EAMF-Driven Requirements Model Engineering

Part I

The EAMF architecture elicitation methodology helps populates a bookkeeping artifact stored in the EAMF Framework and referred to as the EAMF “grid”. The EAMF grid acts as the main architectural artifacts container and partitions the architectural landscape into five perspectives including business, information, application, technology, and Enterprise. These perspectives help focus the work of architects. Business architects focus on the requirements and business perspective, information architects work with the requirements and information perspectives, application architects focus on the requirements and application perspectives, and technology architects work with the requirements and technology perspectives. Enterprise architects populate the Enterprise perspective and also have the daunting responsibility of ensuring the overall sanity of the EAMF grid as it gets developed throughout the project lifecycle.

As they develop new artifacts in their assigned perspectives, architects are provided with “analysis input” by various parties. Business architects obtain their analysis input from Business Analysts responsible for the requirements definition and management. Requirements engineering is a discipline that includes both requirements definition and requirements management. To get started, Business Analysts typically create a requirements management plan that documents the requirements engineering approach they will follow on the project. This document initially describes the requirements and document types that will be used to document project requirements. Tools may be used to assist with the requirements engineering discipline. For example IBM publishes a tool called Rational RequisitePro to support requirements definition. Another IBM tool called Rational ClearQuest may be integrated with RequisitePro to handle requirement change management. Other vendors such as Telelogic publish tools in the same market segment. All these tools only help with bookkeeping and collaboration around requirements definition and management. It is the responsibility of the Business Analysts to elicit “good” requirements and manage related modifications.

What constitutes a “good” requirement is out of the scope of this document. We will therefore assume that Business Analysts do a good job at providing analysis input to Business Architects. Assuming it is the case Business Architects consume the requirements definition information provided by Business Analysts and engineer an EAMF-Compliant Requirements Model that becomes the requirements reference used by all other architects working with the EAMF methodology and Framework.

Similar to Requirements Engineering, Tests Requirements Engineering is a discipline that includes both test requirements definition and test requirements management. To get started, test analysts typically create a test management plan that documents the tests requirements engineering approach they will follow on the project. This document initially describes the tests.

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1 The EAMF business perspective contains two sets of artifacts that are developed separately. The first set of artifacts pertains to the project Requirements Model that is derived via analysis and design steps from analysis input provided by Business Analysis. The second set of artifacts pertains to the project Business Architecture that is derived via analysis and design steps from the Requirements Model information collected in the first set of artifacts. The exact nature of these artifacts and the methodology followed by Business Architects to create them is not described in this document.
requirements and document types that will be used to document project tests requirements. Tools may be used to assist with the tests requirements engineering discipline. For example IBM publishes a tool called Rational TestManager that supports tests requirements definition. IBM Rational ClearQuest may also be integrated with TestManager to handle tests requirements change management. While testing is an important aspect of the SDLC, the methodology described in this document focuses mostly on weaving the EAMF architecture-driven approach into an existing SDLC. As a result, the testing disciplines are not described at length in this document. Nevertheless, this document emphasizes the importance of tests to requirements traceability as part of the methodology. Moreover, collaborative access to the Enterprise test management framework is an inherent part of the collaboration framework that enables the use of the methodology within the Enterprise.

The following sub-section explains the requirements definition information structure, the methodology for building such structure, and the implementation of the structure and methodology in IBM Rational RequisitePro. Another handout documents the EAMF requirements model structure, the methodology for building such structure, and the implementation of the structure and methodology in Sparx Systems EA. The last sub-section demonstrates how the requirements model was compiled practically by the Business Analysts and used subsequently by the Business Architects to piece together the EAMF Requirements Model.

1.1 Requirements Engineering

1.1.1 Requirements Definition Methodology

1.1.1.1 Project Requirements Types and Categories

Requirements are defined by Business Analysts according to the template shown in Figure 1 and the steps described below. Figure 1 details requirements types used in the project requirements category. These requirements are referred to as project requirements types. In addition, there are several Enterprise requirements categories that are mentioned at the bottom of Figure 1. The Enterprise Project Requirements category uses the same template as the Project Requirements category. The other categories use additional and/or different requirements types and have their own separate templates. It is important to note that Business Analysts may decide to introduce new requirements categories and/or requirements types on a project per project basis and/or to satisfy a specific need identified at the Enterprise level.
Figure 1 - Project Requirements Types and Enterprise Requirements Categories

Project Requirements Types and Enterprise Requirements Categories are further defined as follows:

**Project requirements types**:

_Glossary requirements_ are used to specify terms that should be used in a project. An example of a project glossary requirement may be a “Service Requestor” defined as “A party who places a service request and consumes the results of the request”.

_Stakeholder Requests_ requirements are used to specify high-level business needs that must be addressed by a project. Stakeholder requirements must be traceable to higher-level strategic and tactical Goals at the Enterprise level. An example of a stakeholder request may be: “Answer customer questions promptly, completely, and accurately”.

_Business Objectives_ requirements are used to specify high-level business goals that must be addressed by a project. An example of a business objective may be: “Provide automated channels for customer service requests processing”.

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**Diagram Content**:

- **Glossary**
- **Stakeholder Requests**
- **Business Objectives**
- **Features and Events**
- **Use Cases**
- **Location**
- **Organization**
- **Process**
- **Business Rules**
- **Workflow Rules**
- **Business or Functional Requirements**
- **Non Functional Requirements**
- **Project Requirements Types**
  - Pattern/Product/Enterprise Solution Reqs
  - Enterprise Business Vocabulary Reqs
  - Business Rules Reqs Repository
  - Enterprise Solution Patterns Requirements
  - Business Strategy and Innovation Reqs
  - Enterprise Project Requirements
  - Enterprise Requirements Categories
Features and events requirements are used to specify how business goals should be met and when in a given project. An example of a feature may be: “An employee will be able to submit change requests via the Web”. An example of an event may be: “Change request submitted by the employee/member”.

