for their interaction with systems, services, and applications that are identified as technology solutions requiring development.

Example



Relationship to Other EA Frameworks

FEAF: Business Level	FEA: BRM	Zachman: C6/R3, C6/R4	DODAF: OV-6a, SV-10a

EA³ Framework Area	Artifact # and Name
	**D-2: Information Exchange Matrix** The Information Exchange Matrix describes relevant attributes of data exchanges between systems. These attributes include size, logical specification of the information i.e., media, timeliness required, and the security classification and properties of the information.

Example

Information exchanges express the relationships across four important aspects of the architecture (information, activities, locations, and times) with a focus on the specific aspects of the information flow. Information exchanges identify which business nodes exchange what information during the performance of what activities and in response to which events. Additional information on who is performing the activity can be added, if needed for security analysis. The detailed information in the Information Exchange Matrix may be hard to collect but it is necessary to fully understand the information flow in the enterprise and its security aspects.

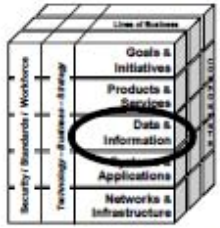
The matrix also identifies the event that triggers the information exchange (e.g., set schedule or citizen request). The matrix keys the exchange to the producing and using activities and nodes and to the needline (from the Node Connectivity Diagram) the exchange satisfies. The Information Exchange Matrix partitions each high-level needline into its component parts, i.e., into distinct information exchanges between business nodes. An example format for this artifact is provided below. Additional characteristics may be added to the D-1 matrix based on the purpose or goals of the enterprise.[1]

INFORMATION DESCRIPTION			SOURCE	DESTIN-ATION	INFORMATION EXCHANGE ATTRIBUTES							
NEEDLINE IDENTIFIER	INFORMATION EXCHANGE NUMBER	CONTENT	MEDIA	SIZE	SENDING NODE	SENDING ACTIVITY	RECEIVING NODE	RECEIVING ACTIVITY	TRIGGERING EVENT	FREQUENCY TIMELINESS THROUGHPUT	SECURITY	INTEROPER-ABILITY REQUIREMENTS
			DIGITAL, VOICE, TEXT, IMAGE, ETC.	RANGE LIMITS								

[1] K. Sowell and A. Reedy

Relationship to Other EA Frameworks

FEAF: Data Level	FEA: DRM	Zachman: C3/R2, C4/R2	DODAF: OV-3

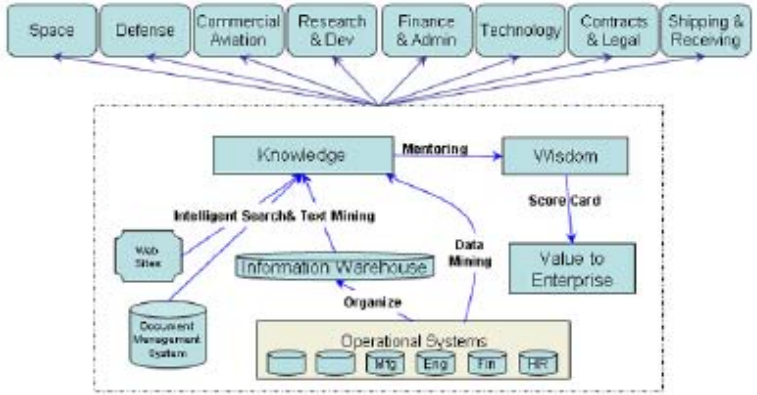
EA³ Framework Area	Artifact # and Name
	**D-1: Knowledge Management Plan** The Knowledge Management (KM) Plan provides a detailed description of how knowledge, information, and data are shared across the enterprise. The KM Plan includes descriptions and diagrams of information sharing between systems, applications, knowledge warehouses, and databases

Description and Example

KM Plan Contents

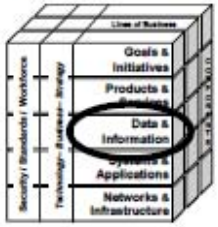
- The approach to managing data, information, and knowledge across the enterprise
- How data and information-sharing support the Business Plan
- Data and information-sharing strategies and diagrams for each line of business
- Data and information sharing strategies with external partners and customers
- Which types of data in the enterprise require extra protection
- The lifecycle for data and information that is key to the success of the enterprise (data creation, sharing, updating, storage, retrieval, and deletion)

Example of a High Level KM Diagram



Relationship to Other EA Frameworks

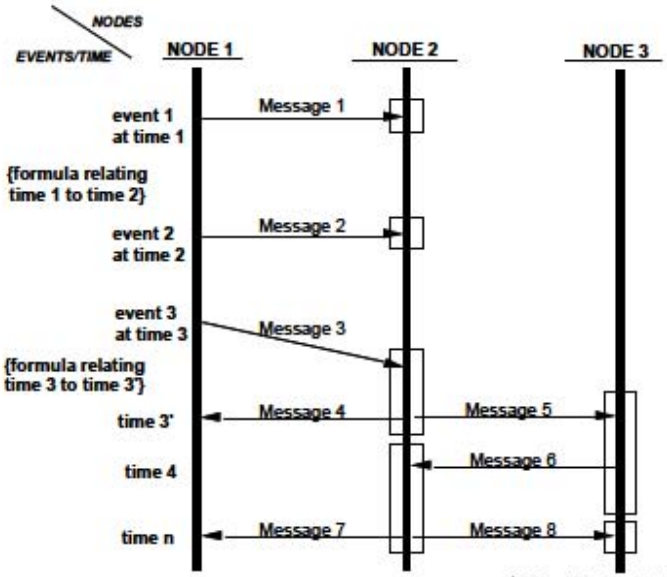
FEAF: Data Level	FEA: DRM	Zachman: C1/R1, C1/R2	DODAF: None

EA³ Framework Area	Artifact # and Name
	**D-4: Object Event Trace Diagram**

Also called an Object 'Sequence' Diagram, the D-5 diagram allows the tracing of actions in a set of scenarios or operational threads. Each model should focus on a critical sequence of events and a description of this scenario should accompany the model.

Example

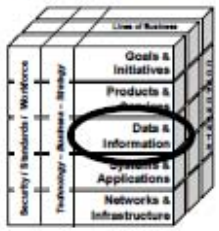
With time proceeding from the top of the diagram to the bottom, a specific diagram lays out the sequence of information exchanges that occur between business nodes for a given scenario. These information exchanges are associated with events and actions (see Information Exchange Matrix). The direction of the event arrows shows flow of control, in terms of the business process, from node to node.[1]



[1] K. Sowell and A. Reedy, 2001

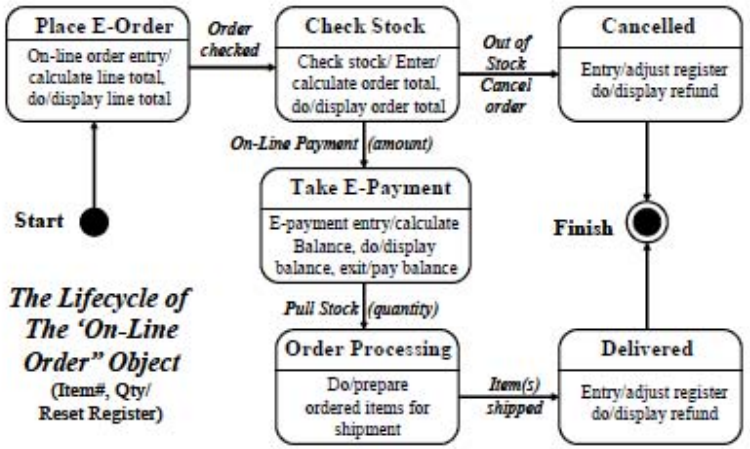
Relationship to Other EA Frameworks

FEAF: Data Level	FEA: DRM	Zachman: C2/R2, C5/R3	DODAF: OV-6c, SV-10c

EA³ Framework Area	Artifact # and Name
	**D-3: Object State Transition Diagram**

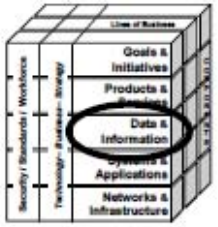
A State Transition Diagram uses the notation from the Unified Modeling Language to show how the lifecycle of a specific data object. This diagram shows changes to attributes, links, and/or behavior(s) of the "On-Line Order" object that are a result of internal or external system events which trigger changes in state.

Example



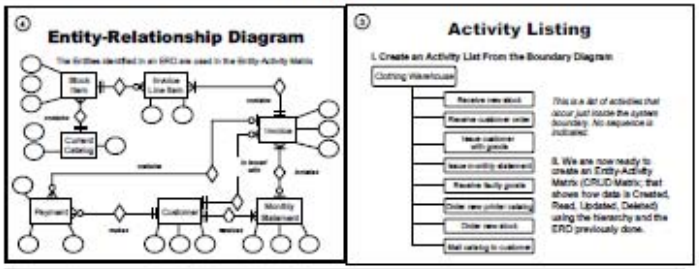
Relationship to Other EA Frameworks

FEAF: Data Level	FEA: DRM	Zachman: C1/R3	DODAF: OV-6b, SV-10b

EA³ Framework Area	Artifact # and Name
	**D-7: Activity/Entity Matrix**

An Activity/Entity Matrix is developed by mapping which data entities are affected by related line of business activities. Often called a 'CRUD' Matrix because it identifies the basic types of transformations that are performed on data (Create, Read, Update, Delete) through a business process.