Use cases requirements are typically initiated by external events or encapsulate processes that must be followed to take advantage of a feature. In general, a use case captures who (Actor) does what (interaction) with the business solution, for what purpose (goal), without dealing with business solution internals. An example of a use case requirement derived from the event mentioned above may be: “Handle change request received from employee/member”.

Business model requirements include the location, organization, and process requirements that must be addressed by a project.

Location requirements are used to specify the geographic requirements imposed on a business solution that must be considered in a given project. An example of a location requirement may be: “Business agent shall gather customer data at their location and submit it to the central business unit”.

Organization requirements are used to specify the actor requirements that should be considered in a given project. An example of an organization requirement may be a list of actors such as: “Plan Administrator”, and “Policy Holder”.

Process requirements specify business rules, and business workflow rules requirements that must be addressed by a project.

Business rules requirements are used to provide guidance for business processes. These requirements guide business processes, regardless of the business workflow rules requirements that apply to the process or procedure chosen to execute them. Business rules requirements may also be the basis for a hierarchy of business policies requirements that govern business processes. An example of a business rules requirement for a project may be: “A supervisor shall assess the validity of a policy cancellation request faxed to the company”. An example of a business policy requirement that govern the processing of any faxed service requests may be: “A supervisor shall assess the validity of any service request faxed to the company”.

Business workflow rules requirements pertain to the process by which business is done; they are bound by the business rules and/or business policies requirements. An example of a business workflow rule requirement corresponding to the business rule mentioned above may be: “When assessing the validity of a paper request faxed to the company, the client services agent shall fill out an approval slip and have a supervisor sign it”.

Business or Functional requirements specify the actual business functionality that must be addressed by a project. Functional requirements capture the intended behavior of a business solution. This behavior may be expressed as services, Tasks or functions the business solution is required to perform. An example of a functional requirement may be: “An employee will be able to submit a name change request“.

Non-functional requirements specify the constraints that must be addressed by a project. Non-functional requirements include both interface and operational constraints placed on a business
solution. Figure 2 partially documents the various categories of non-functional requirements that should be considered at this stage. These include non-functional project, process, and external requirements. Non-functional project requirements are defined in terms of quality metrics that must be met by the business solution being developed as part of a project. Examples of such metrics include reliability and efficiency. Non-functional process requirements define the guidelines that must be followed while working on a project within the Enterprise. An example of a non-functional process standard requirement may be: “Standards for business rules and business policy shall abide to the specification of directives specified in Revision 1.2 of the OMG’s Business Motivation Model specification”. Non-functional external requirements capture external constraints that are imposed on a project such as industry regulations. An example of a non-functional external HIPAA regulatory requirement may be: “A service requestor should always be identified”.

**Figure 2 – Non-Functional Requirements Categories**

**Enterprise requirements categories:**

The *Pattern Requirements* category contains requirements that apply to pattern cluster networks and associated pattern languages contained in the EAMF standard pattern catalogs. An example of such a requirement may be that “agent patterns contained in the EAMF business pattern catalog shall be categorized as architecture, communication, travel, or coordination patterns”. Placing EAMF pattern requirements in the Pattern Requirements category allows individual projects to trace from requirements in this common category for reusability purpose rather than duplicate EAMF pattern related requirements.

The *Product Requirements* category contains requirements that apply to products contained in the EAMF standard and domain-specific product catalogs. An example of such a requirement may be: “Application server products contained in the EAMF product catalog shall be categorized as
CORBA, .NET, or J2EE application servers”. Placing EAMF product requirements in the Product Requirements category allows individual projects to trace from requirements in this common category for reusability purpose rather than duplicate EAMF product related requirements.

The Enterprise Solution Requirements category contains requirements that apply to pattern cluster networks and associated pattern languages contained in the EAMF domain-specific pattern catalogs. Examples of such a requirement may be that “agent patterns contained in the EAMF business pattern catalog and pertaining to eCommerce architectures shall use agents a delegates”. Placing EAMF solution requirements in the Enterprise Solution Requirements category allows individual projects to trace from requirements in this common category for reusability purpose rather than duplicate requirements.

The Enterprise Business Vocabulary Requirements category contains glossary requirements used to specify terms that are commonly used in the Enterprise and should be used across all projects. Note that there may be project specific glossary requirements that are not part of the Enterprise-wide business vocabulary requirements. These project specific glossary requirements would be maintained within individual project requirement sets. An example of a glossary requirement that falls in the Enterprise Business Vocabulary Requirements category is an “Account” defined as a “Group of employees each of which has at least one policy”. Placing glossary requirements in the Enterprise Business Vocabulary Requirements category allows individual projects to trace from requirements in this common category for reusability purpose rather than duplicate glossary related requirements.

The Business Rules Requirements Repository contains requirements sub-categories that pertain to Enterprise business rules and workflow rules, and Enterprise business policies. Enterprise business processes are guided by business rules that abide to the requirements contained in the Business Rules Requirements Repository. Higher level Enterprise tactical requirements that implement strategic requirements regulate the enforcement level of individual business rules requirements. Enterprise business rules and associated requirements are also the basis for a hierarchy of business policies and associated requirements that govern Enterprise business processes. Enterprise workflow rules requirements apply to the process by which business is done and are bound by the Enterprise business rules and/or policies requirements. Enterprise workflow rules abide to the business workflow rules requirements contained in the Business Rules Requirements Repository. Note that there may be project specific business and workflow rules requirements that are not part of the Enterprise-wide business rules requirements repository. These project specific requirements would be maintained within individual project requirement sets. An example of a policy requirement for an insurance company may be: “The company shall contact a policy holder to verify the validity of a service request (e.g., add person to a policy) when a non-policy holder places a service request on his or her policy”. The associated business rule requirement may be: “A policy holder shall approve any service request issued on his or her policy”. The corresponding workflow rule requirement may be: “When a service request is placed on a policy by a non-policy holder, the company shall send a letter to the policy holder to verify the validity of a request and wait for a signed letter to come back from the policy holder before processing the service request”. Placing business rules and business workflow rules in the Business Rules Requirements Repository allows individual projects to trace from requirements in this common category for reusability purpose rather than duplicate business rules and business workflow rules related requirements.