Example



⑤ **Entity-Activity Matrix**

Entity-Activity (CRUD) Matrix:

		Entity Type						
		Stock Item	Invoice	Invoice Line Item	Customer	Monthly Statement	Warehouse	Catalog
		Stock Control						
1	Receive new stock	U						
2	Receive customer order	R			Customer Services	R		
3	Issue customer with goods	U	C	C		U		
4	Issue monthly statement		R		R	C		
5	Receive faulty goods			R	R			
6	Order new printed catalog							C
7	Order new stock	R						
8	Mail catalog to customer				R			Catalog Production

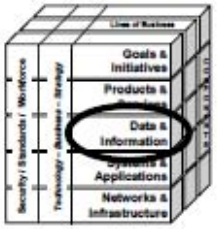
Entity-Activity Matrix (CRUD): C=Create, R=Read, U=Update, D=Delete

Check matrix that:
- Is every entity affected by at least one activity, If not, it's "singular" and should be dropped?
- Is there *just one* "Create" activity for each entity?
- Note that "Create" may be a boundary activity, that may have happened through internal processes.

Matrix may be used to:
- Define the scope of the problem
- Describe a "system map"
- Partition the system (Cluster Analysis)
- Determine "who owns the data and/or processes (activities)

Relationship to Other EA Frameworks

FEAF: Data Level	FEA: DRM	Zachman: C1/R3, C4/R2	DODAF: SV-9

EA³ Framework Area	Artifact # and Name
	**D-6: Physical Data Model**

The Physical Data Model is used to describe how the information represented in the Logical Data Model is actually implemented in automated information systems.

Example

There should be a mapping from a given Logical Data Model to the Physical Data Model (PDM). The PDM is a composite model whose components can vary greatly, as shown in the template below. For some purposes, an entity-relationship style diagram of the physical database design will suffice. Data Definition Language may also be used in the cases where shared databases are used to integrate systems. References to message format standards (which identify message types and options to be used) may suffice for message-oriented command and control subsystems. Descriptions of file formats may be used when file passing is the mode used to exchange information. Interoperating systems may use a variety of techniques to exchange data, and thus have several distinct partitions in their PDM with each partition using a different form.[1]

Physical Data Model Provides

Message Format:
- Standards Reference
- Message Type(s)
- Message Fields with Representation
- Map From the Logical Data Model to the Message Fields

File Structure:
- -Standards Reference
- -Record and File Descriptions
- -Map from Logical Interface Model to Record Fields

Physical Schema:
- -DDL or ERA Notation with sufficient detail to generate the schema
- -Map from the Logical Data Model to the Physical Data Model with Rationale

[1] K. Sowell and A. Reedy, 2001

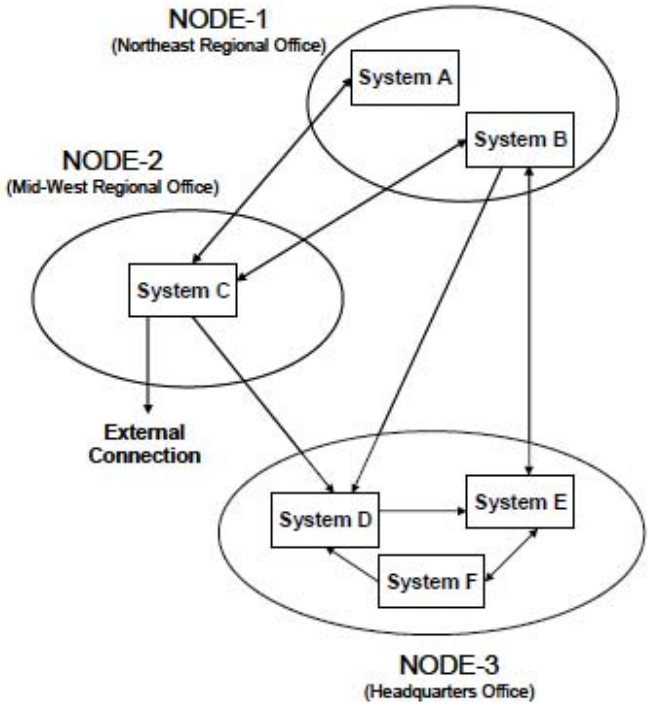
Relationship to Other EA Frameworks

FEAF: Data Level	FEA: DRM	Zachman: C1/R4	DODAF: OV-7, SV-11

EA³ Framework Area	Artifact # and Name
	**SA-1: System Interface Diagram**

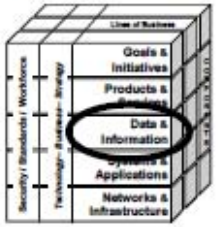
The System Interface Diagram shows the logical and/or physical interfaces between the enterprise's systems for information, production, etc. where information and/or other resources are exchanged.

Examples



Relationship to Other EA Frameworks

FEAF: Application Level	**FEA**: SRM	**Zachman**: C3/R4, C3/R2	**DODAF**: SV-1

EA³ Framework Area	Artifact # and Name
	**D-8: Data Dictionary**

The Data Dictionary provides a comprehensive listing of the data entities that are collected and maintained by the enterprise, including standards for the attribute fields, keys, and relationships. The Data Dictionary may also include a 'library' of re-useable Data Objects that use UML methods.

Example

FIELD NAME	DATA TYPE	FIELD LENGTH	KEY	CAPTION	DESCRIPTION	SAMPLE
PRT_ID	NUMBER	8	PK	PROTOTYPE ID	A sequential number that uniquely identifies each record in tblPrototype	96382
PROP_ID	NUMBER	8	FK	PROPOSAL ID	A sequential number that uniquely identifies each record in tblProposal	37642
PRT_PRDLINE	TEXT	20		PROTOTYPE PRODCUT LINE	The target Solar Cell product line	Consumer
PRT_VOLTAGE	NUMBER	8		PROTOTYPE VOLTAGE	Electrical output, in volts	3.6
PRT_DESCRIPTION	TEXT	100		PROTOTYPE DESCRIPTION	A brief description of the prototype	---
PRT_WIDTH	NUMBER	20		PROTOTYPE WIDTH	Width, in inches, of the prototype	2
PRT_LENGTH	NUMBER	20		PROTOTYPE LENGTH	Length, in inches, of the prototype	4.25
PRT_THICKNESS	NUMBER	20		PROTOTYPE THICKNESS	Thickness, in inches, of the prototype	.375
PRT_WEIGHT	NUMBER	20		PROTOTYPE WEIGHT	Weight, in ounces, of the prototype	10
PRT_START	DATE			PROTOTYPE START DATE	Date development of the prototype began	11/28/2000
PRT_END	DATE			PROTOTYPE END DATE	Date development of the prototype was completed	5/17/2001

Relationship to Other EA Frameworks

FEAF: Data Level	**FEA**: DRM	**Zachman**: C1/R5	**DODAF**: AV-2

EA³ Framework Area	Artifact # and Name
	**SA-3: System Interface Matrix** The System Interface Matrix shows the nature and status of physical and logical interfaces between information systems throughout the enterprise.

Example

1. Provides detail on the interface characteristics of the SA-1 artifact.
   - Allows quick overview
   - Enables rapid assessment of potential re-use or redundancies
2. Useful tool for managing the evolution of systems, infrastructures, technology insertion, functional upgrades.
3. Interface characteristics that could be captured include:
   Status (existing, planned, potential, deactivated), purpose, classification level, key interface(s)

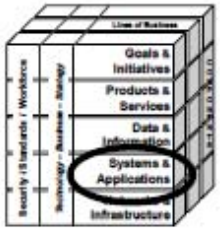
System Interface Matrix

	System 1	System 2	System 3	System 4	System 5	System 6	System 7	System 8	System 9
System 1	*								
System 2	X	*							
System 3		X	*						
System 4		X		*					
System 5			X		*				
System 6	X	X	X	P	P	*			
System 7			X		P		*		
System 8					R	R		*	
System 9	X								*

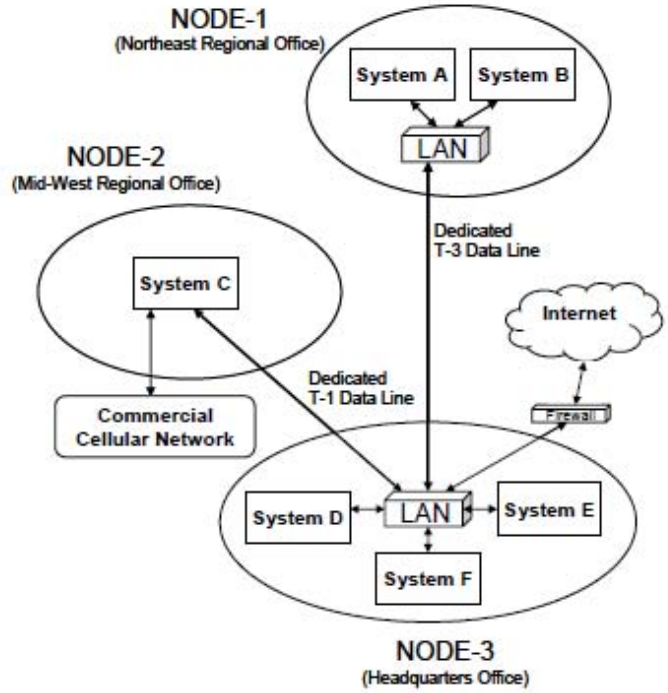
X = Existing Interface P = Planned Interface R = Retire Interface

Relationship to Other EA Frameworks

FEAF: Application Level	FEA: SRM, TRM	Zachman: C2/R4	DODAF: SV-3

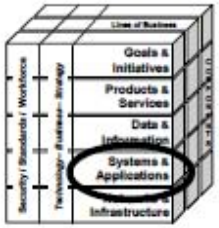
EA³ Framework Area	Artifact # and Name
	**SA-2: System Communication Description** The S-2 artifact compliments the S-1 System Interface Diagram by providing a description of how data is communicated between systems throughout the enterprise, and includes specifics about links, paths, networks, and media.

Example



Relationship to Other EA Frameworks

FEAF: Application Level	FEA: SRM	Zachman: C2/R4, C3/R2	DODAF: SV-2

EA³ Framework Area	Artifact # and Name
	**SA-5: System/Operations Matrix**

The System/Operations Matrix relates operational activities to system functions within and between lines of business throughout the enterprise.

Example

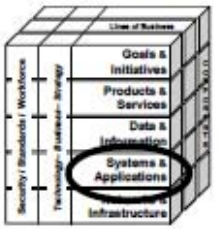
1. Relates operational activities to system functions
2. Identifies the transformation of an operational need into a purposeful action performed by a system
3. Supports decision making as follows:
   - Identify 'stovepipe' systems and opportunities for automation
   - Identify redundant systems and functions
   - Analyze gaps in performance
   - Target investment opportunities

System / Operations Matrix

Operational Activity	Call for Sales Data	Input Sales Data	Update Sales Data	Distribute Sales Data	Use Sales Data
System Function					
Load Sales Data Input Template	X				
Display Sales Data Input Template	X				
Load New Sales Database	X				
Receive New Sales Data		X			
Load Historical Sales Database			X		
Update New Sales Data Sub-Table			X		
Update Historical Sales Database			X		
Receive Sales Data Corrections		X			
Update Historical Sales Database			X		
Send New Sales Data				X	
Send Updated Historical Sales Data				X	
Receive New Sales Data Querry					X
Send New Sales Data				X	X
Receive Historical Sales Data Querry					X
Send Updated Historical Sales Data				X	X

Relationship to Other EA Frameworks

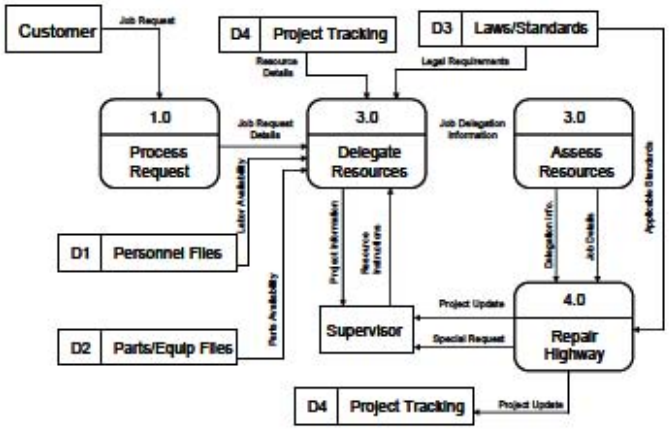
FEAF: Application Level	FEA: BRM, SRM	Zachman: C2/R4	DODAF: SV-5

EA³ Framework Area	Artifact # and Name
	**SA-4: System Data Flow Diagram**

The System Data Flow Diagram is better known as a 'Data Flow Diagram' and is intended to show the processes within a system that exchange data, and how those exchanges occur. The SA-4 artifact compliments the B-4 Business Process Diagram, and can be decomposed to show additional detail.

Example

1. Captures and describes system functions and the data flows between them.
2. Documents system functional hierarchies.
3. Primary purpose is to:
   - Develop a clear description of the necessary system data flows that are input (consumed) and output (produced) by each system
   - Ensure functional connectivity is complete
   - Support appropriate level of functional decomposition for additional detail
4. Is the systems counterpart to the B-4 Business Process Model (IDEF-0 diagram).



Relationship to Other EA Frameworks

FEAF: Application Level	FEA: SRM, DRM	Zachman: C2/R3	DODAF: SV-4

EA³ Framework Area	Artifact # and Name
	**SA-7: System Performance Matrix**

The System Performance Matrix lists the metrics that are important with regard to reliability, availability, and maintainability.

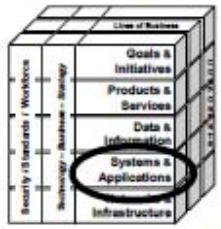
Example

1. Specifies the quantitative characteristics of system:
   - Hardware/software
   - Interfaces
   - Communication components
2. Identifies both current and future parameters.
3. Includes all relevant technical performance characteristics, for instance:
   - Mean Time Between Failure
   - Restart Rate
   - System Initialization Time
   - Data Transfer Rate

System Performance Measures				
Measure Area	**Type of Measure**	**Original Baseline**	**Current Status**	**Target**
System Maintainability	Percentage	0.45	0.52	0.6
System Availability	Percentage	0.86	0.93	0.95
System Start-up (Initialization) Time	Seconds	32	23	15
System Restart (Re-boot) Time	Seconds	35	26	18
Hosted Application Start-up Time (>100 MB)	Seconds	28	26	25
Hosted Application Start-up Time (<100 MB)	Seconds	19	17	15
Data Throughput Capacity (# of Input types)	Megabytes	100	250	500
Mean Time Between Hardware Failures	Days	68	69	90
Mean Time Between Software Failures	Days	12	14	20
System Settings Back-up Time	Minutes	22	21	18
System Data Back-up Time	Minutes	146	137	120
Email Outbox Transfer Rate (<1MB)	Seconds	12	11	10
Email Outbox Transfer Rate (<300KB)	Seconds	5	4	2

Relationship to Other EA Frameworks

FEAF: Application Level	FEA: SRM, TRM	Zachman: C2/R3	DODAF: SV-7

EA³ Framework Area	Artifact # and Name
	**SA-6: System Data Exchange Matrix**

The System Data Exchange Matrix uses a table format to show which systems exchange particular types of data within and between lines of business throughout the enterprise.

Description and Example

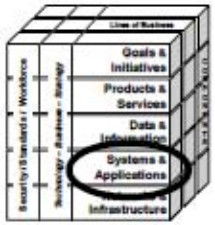
The System Data Exchange Matrix describes, in tabular format, data exchanges between systems within a systems node and across systems nodes. The focus of the System Data Exchange Matrix is on how the data exchanges actually are (or will be) implemented, in system-specific details covering such characteristics as specific protocols and data or media formats. These aspects of exchanges, while difficult to document, are critical to understanding the potential for overhead and security constraints introduced by the physical aspects of the implementation. The System Data Exchange Matrix relates to, and grows out of, the Information Exchange Matrix. That is, the automated portion(s) of each information exchange in the Information Exchange Matrix is associated with the system interface that carries the corresponding system data in the System Interface Description. The business characteristics for the information exchange are replaced with the corresponding system data exchange characteristics. For example, performance attributes for the business information exchanges are replaced by the actual system performance attributes for the automated portion(s) of the information exchange. Automation may introduce characteristics that are not intrinsic to the business information exchange.[1]

Identification & Traceability				Nature of Transaction				Source & Destination				Performance			Security		
								Source		Destination							
Nexdrive	System Interface	Information Exchange	Data Exchange	Data Element Name	Size	Format/Standard	Triggering Event	System	System Function	System	System Function	Frequency	Timeliness	Throughput	Classification	Priority	Services

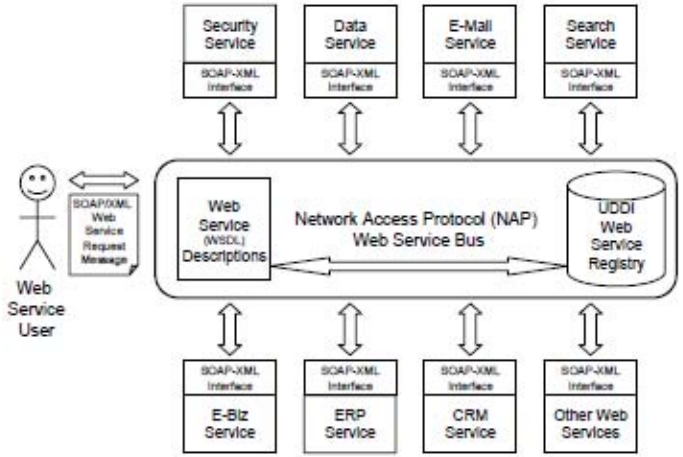
[1] K. Sowell and A. Reedy, 2001

Relationship to Other EA Frameworks

FEAF: Application Level	FEA: SRM, TRM	Zachman: C2/R3	DODAF: SV-6

EA³ Framework Area	Artifact # and Name
	**SA-9: Web Application Diagram** The web application diagram shows the logical relationships between web-based information services, in this case showing a detailed diagram of services that interact via standard protocols and interfaces that promote platform-independent data interchanges.

Example

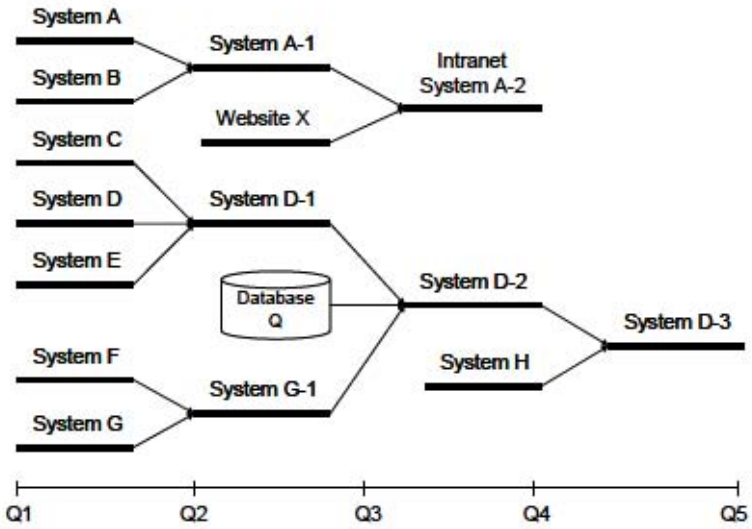


Relationship to Other EA Frameworks

FEAF: Application Level	**FEA:** SRM, TRM	**Zachman:** C2/R3	**DODAF:** SV-2

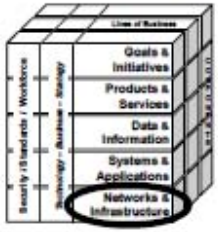
EA³ Framework Area	Artifact # and Name
	**SA-8: System Evolution Diagram** The System Evolution Diagram shows the evolution of a system including the relationship and timing of consolidations installations, upgrades, and retirements, sometimes shown in the context of changes to other systems, applications, websites, and databases.