2 Such requirements might be part of a sub-category in the Business Strategy and Innovation Requirements category.
The **Enterprise Solution Patterns Requirements** category classifies project governance (i.e., process pattern) requirements sub-categories that are maintained by the Project Management Office (PMO). An example of an Enterprise Solution Patterns Requirements sub-category is the SDLC requirements sub-category used to classify functional and non-functional process requirements that regulate the use of iterative and non-iterative SDLCs. An example of a functional process requirement that falls in this category may be: “Agent patterns shall be considered in the EAMF methodology when reasoning about business entities’ Dependencies and goals”. Placing governance requirements in the Enterprise Solution Patterns Requirements category allows individual projects to trace from requirements in this common category for reusability purpose rather than duplicate project governance related requirements.

The **Business Strategy and Innovation Requirements** category contains high-level strategic and tactical stakeholder requirements categories that are driven by the company strategic planning group. Business Strategy and Innovation requirements are clearly above and beyond specific project requirements. An example of a Business Strategy and Innovation Requirements sub-category is the project roadmap sub-category that classifies requirements that apply to a company programs and projects for the purpose of traceability all the way back to the company’s leadership strategic requirements. Placing high-level stakeholder requirements in the Business Strategy and Innovation Requirements category allows individual projects to trace from requirements in this common category for reusability purpose rather than duplicate high-level stakeholder related requirements.

The **Enterprise Project Requirements** category classifies requirements sub-categories that pertain to Enterprise-wide solutions. An example of a requirements sub-category that falls in that category is the Enterprise Worker Services (EWSs) requirements sub-category that classifies requirements set that apply to an extensible set of worker services (e.g., service lifecycle management) for a company’s Enterprise SOA. Placing this requirement set in the Enterprise Solution Requirements category allows individual projects to trace from project requirements in the common set for project reusability purpose rather than duplicate Enterprise project requirements.

In addition to the categories listed in Figure 1, an example of a custom Enterprise requirements category that may be useful to Business Analysts would be an **Enterprise Project Assessment Requirements** category. This custom category would be used to hold projects-to-be requirements as part of the analysis of new business needs.

### 1.1.1.2 Requirements Relationships

There may be relationships between requirements such as traceability and hierarchical relationships. A traceability relationship is a relationship between two requirements that indicates the source of a requirement, a derivation association between requirements, or a dependency between requirements. A traceability relationship may be illustrated as follows: there may be a requirement (Requirement A) that calls for a new button to be added to a form in a Web application. Creating this requirement may lead to the creation of another requirement (Requirement B) associated with the button. This example implies a traceability relationship in which Requirement B is traced from Requirement A as well as a traceability relationship in which Requirement A is traced to Requirement B. There should typically only be only one traceability relationship between any two requirements. Therefore, the difference between calling it a “trace to” or a “trace from” relationship is one of perspective.
Traceability relationships differ from hierarchical relationships between requirements that are used to detail higher level requirements. A hierarchical relationship may be illustrated as follows: there may be a requirement (Requirement C) that calls for allowing a bank account holder to withdraw funds from his or her account, and another requirement (Requirement D) that calls for printing a receipt for a withdrawal transaction. In this example, requirement D would be considered as a child requirement of Requirements C and would be renamed as Requirement C-1.

The requirements traceability graph illustrated in Figure 3 documents traceability relationships that may exist between the different types of project requirements shown in Figure 1. Bidirectional arrows indicate that trace to or trace from (but not both) traceability relationships may be created between requirements types being pointed to. Business analysts should only document direct traceability relationships. The dashed bidirectional arrow shown on the diagram indicates that traceability between Business Objectives and lower level requirements is possible but should only be used when business objectives may not be reached indirectly via Features and Events requirements. Glossary requirements are not used in the traceability graph but they are implicitly attached to the requirement set. It is the implied responsibility of Business Analysts to apply glossary requirements throughout a requirements set.

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3 If Requirement A is traced to Requirement B, and Requirement B is traced to Requirement C, then the relationships between requirements A and B and between requirements B and C are direct. However, the relationship between requirements A and C is indirect (or inferred).
1.1.1.3 Suggested Requirements Definition Steps

The main goal of Business Analysts involved in using the requirements definition discipline is to work with stakeholders to analyze and decompose requirements. They must keep track of traceability and/or hierarchical relationships between requirements and ensure that the overall requirement set is complete. A requirement set is complete when all the requirements below the stakeholder level can be traced back indirectly to stakeholder requirements.

It is the responsibility of Business Analysts to leverage requirements contained in the Enterprise Requirements categories. Early requirements elicitation efforts should reference specific requirements from the Pattern/Product/Enterprise Solution Requirements category, and leverage Enterprise-wide domain-specific pattern requirements obtained from the Enterprise Solution Patterns Requirements category. Business analysts may also leverage high-level requirements

Figure 3 – Requirements Traceability Graph
from the Business Strategy and Innovation Requirements category and business/workflow rules requirements from the Business Rules Requirements Repository. Furthermore, all Enterprise Requirements categories (particularly the Enterprise Business Vocabulary Requirements, and Enterprise Project Requirements categories) should be leveraged by Business Analysts on an ongoing basis as part of the iterative requirements elicitation process that is an inherent part of the overall requirements engineering effort on a given project.

Suggested iterative steps that should be followed by Business Analysts to document requirements when using the requirements engineering discipline are documented below. It should be noted that steps 6-9 may be worked on in parallel. These steps are based on a generic set of requirement (and document) types that should be documented by Business Analysts in a requirements management plan. All requirements collected during a project increment should be reflected, either physically or via traceability, in the project requirements specification. The project requirements management plan should be included with the requirements specification (either as a section or an addendum) to compile the report required to obtain executive sign-off at the end of the project elaboration phase.

It is typically the case that new projects are a continuation of work accomplished as part of past projects. In that case, Business Analysts must verify that requirements engineering work on the new projects leverages requirements from previous related projects. It is the responsibility of Business Analysts to (re)create requirements documentation for past projects as needed to facilitate requirements engineering work on new projects as per the methodology described in this document.

**Step 1 - Gather Existing Requirements Documentation**

It is the responsibility of Business Analysts to gather all project documents that contain relevant requirements and/or new or updated requirements before proceeding with the remaining steps below.

**Step 2 - Gather Glossary Requirements:**

In this step, Business Analysts document the known business terminology that must be used in the project. As a result the terms defined in this step become project glossary requirements used for communication purpose. Business analysts must also reference relevant terminology requirements obtained from the Enterprise Business Vocabulary Requirements category.

**Step 3 - Gather Stakeholder Requests Requirements (i.e., “what the business needs”):**

In this step, Business Analysts obtain stakeholder requests requirements from existing documentation. This documentation typically results from Enterprise strategic planning and associated requirements may come from the Business Strategy and Innovation Requirements category or from later documentation produced by Business Analysts. The exact nature and origin of the documentation is company specific. It is the responsibility of Business Analysts to ensure traceability of the stakeholder requests to higher-level strategic and tactical goals at the Enterprise level. It is also the responsibility of Business Analysts to ensure that all stakeholder requests are well understood by all architects working on the project.

**Step 4 - Gather Business Objectives Requirements (i.e., “project goals”):**
In this step, Business Analysts obtain business objectives requirements from existing documentation. This documentation typically results from Enterprise strategic planning and associated requirements may come from the Business Strategy and Innovation Requirements category or from later documentation produced by Business Analysts. The exact nature and origin of the documentation is company specific. Traceability relationships between business objectives and stakeholder requests requirements must be maintained by Business Analysts.

**Step 5 - Gather Features and Events (i.e., “how the goals are met and when”):**

In this step, Business Analysts obtain the features and events requirements from existing documentation. As for the stakeholder requirements, this documentation typically results from Enterprise strategic planning and associated requirements may come from the Business Strategy and Innovation Requirements category or from later documentation produced by Business Analysts. The exact nature and origin of the documentation is company specific. Traceability relationships between features and events, events and business objectives, and features and business objectives requirements must be maintained by Business Analysts.

**Step 6 - Gather Functional Requirements (i.e., “the actual functionality required”):**

In this step, Business Analysts keep analyzing and decomposing higher level requirements (i.e., features and events and business objectives) as necessary to identify functional requirements. In some cases, functional requirements may be identified by applying common knowledge of the business domain to the problem under observation. Traceability relationships between functional requirements and other requirements (including business objectives, features and events, and use cases requirements) must be maintained by Business Analysts.

**Step 7 - Gather Non-Functional Requirements (i.e., “the project constraints”):**

In this step, Business Analysts analyze and decompose higher level requirements (including features and events and possibly business objectives requirements) as necessary to identify non-functional requirements. In some cases, non-functional requirements may be identified by applying common knowledge of the business domain to the problem under observation. Traceability relationships between non-functional requirements and other requirements (including business objectives, features and events, and use cases requirements) must be maintained by Business Analysts.

**Step 8 – Gather Use Case Requirements (i.e., “who does what and for what purpose”):**

In this step, Business Analysts analyze and decompose existing requirements (including features and events and possibly business or functional requirements) as necessary to identify use case requirements. At this stage, Business Analysts only have to document requirements for use cases, including actors, interactions, and goals, in an easy-to-understand narrative using the vocabulary of the domain. It is the responsibility of Business Analysts to derive as many potential use cases as possible as a result of requirements analysis and interactions with stakeholders. Traceability relationships between use cases requirements and other requirements (including features and events, business or functional, and non-functional requirements) must be maintained by Business Analysts.

**Step 9– Gather Business Model Requirements (i.e., “the location, organization, and business process/rules/workflow details”):**
In this step, Business Analysts analyze and decompose existing requirements (including features and events and possibly business or functional requirements) as necessary to identify business model requirements. At this stage, Business Analysts only have to document location, organizational, and process requirements as explained in the sub-steps below.

**Step 9-1 – Gather Location Requirements (i.e., “the applicable business locations”):**

In this sub-step, Business Analysts analyze and decompose existing requirements (including features and events and possibly business or functional requirements) to gather and document the business locations requirements applicable to the project. This typically results in an initial list of business locations and a project specific location hierarchy diagram. Traceability relationships between location requirements and other requirements (including business or functional, non-functional, use cases, organizational, process, business rules, and workflow rules requirements) must be maintained by Business Analysts.

**Step 9-2 – Gather Organizational Requirements (i.e., “the applicable organizational entities”):**

In this sub-step, Business Analysts analyze and decompose existing requirements (including features and events and possibly business or functional and use cases requirements) to gather and document the organizational requirements applicable to the project. This typically results in an initial list of business actors and a project specific organizational hierarchy diagram. Traceability relationships between organizational requirements and other requirements (including business or functional, use cases, location, process, business rules, and workflow rules) requirements must be maintained by Business Analysts.