Example



Relationship to Other EA Frameworks

FEAF: Application Level	**FEA:** SRM, TRM	**Zachman:** C2/R4	**DODAF:** SV-8

EA³ Framework Area	Artifact # and Name
	**NI-2: Network Inventory** The Network Inventory lists all of the hardware and software on the enterprise's voice, data, and video networks throughout the enterprise. The list may include bar code numbers or other unique identifiers.

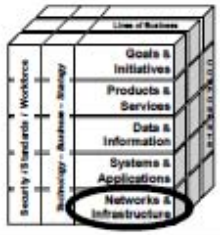
Example

DMC, Inc. Network Equipment Inventory

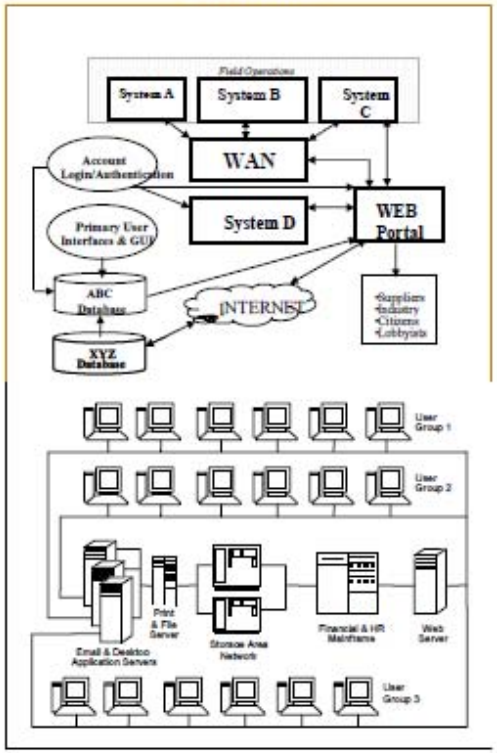
Description	Bar Code	Location	Vendor	Model #
Data Network				
100-Port Stackable Switch #1	DMC-620	Bldg 1	SMV	73G20
100-Port Stackable Switch #1	DMC-621	Bldg 1	SMV	73G20
100-Port Stackable Switch #1	DMC-622	Bldg2	SMV	73G20
100-Port Stackable Switch #1	DMC-623	Bldg3	SMV	73G20
100-Port Stackable Switch #1	DMC-624	Bldg 3	SMV	73G20
100-Port Stackable Switch #1	DMC-625	Bldg 4	SMV	73G20
100-Port Stackable Switch #1	DMC-626	Bldg 4	SMV	73G20
50-Port ATM/Gigabyte Router	DMC-611	Bldg 1	Hamre	H7500
50-Port ATM/Gigabyte Router	DMC-612	Bldg 2	Hamre	H7500
50-Port ATM/Gigabyte Router	DMC-613	Bldg 3	Hamre	H7500
50-Port ATM/Gigabyte Router	DMC-614	Bldg 4	Hamre	H7500
Application Server #1	DMC-616	Bldg 1	Kayprime	K455
Application Server #2	DMC-617	Bldg 1	Kayprime	K455
Application Server #3	DMC-618	Bldg 1	Kayprime	K455
Print Server #1	DMC-603	Bldg 1	Kayprime	K430
Print Server #2	DMC-604	Bldg 3	Kayprime	K430
Web Server #1	DMC-605	Bldg 1	Kayprime	K502
Web Server #2	DMC-606	Bldg 3	Kayprime	K502
Internet Firewall	DMC-610	Bldg 1	Gladiator	3000
Color Network Printer	DMC-370	Bldg 1	HG	755
B/W Network Printer #1	DMC-375	Bldg 2	HG	380G
B/W Network Printer #2	DMC-375	Bldg 3	HG	380G
B/W Network Printer #3	DMC-375	Bldg 4	HG	380G
B/W Network Printer #4	DMC-375	Bldg 5	HG	380G
Telecommunications Network				
Master PBX Switch	DMC-801	Bldg 1	Westcom	W9000
PBX 100-Line Node Controller	DMC-802	Bldg 1	Westcom	W9002
PBX 100-Line Node Controller	DMC-803	Bldg 2	Westcom	W9002
PBX 100-Line Node Controller	DMC-804	Bldg 3	Westcom	W9002
PBX 100-Line Node Controller	DMC-805	Bldg 4	Westcom	W9002
VOIP Interface Unit	DMC-807	Bldg 1	Westcom	W1380
GreenBerry Cell Phone Unit	DMC-808	Bldg 1	Greenberry	KJ1700
Video Network				
VTC Roll-Around Unit #1	DMC-960	Bldg 1	ClearTel	CT1800
VTC Network Interface Box	DMC-961	Bldg 1	ClearTel	CT739

Relationship to Other EA Frameworks

FEAF: Technology Level	FEA: TRM	Zachman: C3/R5	DODAF: None

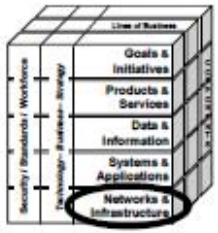
EA³ Framework Area	Artifact # and Name
	**NI-1: Network Connectivity Diagram** The Network Connectivity Diagram shows the physical connections between the enterprise's voice, data, and video network… including external Wide Area Networks (WANs) and Local Area Networks (LANs)… also called 'extranets' and 'intranets.'

Example

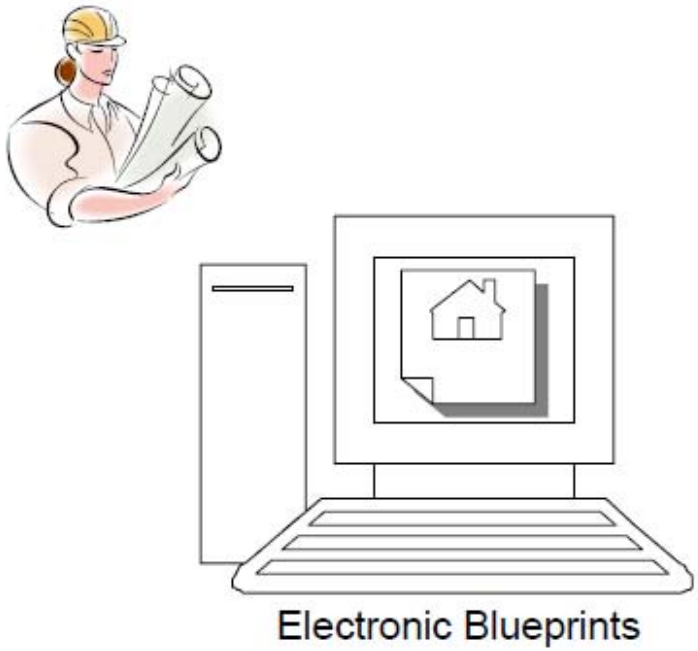


Relationship to Other EA Frameworks

FEAF: Technology Level	FEA: TRM	Zachman: C3/R5	DODAF: None

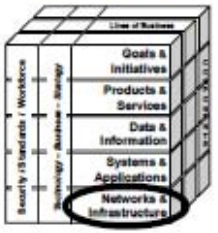
EA³ Framework Area	Artifact # and Name
	**NI-4: Building Blueprints**

The NI-4 artifact is a full set of electronic blueprints for all of the physical buildings and rooms throughout the enterprise. The blueprints aid in planning and decision-making regarding the placement of workspaces, production facilities, warehouses, networks and other business functions.



Relationship to Other EA Frameworks

FEAF: None	FEA: None	Zachman: None	DODAF: None

EA³ Framework Area	Artifact # and Name
	**NI-3: Capital Equipment Inventory**

The Capital Equipment Inventory lists all of the non-information technology capital (depreciable) equipment in each line of business throughout the enterprise. The list may include bar code numbers or other unique identifiers.

Example

DMC, Inc. Capital Equipment Inventory

Description	Bar Code	Location	Vendor	Model #
Manufacturing Equipment				
Robotic Welder #1	DMC-1501	Bldg 4	Daiwoo	4R35
Robotic Welder #2	DMC-1502	Bldg 4	Daiwoo	4R35
Robotic Welder #3	DMC-1503	Bldg 4	Daiwoo	4R35
Die Cast Extractor #1	DMC-1546	Bldg 4	Avex	500G
Die Cast Extractor #2	DMC-1547	Bldg 4	Avex	500G
Metal Press-Stamper	DMC-1560	Bldg 4	Avex	360 Series
Final Assembly Unit	DMC-1565	Bldg 4	Avex	200 Series
Quality Control Checker	DMC-1607	Bldg 4	Humbart	H201G
Boxing Unit #1	DMC-1615	Bldg 3	Janro	J-700
Boxing Unit #1	DMC-1616	Bldg 3	Janro	J-700
Storage Shelving Unit #1	DMC-901	Bldg 2	SMG	J3000
Storage Shelving Unit #2	DMC-902	Bldg 2	SMG	J3000
Building Equipment				
40-Ton Air Conditioner #1	DMC-465	Bldg 1	Liebert	400L
40-Ton Air Conditioner #1	DMC-466	Bldg 2	Liebert	400L
40-Ton Air Conditioner #1	DMC-467	Bldg3	Liebert	400L
40-Ton Air Conditioner #1	DMC-468	Bldg 4	Liebert	400L
Fire Sensing Control Box #1	DMC-763	Bldg 1	GE	1600
Fire Sensing Control Box #2	DMC-764	Bldg 2	GE	1600
Fire Sensing Control Box #3	DMC-765	Bldg 3	GE	1600
Fire Sensing Control Box #4	DMC-766	Bldg 4	GE	1600
Diesel Back-up Generator #1	DMC-248	Bldg 3	Honda	36H-750
Diesel Back-up Generator #2	DMC-249	Bldg 4	Honda	36H-750

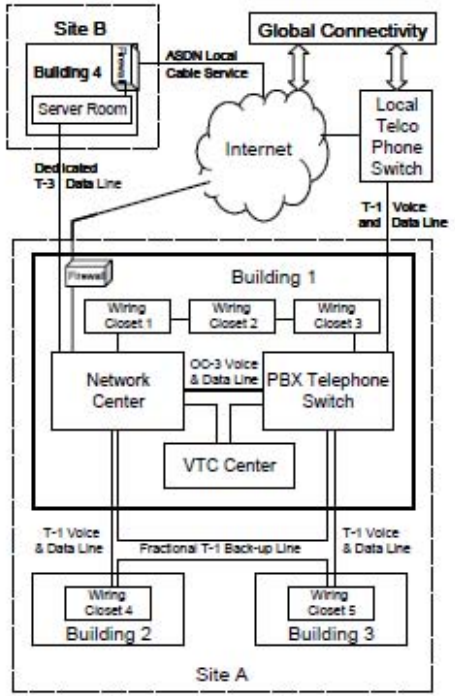
Relationship to Other EA Frameworks

FEAF: None	FEA: None	Zachman: None	DODAF: None

EA³ Framework Area	Artifact # and Name
	**NI-6: Cable Plant Diagram**

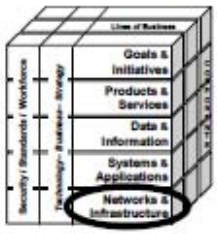
The Cable Plant Diagram shows physical connectivity between voice/data/video networks throughout the enterprise and to global suppliers. The diagram should show the types of cable (fiber, CAT-6, etc.) and the bandwidth (T-1, OC-3, etc.) of each cable run between network centers, server rooms, wiring closets, and external connections.

Example



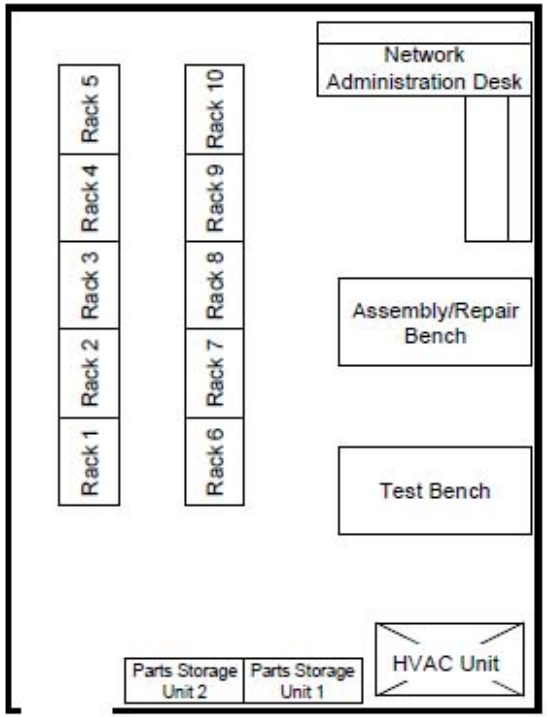
Relationship to Other EA Frameworks

FEAF: None	FEA: None	Zachman: C3/R5	DODAF: None

EA³ Framework Area	Artifact # and Name
	**NI-5: Network Center Diagram**

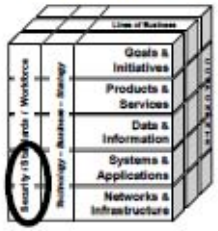
The NI-5 artifact is an overhead diagram of the information technology network center. This diagram can be part of the NI-4 set of blueprints, and is maintained electronically to support the numerous changes to network center(s) and server rooms that can be expected over a number of years.

Example



Relationship to Other EA Frameworks

FEAF: None	FEA: None	Zachman: None	DODAF: None

EA³ Framework Area	Artifact # and Name
	**SP-1: Security Plan**

The Security Plan provides both high-level and detailed descriptions of the security program that is in effect throughout the enterprise. This includes physical, data, personnel, and operational security elements and procedures. Chapter 11 provides additional detail on Security Plans.

Example Outline

1. Introduction
Purpose of the IT Security Program
Principles of IT Security
Critical Success Factors
Intended Outcomes
Performance Measures

2. Policy
Executive Guidance
Technical Guidance
Applicable Law and Regulations
Standards

3. Reporting Requirements
IT Security Program Roles and Responsibilities
IT Security Program Schedule and Milestones
IT Security Incident Reporting

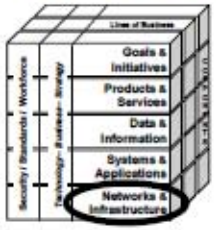
4. Concept of Operations
IT Security Threat Summary
IT Security Risk Mitigation
Integration with Enterprise Architecture
Component/System Security Plans

5. Security Program Elements
Information Security
Personnel Security
Operational Security
Physical Security

6. Standard Operating Procedures
Test and Evaluation
Risk Assessment
Certification and Accreditation
Disaster Recovery/Continuity of Operations
Records Protection and Archiving
Data Privacy

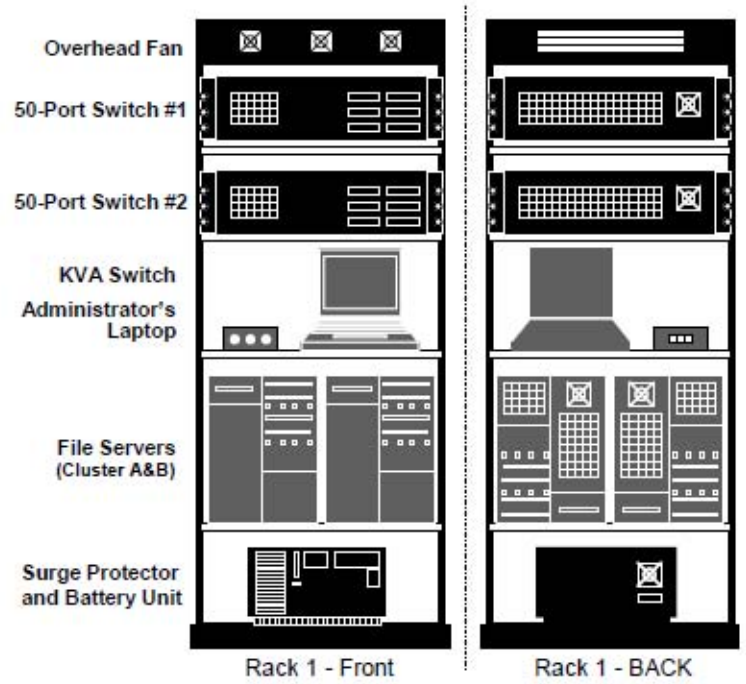
Relationship to Other EA Frameworks

FEAF: None	FEA: SPP	Zachman: C4/R5	DODAF: None

EA³ Framework Area	Artifact # and Name
	**NI-7: Rack Elevation Diagram**

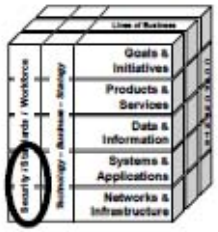
This diagram provides a front and rear view of each of the information technology equipment racks that go into a network center, server room, and/or wiring closet. This diagram supports the NI-5 and NI-6 diagrams and is maintained electronically to support the numerous changes that can be expected over a number of years.

Example



Relationship to Other EA Frameworks

FEAF: None	FEA: None	Zachman: None	DODAF: None

EA³ Framework Area	Artifact # and Name
	**SP-3: System Accreditation Document** The System Accreditation Document uses a standard format for evaluating the security status of information systems throughout the enterprise. There are a number of parts to a system security accreditation as are illustrated in the example.

Example Outline

1. System Security Plan. This opening section of the System Accreditation Document provides an overview of the business context that the information system operates in, states the current security status of the system (last accreditation), and summarizes the contents and finding of the other accreditation documents.

2. System Risk Assessment. This section of the document uses a standardized format for showing areas of risk to the information system in the four primary areas security threat areas that are covered in artifact SP-2; physical, data, operational, and personnel. Assigns a level of risk based on the business context for system operations and the type of system data to be protected. Provides security risk remediation strategies (how to avoid a security risk, or deal with it if a problem occurs) for each area of risk that is identified.

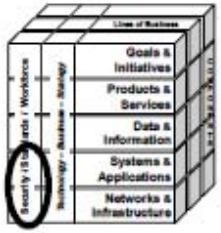
3. System Test and Evaluation. Also called a system 'penetration test.' The System Test and Evaluation (ST&E) section of the document provides the results of a live test that attempts to enter the system through other-than-normal log-in procedures, as well as attempts to overwhelm the system (denial of service attack), or infect the system with an active virus, worm, or other type of problematic element that reduces or eliminates information system functionality.

4. Remediation Plan. This section of the document provides the status of corrective actions taken to fix all of the security risks found during the risk assessment/ST&E.

5. Approval to Operate. This section of the document is the formal (signed) approval to operate the information system that is provided by the designated person in the enterprise (usually the Chief Information Officer or the IT Security Manager).

Relationship to Other EA Frameworks

FEAF: None	FEA: SPP	Zachman: C4/R5	DODAF: None

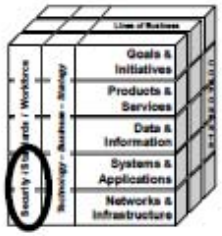
EA³ Framework Area	Artifact # and Name
	**SP-2: Security Solutions Descriptions** The Security Solutions Description provides a high-level view of how security is provided for selected resources throughout the enterprise. The solutions cover four dimensions of security: physical, data, personnel, and operations and may include diagrams or matrices.