**Step 9-3 – Gather Process Requirements (i.e., “the applicable processes, and process guiding business/workflow rules”):**

In this sub-step, Business Analysts analyze and decompose existing requirements (including features and events and possibly business or functional and use cases requirements) as necessary to identify process requirements. Associated requirements may come from Enterprise Project Requirements (i.e., when the project under consideration involves evolution or reuse of a pre-existing Enterprise process model) or may be project specific. Process requirements may involve business rules and workflow rules as explained in the sub-steps below. Traceability relationships between process requirements and other requirements (including business or functional, non-functional, use cases, location, organizational, business rules, and workflow rules requirements) must be maintained by Business Analysts.

**Step 9-3-1 – Gather Business Rules Requirements:**

In this sub-step, Business Analysts gather and document business rules requirements. Associated requirements may come from the Business Rules Requirements Repository or may be project specific. Traceability between business rules requirements and other requirements (including business or functional, non-functional, use cases, location, organizational, process, and workflow rules requirements) must be maintained by Business Analysts.

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4 Capturing project specific process requirements may require current state analysis and documentation of pre-existing processes when related information is not already documented in ReqPro.
Step 9.3.2 – Gather Workflow Rules Requirements:

In this sub-step, Business Analysts gather and document business workflow rules requirements. Associated requirements may come from the Business Rules Requirements Repository or may be project specific. Traceability between business workflow rules requirements and other requirements (including business or functional, non-functional, use cases, location, organizational, process, and business rules requirements) must be maintained by Business Analysts.

1.1.1.4 Tests Requirements Definition Methodology

The definition of tests requirements and test case requirements typically overlaps the later part of the requirements definition process. Test requirements are associated to project requirements and are meant to validate these requirements. Test requirements lead to the definition of test case requirements that motivate the creation of corresponding test scripts (e.g., manual, automated, and performance test scripts). Test scripts may then be grouped into test suites to support regression testing. Following this approach allows traceability of individual tests all the way to high-level requirements. Therefore a specific test failure may result in invalidating a project feature. Under time crunch, it may still be possible to meet a release date by omitting the particular feature that did not validate.

It should be noted that verification testing and validation testing cover two complementary aspects of testing. Validation testing is geared towards making sure that “the right product” is built (i.e., a product that meets the requirements). Verification testing ensures that the “product is built right” (i.e., the functionality actually works). Without validation in mind and regardless of verification testing, a product could easily be released with missing or extra features and would not be acceptable from a stakeholder standpoint.

This document does not describe specific tests requirements types and associated documents, and does not cover the details of the tests requirements definition methodology. However, it is the responsibility of the Business Analysts to get together with tests analysts to ensure that tests requirements are properly traced to project requirements.

1.1.1.5 Requirements and Tests Management

This document does not describe specific methodologies for handling project or tests requirements changes. While change management in these areas is clearly an important aspect of the SDLC, it is out of the scope of this document.

1.1.2 RequisitePro Implementation Details

Rational RequisitePro (a.k.a., “IBM Rational ReqPro”) was used to handle requirements definition for the project. Associated change management tools were not considered due to the project’s aggressive timeline. It should be noted that the use of IBM Rational ReqPro was mostly motivated by the fact that some of the project architects had access to the tool and had previous experience with it. Project time constraints did not allow for evaluation of other tools such as Telelogic DOORS. It is the authors’ opinion that IBM Rational ReqPro does quite a good job at bookkeeping requirements, allows integration of pre-existing requirements specifications developed in Word for Windows, and facilitates group discussions around requirements definition and analysis.
The initial setup of IBM Rational ReqPro required a joint effort between Business Analysts and architects working on the project to come up with generic templates applicable to the project and Enterprise requirements categories illustrated in Figure 1. The template that was created for the project requirements category includes IBM Rational ReqPro document outlines for all the document types used in projects. Since some of the requirement types had already been identified, associated prefix were created for them in IBM Rational ReqPro. Various document types were also created to host the corresponding requirements. Existing document types (e.g., Project Charter, Concept Phase, and Requirements Specification documents) need to be integrated as needed in the list of IBM Rational ReqPro document types.

Business Analysts usually include diagrams to document use case and process requirements. These diagrams are generally high-level and do not typically follow standardized notations (i.e., BPMN)\(^5\). In addition, these diagrams are created together using a variety of tools including Microsoft Visio, and Provision. It is the responsibility of Business Analysts to work closely with Business Architects to leverage the information contained in these diagrams as formal representations of Business Use Cases and Business Processes are created by Business Architects.

In addition to the project template, several Enterprise project templates were partially designed and integrated within IBM Rational ReqPro to support the Enterprise requirements categories illustrated in Figure 1. As suggested in Figure 1 the list of Enterprise-wide requirements supported in IBM Rational ReqPro includes: Pattern/Product/Enterprise Solution Requirements, Enterprise Business Vocabulary Requirements, Business Rules Requirements Repository, Enterprise Solution Patterns Requirements, Business Strategy and Innovation Requirements, and Enterprise Project Requirements. In general Pattern/Product/Enterprise Solution, Enterprise Solution Patterns, and Enterprise Project Requirements are defined as enterprise-level requirements so they can be re-used across multiple projects as external IBM Rational ReqPro projects. Some of the activity threads in the project relied on Business Strategy and Innovation requirements set forth as strategies and initiatives by the company’s strategic planning group. In addition the ESLM sub-project quickly appeared to be centered on the definition of an Enterprise Worker Service. This motivated the creation of a separate IBM Rational ReqPro project to host high-level business requirements from the strategic planning group, cross-project Enterprise Worker Services requirements, and requirements specific to individual projects. Note that the IBM Rational ReqPro project template does include Glossary requirements that are project specific and are not part of the Enterprise Business Vocabulary Requirements.