Example Outline

Operational Security In the area of operational security, the Security Program should promote the development of standard operating procedures (SOPs) for all EA components that support line of business operations. SOPs should also be developed for recovery from major outages or natural disasters, and for enabling the continuity of operations if all or part of the enterprise becomes disabled.	**Data Security** In the area of information security, the Security Program should promote security-conscious designs, information content assurance, source authentication, and data access control. The assessment of types of data being handled for privacy protection concerns should also be done (e.g. customer credit data or employee SSNs
Personnel Security In the area of personnel security, the Security Program should promote user authentication and IT security awareness, and new user/recurring training. badges, biometrics, card swipe units, cipher locks, and other methods of combining personnel and physical security solutions should be implemented.	**Physical Security** The elements of physical security that should be captured in the EA include protection for the facilities that support IT processing, control of access to IT equipment, networks, and telecommunications rooms, as well as fire protection, media storage, and disaster recovery systems.

Relationship to Other EA Frameworks

FEAF: None	FEA: SPP	Zachman: C4/R5	DODAF: None

EA³ Framework Area	Artifact # and Name
	**SP-5: Disaster Recovery Plan** The Disaster Recovery Plan is an assessment matrix and set of procedures to handle outages in various business and/or technology capabilities that do not require the enterprise to relocate its operations. Outages can be caused by natural or man-made events (e.g. fire, flood, power outage).

Example Contents

The activation of the Disaster Recovery Plan may have to be accomplished in the midst of a natural or man-made disaster that makes clarity, brevity, completeness, and flexibility (backups) key to success. The following are some of the recommended elements in a Disaster Recovery Plan:

1. Disaster Recovery Activation. Conditions for Activating the COOP.

2. Recovery Roles and Responsibilities. A matrix of the roles and responsibilities (by position) of all personnel throughout the enterprise who are involved in activating the COOP. Alternates are provided for each position.

3. Disaster Impact and Recovery Assessment. A standard matrix for assessing the type and duration of the outage, as well as the systems and functions throughout the enterprise that are affected. Depending on the type of outage and the projected period of outage (minutes, hours, days), the recovery procedure may differ.

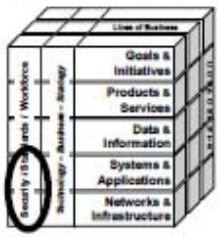
4. Recovery Procedures. The procedures that are used to restore the business and/or system functions that have been disrupted. Examples include:

- Electrical Outage
- Air Conditioning/Heating Outage
- Building Damage (Fire, Flood, Earthquake)
- Room Damage (Fire, Flood, Earthquake)
- Virus Infection of Information System(s)
- Loss of Internal or External Data Communications
- Loss of Internal or External Telephone Communications

Enterprise Functions Do Not Relocate

Relationship to Other EA Frameworks

FEAF: None	FEA: SPP	Zachman: C4/R5	DODAF: None

EA³ Framework Area	Artifact # and Name
	**SP-4: Continuity of Operations Plan** The Continuity of Operations Plan (COOP) uses a standard format for describing where all or part of the enterprise will relocate to if the normal operating location cannot be occupied for an extended period (more than a few days) due to a natural or man-made event.

Example Contents

The activation of the COOP relocation site may have to be accomplished in the midst of a local or national disaster that makes clarity, brevity, completeness, and flexibility (backups) key to success. The following are some of the recommended elements in a COOP document:

1. COOP Activation. Conditions for Activating the COOP.

2. COOP Roles and Responsibilities. A matrix of the roles and responsibilities (by position) of all personnel throughout the enterprise who are involved in activating the COOP. Alternates are provided for each position.

3. COOP Checklist. A step-by-step checklist of actions for each person participating in the COOP.

4. COOP Relocation Site Map and Directions. How to get to the COOP site from various probable routes.

5. COOP Relocation Site Activation. The process for activating the COOP site, establishing internal/external communications, and reconstituting key enterprise functions at the COOP site.

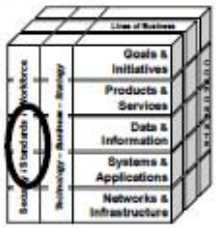
6. COOP Relocation Site Inventory. An inventory of systems, equipment, and supplies at the COOP relocation site, along with the person(s) responsible for ensuring that the systems are operational and the equipment is present when needed.

7. COOP Relocation Site De-Activation. Procedures for de-activating the COOP site and restoring it to a 'ready status' after a real relocation event or training exercise.

Enterprise Functions Have to Relocate

Relationship to Other EA Frameworks

FEAF: None	FEA: SPP	Zachman: C4/R5	DODAF: None

EA³ Framework Area	Artifact # and Name
	**ST-2: Technology Forecast**

The Technology Forecast supports and relates to the ST-1 Technology Standards Profile. The Technology Forecast documents expected changes in any of the standards listed in the ST-1 artifact, where future changes appear to be happening or about to happen.

Example

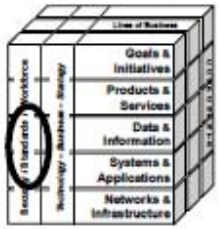
- Captures expected changes in technology related standards and conventions
- Identifies critical technology standards, their fragility, and impact of changes to the architecture
- Contains specific predictions about the availability of emerging standards, and relates to specific System/Application (SA) framework elements

Technology Forecast

Forecast Area	Short Term (Next 12 Months)	Mid-Term (12-24 Months)	Long Term (2-3 Years Away)
Operating Systems	Macrovox GT basic Operating System will be supported until late 2007	Macrovox GT-2 will be launched in early 2006	Linux is gaining in capability and reliability, should consider migration to Linux in mid 2006 as an alternative to Macrovox GT upgrade.
Office Automation Suite	Kona Big Suite upgrade finished in early 2005	Kona Big Suite II is due out in late 2006, will provide xml data exchange between applications and a bundled graphics and photo editor.	Kona Project X is going to incorporate a database application
Desktop PCs	Gell 2000 became standard in 2004, is installed on 70% of desktops; will be 100% in mid-2005.	Gell 2000 units will remain	Conduct vendor fly off in early 2006 based on updated application and performance requirements
Desktop Monitors	15" Color CRTs being replaced by 21" Color LCDs as Desktops are replaced: 100% in mid 2005	LCD units will remain	Conduct vendor fly off in early 2006 based on desktop PC compatability and user requirements
Persistent Storage	5 Gigabyte PCMCIA type 2 card available	10GB card expected	40+GB cards
Personal Digital Assistants	Executive level only - Greenberry X400	Office Directors also get Greenberry X400s	Conduct vendor fly off in early 2006 based on updated application and performance requirements

Relationship to Other EA Frameworks

FEAF: Technology	**FEA:** TRM	**Zachman:** C3/R4	**DODAF:** TV-2, SV-9

EA³ Framework Area	Artifact # and Name
	**ST-1: Technology Standards Profile**

The Technology Standards Profile is a listing of business services and associated technologies that are accepted by the enterprise as being a primary or secondary standard. Further detail can be added regarding particular types of standards (e.g. data, telecommunications) and vendor products.

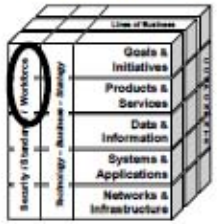
Example

Technical Standards Profile

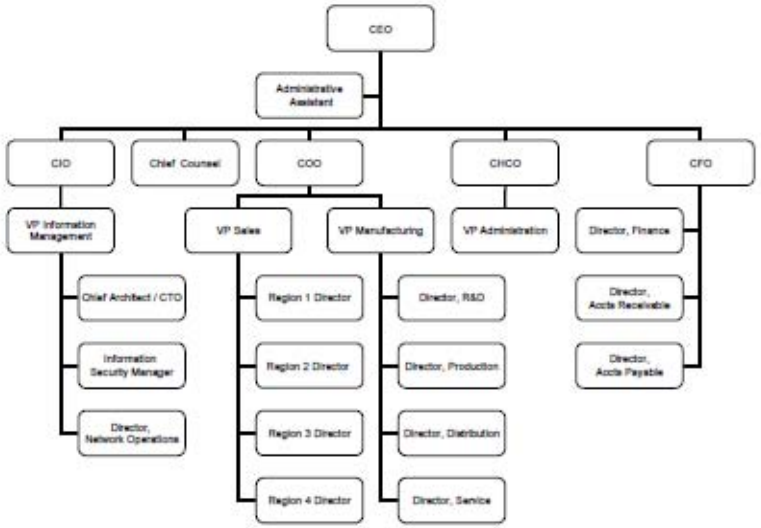
Item Description	International Standard 1	International Standard 2	National Standard	Local Standard	Standard Product	Alternative Product
Information Systems Hardware						
Network Router	ISO 802.1	CEN 7102	NIST 400-1		Sasco 7300	IronBox 300H
Network Server	ISO 802.1	CEN 7102	NIST 400-1		Gell 2000	CowBox 710
Network Printer	ISO 802.1	CEN 7102	NIST 400-1		Micop 85	HV 550
Desktop PC	ISO 802.1	CEN 7102	NIST 400-1		Gell 1650	CowBox 200
Information Systems Software						
Server Operating System	ISO 802.1	CEN 7102	NIST 400-1		MacroSwift OS	BlueCap Linux
Desktop Operating System	ISO 802.1	CEN 7102	NIST 400-1		MacroSwift OS	Linux Desktop
Desktop Office Automation Suite	ISO 802.1	CEN 7102	NIST 400-1		MacroSwift SuitePro	Kona Big Suite
Computer Aided Design	ISO 802.1	CEN 7102	NIST 400-1		Grafex CAD	MacroCAD
Telecommunications System Hardware						
PBX Central Switch	ISO 877.1F	CEN 7306	IEEE 7735	Verizo 679	Weebel 7200	BlamoTel 80X
PBX Central Switch	ISO 877.1F	CEN 7306	IEEE 7735	Verizo 679	Weebel 7202	BlamoTel 830
Desk Telephone	ISO 877.1F	CEN 7306	IEEE 7735	Verizo 679	Weebel 55J	BlamoTel 10J
Telecommunications System Software						
PBX Switching Controller	ISO 877.1F	CEN 7306	IEEE 7735	Verizo 679	Weebel PBX Max	Blamo PBX
VOIP Interface	ISO 877.1F	CEN 7306	IEEE 7735	Verizo 679	Weebel VOIP Max	Blamo VOIP
Video Conferencing System Hardware						
Roll-Around VTC Unit	ISO 478.3		IEEE A845		PhotoVox 1300	Humbel 850
Desktop VTC Unit	ISO 478.3		IEEE A845		PhotoVox 350	Picture/t 750
VTC Multiplexer & Control Box	ISO 478.3		IEEE A845		PhotoVox M45	
Video Conferencing System Software						
Desktop Video Conferencing	ISO 478.3		IEEE A845		MacroSwift Meet	

Relationship to Other EA Frameworks

FEAF: Technology	**FEA:** TRM	**Zachman:** C3/R4	**DODAF:** TV-1

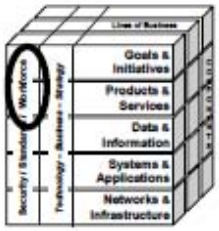
EA³ Framework Area	Artifact # and Name
	**W-2: Organization Chart** The Organization Chart shows how positions and personnel are organized in hierarchical diagrams or matrix formats. Organization Charts help to show lines of authority, working relationships, as well as ownership of resources, products, and processes.

Example



Relationship to Other EA Frameworks

FEAF: None	FEA: None	Zachman: C4/R2	DODAF: OV-4

EA³ Framework Area	Artifact # and Name
	**W-1: Workforce Plan** The Workforce Plan provides a high-level description of how human capital is managed throughout the enterprise. The Workforce Plan includes strategies for hiring, retention, and professional development at the executive, management, and staff levels of the enterprise. .

Example

Workforce Plan Outline

- Summary of Human Capital Management Strategy
- Line of Business Requirements
- Executive Level Competencies and Professional Development Plans
- Management Level Competencies and Professional Development Plans
  - Line of Business A
  - Line of Business B
  - Line of Business C
  - Line of Business D
- Staff Level Competencies and Professional Development Plans
  - Line of Business A
  - Line of Business B
  - Line of Business C
  - Line of Business D
- Performance Review Process
- Benefits Program
- Training and Tuition Assistance Program

Relationship to Other EA Frameworks

FEAF: None	FEA: None	Zachman: C4/R1	DODAF: None

EA³ Framework Area

Artifact # and Name

W-3: Knowledge & Skills Profile

The Knowledge and Skills Profile provides a detailed inventory of what a person should know and be able to do in a particular position within the enterprise. The example provided is a "Knowledge, Skills, and Abilities" List for Enterprise Architects developed by Carnegie Mellon University in 2004.

Example

Carnegie Mellon University — Institute for Software Research International

Enterprise Architecture Education Standards ©		Junior Architect	Mid-Level Architect	Senior Architect	
Knowledge and Skill Areas (KSAs)		EA Apprentice (0-2 Years)	EA Journeyman (3-5 Years)	EA Master (5+ Years)	Notes
1.0	**EA Practice and Theory**				
1.1	Governance, Planning and Decision-Making			x	
1.2	Organizational Theory, Culture and Communication		x	x	
1.3	The Information Age: Driver of Architectures	x	x	x	
1.4	Enterprise Architecture Frameworks	x	x	x	
1.5	Architecture Implementation Methodologies	x	x	x	
1.6	Enterprise Architecture Critical Success Factors	x	x	x	
1.7	Architecture Use in Planning/Decision-Making	x	x	x	
1.8	Architecture Maturity Evaluation			x	
2.0	**EA Documentation**				
2.1	Strategic Goals, Initiatives, and Plans	x	x	x	
2.2	Business Sub-Architecture	x	x	x	
2.3	Information and Data Sub-Architecture	x	x	x	
2.4	Service Sub-Architecture	x	x	x	
2.5	Systems Sub-Architecture	x	x	x	
2.6	Technology Sub-Architecture	x	x	x	
2.7	Security Sub-Architecture	x	x	x	
2.8	Architecture Standards and Artifact Types	x	x	x	
3.0	**EA Implementation**				
3.1	EA Program and Project Establishment		x	x	
3.2	EA Requirements and Scope		x	x	
3.3	EA Framework and Methodology Selection		x	x	
3.4	EA Tool and Repository Selection		x	x	
3.5	Documenting the Current Architecture		x	x	
3.6	Documenting the Future Architecture		x	x	
3.7	Architecture Transition Management		x	x	
3.8	Architecture Configuration Management		x	x	
4.0	**EA Project & Program Management**				
4.1	EA Project and Program Management Basics			x	
4.2	Requirements Determination			x	
4.3	Project and Program Schedules			x	
4.4	Project and Program Budgets			x	
4.5	Alternatives Analysis			x	
4.6	Managing Risk			x	
4.7	Earned Value Management			x	
4.8	EA Team Development			x	

Relationship to Other EA Frameworks

FEAF: None	FEA: None	Zachman: C4/R3	DODAF: OV-4

USING ARTIFACTS TO SUPPORT PLANNING AND DECISION-MAKING

The use of a robust and comprehensive set or documentation artifacts, as illustrated by the set provided in this article, is an important part of a complete approach to EA. It is also important that these artifacts be linked to each other and to specific areas of the EA framework to establish relationships and identify the intended areas of use for the artifacts. A number of well-known approaches to EA either lack a specified set of artifacts, or have "holes" in the artifact set such that the EA is sub-optimized to support planning and decision making.

As was previously mentioned, the set of artifacts shown in this article are a combination of basic (primitive) artifacts and composite artifacts that utilize all or part of several basic artifacts. The artifacts that are the most useful to management for planning and decision-making are often composite artifacts which bring together a number of types of information into a dashboard or a holistic abstraction of an enterprise-wide service (e.g., email or human resources), a line of business function (also referred to as segment), or a particular system or business/technology solution.

An EA must provide artifacts that are useful for all stakeholders at the executive, management, and staff levels. Therefore the artifact set will vary in depth of detail and intended use. The best way to ensure that the architecture's documentation is complete and adds value is to specify an artifact set that provides various types of documentation that is actionable – immediately useful and authoritative for various stakeholder groups.

Figure 5 on the next page provides an example of a "storyboard" that is a new type of artifact (Bernard, 2009) which is a composite that brings together information from the S1, B-3, B-4, D-2, SA-3, and N-1 artifact examples provided in this article. This "storyboard" depicts the 'safety inspection and violation reporting process' at the Federal Railroad Administration in the U.S.

Department of Transportation, and was helpful in improving workflow associated with this process, identifying authoritative sources for data, and depicting the systems and networks that support this process, as well as the electronic and hardcopy forms that the agency uses in this process. This 'storyboard' artifact raised awareness about the various parts of the process, relationships in workflow, and the importance of a number of supporting IT resources. All of this served to provide (for the first time) a comprehensive view of an important service area from a strategic, business, and technology perspective – and supports planning and decision-making in this key area of mission activity for the agency.