Figure 4 below illustrates the list of Project and Enterprise Requirements and Documents types and their corresponding IBM Rational ReqPro prefixes and extensions. Requirements types are shown on the left side of the figure and document types are shown on the right side. As mentioned earlier, the IBM Rational ReqPro project template was designed to accommodate company-specific legacy document types. Accordingly and for illustration purpose, Project Charter Documents are mapped to IBM Rational ReqPro documents with a .PCD extension, Concept Phase Documents are mapped to IBM Rational ReqPro documents with a .CPD extension, and Requirements Specification Documents are mapped to IBM Rational ReqPro documents with a .RSD extension. For new projects, it is recommended to work with the more granular document types. For example, rather than creating requirements in a document with a .PCD extension, Business Analysts should work with documents with .SRD, .BOB, and .FNE extensions. Similarly, when working on new projects, requirements traditionally contained in

\(^5\) For example, documents created when using a custom Project Assessment template would require the use of high-level diagrams for analysis purpose.
company-specific legacy documents with a .CPD or .RSD extension should be split into more granular documents as indicated in Figure 4. In general, it is only recommended to use the company-specific legacy document types when creating an IBM Rational ReqPro project for a legacy project that did not use IBM Rational ReqPro initially. This may be useful to start applying IBM Rational ReqPro to an ongoing project or when cataloguing Enterprise Project Requirements from legacy projects for reusability purpose. Otherwise, the more granular document types should be used and IBM Rational SODA reports may be applied if necessary (e.g., to obtain signoff on a Requirements Specification Document) to these documents to create documents compatible with the company-specific legacy document templates. For example, generating a company-specific Concept Phase Document is made possible by applying a SODA report that compiles all the requirements contained in IBM Rational ReqPro documents with extensions .HUC, .HBM, .HFR, and .HNR into a single document with a .CPD extension properly formatted to follow company-specific legacy documentation standards.

As illustrated in Figure 4, different IBM Rational ReqPro prefixes may be used for a given Requirement Type as it is the case for Features and Events (i.e., EVE, and FEA) requirements, or Non Functional Requirements (i.e., requirements with NFE. NFP, and NFR prefixes). Different types of requirements may also be used in a document of a given type as it is the case for Non-Functional Requirements (i.e., requirements with NFE. NFP, and NFR prefixes) within High Level Non Functional Requirements documents (i.e., documents with .HNR or .DNR extensions). Note that the company-specific legacy document typically contains a lot of requirements with different types which contribute to their complexity.
Figure 4 - Use of IBM Rational ReqPro for the Requirements Engineering Phase

Figure 5 below is a screenshot that illustrates the content of the actual IBM Rational ReqPro Project Requirements template used for the project. The IBM Rational ReqPro project explorer shown on the left pane illustrates Business or Functional Requirements for sample project functionality areas. The right pane illustrates an IBM Rational ReqPro traceability matrix view that shows partially established traceability between Business or Functional Requirements and Business Objectives. Being able to trace requirements throughout the requirements hierarchy is one of the main benefits of using a tool like IBM Rational ReqPro. Basically, using such a tool makes it possible to focus on building the “right product” (i.e., the product that meets the requirements) rather than simply building the product right. The EAMF methodology described in this document carries this traceability forward to other phases of the SDLC so that architectural artifacts maintained in Sparx Systems EA may be traced back to requirements captured in IBM Rational ReqPro.
1.2 Enterprise Service Lifecycle Management (ESLM) Requirements Engineering and EAMF Requirements Model Engineering Sample Project

At the inception of the project the conjecture was such that there was a business objective listed in the concept phase document that read as follows: “Provide status on submitted change requests”. The methodology described herewith was followed and led Business Analysts to create an IBM Rational ReqPro project that included the aforementioned requirement. This requirement was then analyzed further by Business Analysts and Business Architects as part of the requirements model engineering and business architecture engineering phases. Based on experience and knowledge of the company’s Enterprise requirements, Business Architects realized that this business objective would be applicable to many other projects within the company. At that point, it was decided that the business objective under study should be promoted to that of an Enterprise Project Requirement. As a result an “Enterprise Transaction Status Tracking” (ETST) project was created under the Enterprise Project category in IBM Rational ReqPro. As described later in this document, the project was renamed to describe an even more comprehensive solution called Enterprise Service Lifecycle Management (ESLM). The circumstances that led to renaming the project will be covered in more detail in the upcoming sections.

1.2.1 ESLM Requirements Definition

The steps outlined in Section 1.1.1.3 were followed to define the business requirements for the ESLM project. The following describes the sequence of steps that was followed by business
analyst to identify and document requirements for the ESLM project. In general, it is recommended to document traceability once all requirements have been identified and documented. This will limit the amount of work that Business Analysts have to put in to clear suspect marks automatically created by IBM Rational ReqPro as inter-related requirements are being reworked.

**Step 1 – Gather Existing Requirements Documentation:**

The group that is in charge of strategic planning at the company created a strategic roadmap that drives the company Enterprise Vision and Goals set forth by the top executives in the company. The strategic roadmap includes programs such as Billing Transformation Program (BTP), Claims Systems, and Marketing Information Systems. In the strategic roadmap, the top level strategic vision and goals requirements are decomposed into strategic and tactical business goals that pertain to each program. Each program has its own strategic planning document; therefore there is a BTP Strategic Plan document for BTP. Within the BTP strategic plan document, there are two main project areas. The first area focuses on improving quality and processes implemented in existing systems. The second area covers the introduction of new technologies to improve the company’s position. The project under study falls in the second category and includes the ESLM project used as a proof of concept example throughout this document.

In terms of documentation, each project includes two sets of supporting documents. The first set covers executive summaries and include documents such as the project profile document. The project profile document is used by executive to make decisions on which projects to fund and when. The second set of documents covers the requirement definitions. These definitions are divided in high level and more detailed levels in the project charter and concept phase documents respectively. While the project profile and charter documents are put together around the same time, the concept phase document is only created when project funding has been approved. The project charter document includes stakeholder requests, business objectives, and features/events. The project concept phase document references the charter requirements, and includes functional requirements, non-functional requirements, use case, and business model requirements.