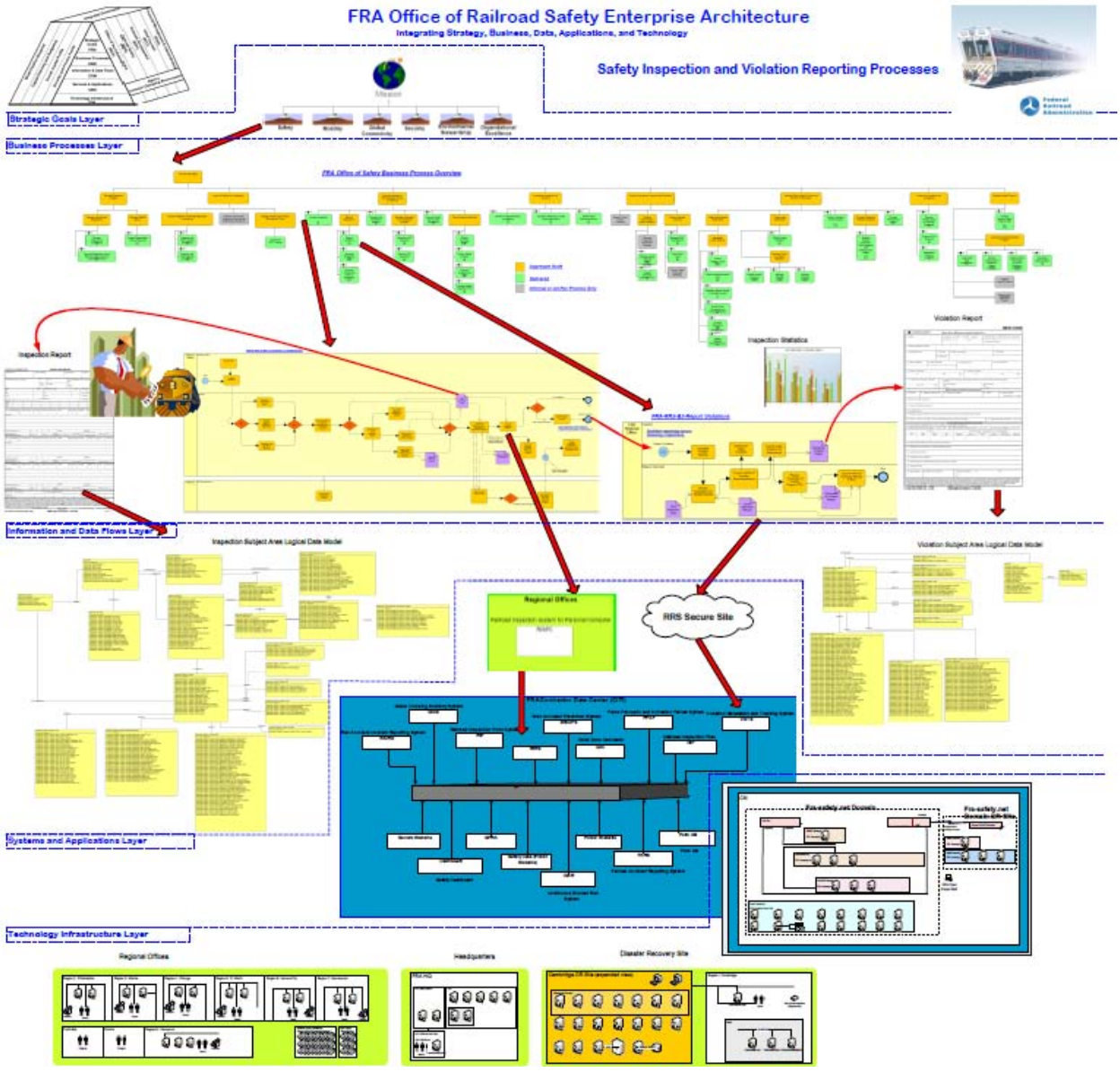


Figure 5. Example of a "Storyboard" EA Artifact to Holistically Describe a Process

Figure 6 on the next page shows another composite artifact that is a new addition to the EA3 'Cube' approach (Bernard, 2005). The "Horse Blanket" artifact captures in one graphic an entire enterprise and gets its name from the typically long length of the print-out that is done

with a blue-print size drawing on a plotter that is continuous to cover all of the organizational segments in an enterprise. The Horse Blanket organizes the segments side-by-side and then also maps hierarchically to the strategic, business, data, application, and infrastructure sub-architecture views of the EA3 Cube framework. This helps to depict all of the strategic goals, lines of business, major and supporting business processes, supporting databases and systems, as well as host infrastructure elements.

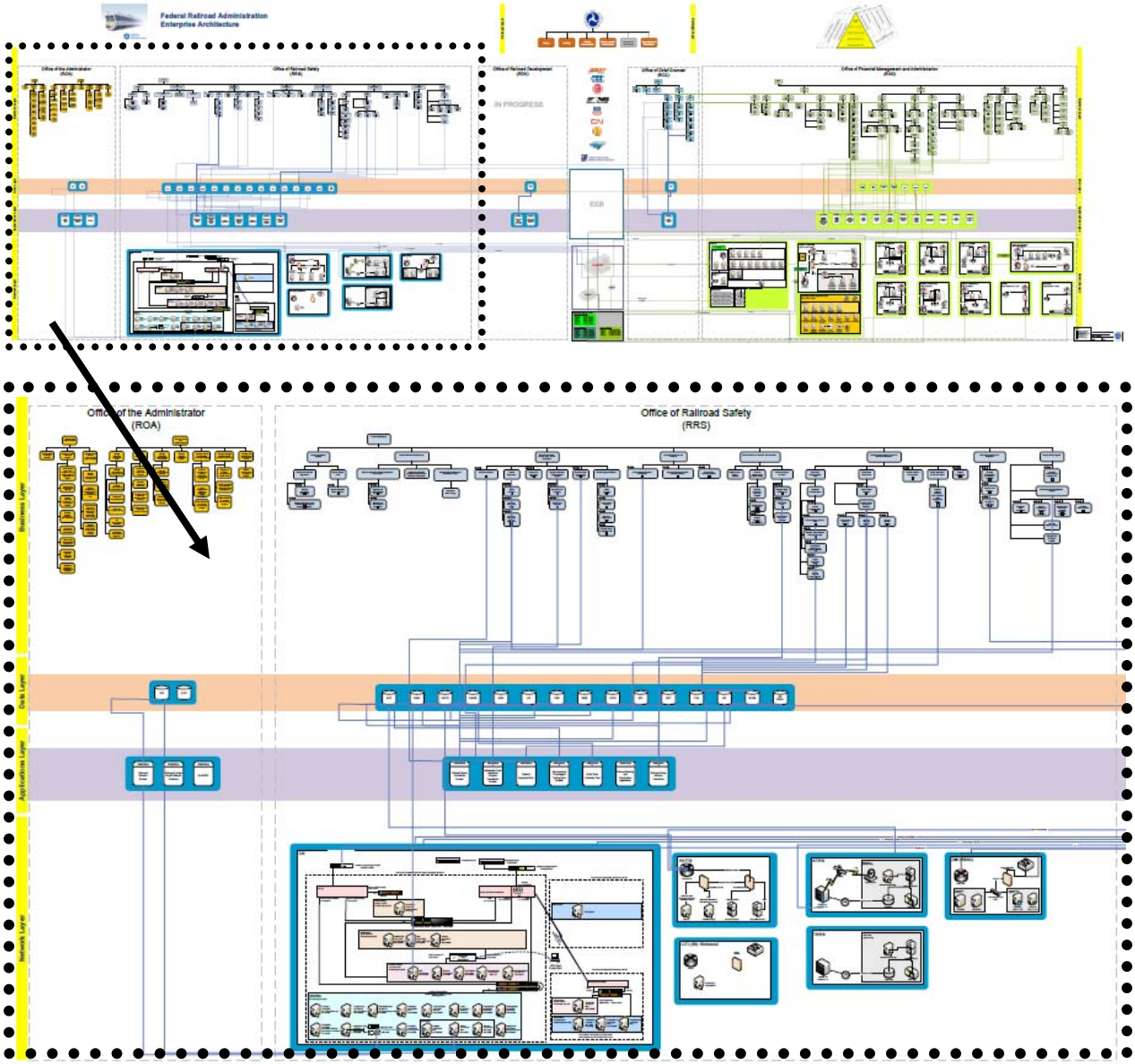


Figure 6. The "Horse Blanket" Artifact that Depicts an Entire Enterprise
(The top graphic is entire enterprise, the graphic below is an extract showing two segments)

NEXT STEPS IN ENTERPRISE ARCHITECTURE DOCUMENTATION

There are three primary areas that improvement in EA documentation area needed: (1) the specification of particular artifact types for each EA approach; (2) inter-linkage between artifacts

where it is possible; and (3) increased sophistication in various types of models.

These improvements will help enterprise architectures to be more useful and valuable in supporting planning and decision-making at the executive, management, and staff levels.

AUTHOR BIOGRAPHY

Dr. Scott Bernard has over twenty years of experience in information technology management, including work in the academic, federal, military, and private sectors. He founded a successful IT management consulting business in 2002 and assisted several major consulting firms in establishing consulting practices aimed at CIO support. In 2004, Dr. Bernard wrote the first textbook on enterprise architecture and subsequently has been a featured speaker at EA conferences globally. He holds trademarks for the *EA3 Cube* ™ framework and methodology that are featured in his book, as well as the design for an on-line architecture repository that is called *Living Enterprise*™. He is also the founding editor of the *Journal of Enterprise Architecture* that is read world-wide.

Dr. Bernard is an Assistant Professor and Director of Executive Education at Syracuse University's School of Information Studies where he teaches enterprise architecture, IT security architecture, and Chief Information Officer (CIO) courses. As a Professor of Practice, he currently serves as the Deputy CIO and Chief Enterprise Architect at the Federal Railroad Administration in the U.S. Department of Transportation. He is also a senior lecturer at Carnegie Mellon University's School of Computer Science, where he developed an executive training curriculum in enterprise architecture that is taught world-wide.

Dr. Bernard earned his Ph.D. at Virginia Tech in Public Administration and Policy; a master's degree in Business and Personnel Management from Central Michigan University, a master's degree in Information Management from Syracuse University, and a bachelor's degree in Psychology from the University of Southern California. He is a graduate of the United States Naval War College, and earned a CIO Certificate and an Advanced Program Management Certificate from the National Defense University. Dr. Bernard is a former career naval aviator who served in positions on aircraft carriers and with shore squadrons, led major IT programs, and was the Director of Network Operations for the Joint Chiefs of Staff at the Pentagon. Dr. Bernard can be contacted at sabernar@syr.edu.

REFERENCES

Bernard S. (2005). An Introduction to Enterprise Architecture (2nd ed.). Authorhouse Publishing, Bloomington, IL.

Bernard, S. and Grasso J. (2009). Enterprise Architecture Formalization and Auditing. In 'Coherency Management: Architecting the Enterprise for Alignment, Agility, and Assurance. Authorhouse Publishers, Bloomington, IL.

DoDAF (2007), "DoD Architecture Framework Version 1.5" United States Department of Defense, 2007.

Doucet, G., Gotze, J., Saha, P. and Bernard S. (2009). Coherency Management. Authorhouse Publishing. Bloomington, IL.

Federal CIO Council (1999), "Federal Enterprise Architecture Framework, Version 1.1", Chief Information Officers Council September, 1999.

Spewak, S. and Hill, J. (1992). Enterprise Architecture Planning: Developing a Blueprint for Data, Applications, and Technology. Wiley & Sons.

TOGAF (2009). The Open Group Architecture Framework, version 9. Available online at http://www.opengroup.org.

Uzzle, Lyn (2009). Using Metamodels to Improve Enterprise Architecture Performance. Journal of Enterprise Architecture, Vol. 5, No. 1, February 2009.

Zachman, J. (1989), "A Framework for Information Systems Architecture" IBM Systems Journal. Volume 26, Number 3, 1987.

Zachman, J. and Sowa, J. (1992). Extending and Formalizing the Framework for Information Systems Architecture. IBM Systems Journal. 31(3). 590-616.