At the inception of the project, Business Analysts’ responsibility in this step consisted of gathering information that would support the creation of the project charter. Once they gathered this information they started using the IBM Rational ReqPro tool to collect requirements for the project charter. As a preliminary step, they used the ReqPro Project Requirements template to create a ReqPro project named “ESLM”. The subset of requirements that are explained and documented in this section pertain to the ESLM sub-project within the project (i.e., “ESLM”). The following explains in detail how the EAMF requirements definition approach was applied by Business Analysts to compile ESLM requirements.

**Step 2 – Gather Glossary Requirements:**

In this step, Business Analysts documented the known business terminology to be used on the ESLM project. Corresponding glossary requirements were created in IBM Rational ReqPro

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6 The project profile document contains a description of the project, its features, its intangible/tangible benefits, its estimated costs, its dependencies with respect to other projects, and the list of systems that it may impact.

7 Unfortunately by the time the Business Analyst got to this step, a concept phase document had already been created for the project. To get back in sync with the methodology, the Business Analyst had to select the requirements already collected in the concept phase document and insert them in IBM Rational ReqPro.
within a “Glossary.agl” document and used the “TERM” requirement ID as documented in Figure 4. The list of glossary requirements created by Business Analysts is as follows:

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TERM1</td>
<td>Business Entity</td>
</tr>
<tr>
<td>TERM2</td>
<td>Service Request</td>
</tr>
<tr>
<td>TERM3</td>
<td>Service Request Status</td>
</tr>
</tbody>
</table>

**Step 3 – Gather Stakeholder Requests Requirements:**

In this step, in an effort to capture “what the business needs” for ELM, Business Analysts obtained stakeholder requests requirements from the BTP roadmap documentation prepared by the company’s Strategic Planning Office and documented under the Business Strategy and Innovation Requirements category. In fact, these stakeholder requirements had already been included in an early version of the Concept Phase Document prepared by Business Analysts. Business Analysts verified that these stakeholder requests that were applicable at the inception of the BTP program were still applicable to the project. Corresponding stakeholder requirements were created in IBM Rational ReqPro within a “Stakeholder Requests.srd” document and used the “SRQ” requirement ID as documented in Figure 4. The list of stakeholder requirements created by Business Analysts is as follows:

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRQ1</td>
<td>Advance the company’s capability to provide services and enable its customers with state-of-the-art technology (traced from Business Strategy and Innovation Requirements category).</td>
</tr>
<tr>
<td>SRQ2</td>
<td>Reduce workload for company employees (traced from Business Strategy and Innovation Requirements category).</td>
</tr>
</tbody>
</table>

**Step 4 – Gather Business Objectives Requirements:**

In this step, in an effort to capture actual ELM “project goals”, Business Analysts compiled project specific business objectives. At the inception of the BTP program, the following business objective had been stated for the program: “Provide status on submitted change requests”. In fact, this particular business objective had already been included in an early version of the Concept Phase Document. Business Analysts verified that this business objective was still applicable to the project. This led to restating the business objective as “Maintain status on submitted service requests” to encompass the need for durability of status maintenance. Corresponding and related business objectives requirements were created in IBM Rational ReqPro within a “Business Objectives.bob” document and used the “BUS” requirement ID as documented in Figure 4. Traceability relationships between business objectives and stakeholder requests requirements were then established and documented by Business Analysts within IBM Rational ReqPro. The list of business objectives requirements created by Business Analysts is as follows:

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUS1</td>
<td>Maintain status on submitted service requests.</td>
</tr>
<tr>
<td>BUS2</td>
<td>Guarantee 100% accuracy on service request status reports.</td>
</tr>
</tbody>
</table>

**Step 5 – Gather Features and Events Requirements:**

In this step, in an effort to capture “how the goals are met and when” for ELM, Business Analysts identified the specific events that should trigger the application of features in order to
meet the previously stated business objectives requirements. Corresponding events requirements were created in IBM Rational ReqPro within a “Features and Events.fne” document and used the “EVE” requirement ID as documented in Figure 4. Traceability relationships between features and events and business objectives requirements were then established and documented by Business Analysts within IBM Rational ReqPro. The list of events requirements created by Business Analysts is as follows:

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVE1</td>
<td>Service Request Submitted</td>
</tr>
<tr>
<td>EVE2</td>
<td>Status Requested</td>
</tr>
<tr>
<td>EVE3</td>
<td>Service Request Status Changed</td>
</tr>
</tbody>
</table>

Business Analysts subsequently identified the specific features required to meet the previously stated business objectives requirements. Corresponding business objectives requirements were created in IBM Rational ReqPro within the “Features and Events.fne” document created previously and used the “FEA” requirement ID as documented in Figure 4. Traceability relationships between events and features requirements were then established and documented by Business Analysts within IBM Rational ReqPro. The list of features requirements created by Business Analysts is as follows:

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEA1</td>
<td>Ability to save service requests</td>
</tr>
<tr>
<td>FEA2</td>
<td>Ability to save service request statuses</td>
</tr>
<tr>
<td>FEA3</td>
<td>Ability to find service request statuses</td>
</tr>
</tbody>
</table>

Step 6 – Gather Functional Requirements:

In this step, in an effort to capture ESLM “actual functionality required”, Business Analysts documented functional requirements. All requirements identified resulted from common knowledge of the company’s business rather than from the decomposition of features and events and business objectives requirements. Corresponding functional requirements were created in IBM Rational ReqPro within a “High-Level Non-Functional Requirements.hfr” document and used the “FNC” requirement ID as documented in Figure 4. Traceability relationships between functional and other requirements (including business objectives, features and events, and use cases requirements) were then established and documented by Business Analysts within IBM Rational ReqPro. The list of functional requirements created by Business Analysts is as follows:

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FNC1</td>
<td>A business entity must be uniquely identified throughout the Enterprise.</td>
</tr>
<tr>
<td>FNC2</td>
<td>All service requests submitted must be resolved.</td>
</tr>
<tr>
<td>FNC3</td>
<td>A service request must be uniquely identified throughout the Enterprise.</td>
</tr>
</tbody>
</table>

Step 7 – Gather Non-Functional Requirements:

In this step, in an effort to capture known ESLM “project constraints”, Business Analysts documented non-functional requirements. Requirements were identified via a decomposition of business objectives requirements. Corresponding non-functional project requirements were created in IBM Rational ReqPro within a “High-Level Non-Functional Requirements.hnr” document. No non-functional external and process requirements were documented as part of this effort. A non-functional project requirement was identified for ESLM and used the “NFR” requirement ID as documented in Figure 4. Traceability relationships between non-functional and
other requirements (including business objectives, features and events, and use cases requirements) were then established and documented by Business Analysts within IBM Rational ReqPro. The list of non-functional requirements created by Business Analysts is as follows:

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFR1</td>
<td>Accuracy of service request status information should be 100%.</td>
</tr>
</tbody>
</table>

No specific non-functional external requirements were identified as a result of this step as indicated in the table below:

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFEs</td>
<td>No non-functional external requirements were identified.</td>
</tr>
</tbody>
</table>

No specific non-functional process requirements were identified as a result of this step as indicated in the table below:

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPs</td>
<td>No non-functional process requirements were identified.</td>
</tr>
</tbody>
</table>

**Step 8 – Gather Use Case Requirements:**

In this step, in an effort to capture “who does what and for what purpose” in the ESLM project, Business Analysts documented use case requirements. Their initial focus was on decomposing features and events and functional requirements to help identify actors, their goals, and all related interactions with the business solution to-be. These interactions were used to document use cases and corresponding use cases requirements were created in IBM Rational ReqPro within a “High-Level Use Cases.huc” document and used the “USE” requirement ID as documented in Figure 4. Traceability relationships between use cases and other requirements (including features and events, business or functional, and non-functional requirements) were then established and documented by Business Analysts within IBM Rational ReqPro. The list of use cases requirements created by Business Analysts is as follows:

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE1</td>
<td>Register Service Request</td>
</tr>
<tr>
<td>USE2</td>
<td>Update Service Request Status</td>
</tr>
<tr>
<td>USE3</td>
<td>Handle Service Request Status Inquiry</td>
</tr>
</tbody>
</table>

**Step 9 – Gather Business Model Requirements:**

In this step, Business Analysts captured “the location, organization, and business/process/rules/workflow” details relevant to the ESLM project. This was accomplished by decomposing existing requirements (including features and events and possibly business or functional requirements). Corresponding requirements were created in IBM Rational ReqPro within a “High-Level Business Model.hbm” document.

**Step 9-1 – Gather Location Requirements:**

In this sub-step, in an effort to capture “the applicable business locations” relevant to the ESLM project, Business Analysts documented location requirements. Their initial focus was on decomposing features and events and functional requirements to help identify where the business solution would be located and/or accessed from. Corresponding location requirements were
created in IBM Rational ReqPro within a “High-Level Business Model.hbm” document and used the “LOC” requirement ID as documented in Figure 4. No project specific location hierarchy diagram was created as a result of this effort due to the simplicity of the location model at that stage. Traceability relationships between location and other requirements (including business or functional, non-functional, use cases, organization, process, business rules, and workflow rules requirements) were then established and documented by Business Analysts within IBM Rational ReqPro. The list of location requirements created by Business Analysts is as follows:

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOC1</td>
<td>Company Offices</td>
</tr>
<tr>
<td>LOC2</td>
<td>Company Customers Sites</td>
</tr>
</tbody>
</table>

Step 9-2 – Gather Organization Requirements:

In this sub-step, in an effort to capture “the applicable organizational entities” relevant to the ESLM project, Business Analysts documented organization requirements. Their initial focus was on decomposing features and events and functional requirements to help identify relevant actors. Corresponding organization requirements were created in IBM Rational ReqPro within the previously created “High-Level Business Model.hbm” document and used the “ACT” requirement ID as documented in Figure 4. No project specific organizational hierarchy diagram was created as a result of this effort due to the simplicity of the organization model at that stage. Traceability relationships between organization and other requirements (including business or functional, use cases, location, process, business rules, and workflow rules requirements) were then established and documented by Business Analysts within IBM Rational ReqPro. The list of location requirements created by Business Analysts is as follows:

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT1</td>
<td>Status Tracker</td>
</tr>
<tr>
<td>ACT2</td>
<td>Status Requestor</td>
</tr>
<tr>
<td>ACT3</td>
<td>Status Provider</td>
</tr>
</tbody>
</table>

Step 9-3 – Gather Process Requirements:

In this sub-step, in an effort to capture “the applicable processes” relevant to the ESLM project, Business Analysts documented process requirements. Their initial focus was on decomposing features and events, functional requirements, and use cases requirements to help identify relevant processes. Corresponding process requirements were created in IBM Rational ReqPro within the previously created “High-Level Business Model.hbm” document and used the “BPR” requirement ID as documented in Figure 4. No project specific business process hierarchy diagram was created as a result of this effort due to the simplicity of the process model at that stage. Traceability relationships between process and other requirements (including business or functional, non-functional, use cases, location, organization, business rules, and workflow rules requirements) were then established and documented by Business Analysts within IBM Rational ReqPro. The list of process requirements created by Business Analysts is as follows:

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPR1</td>
<td>Service requests must be registered before they can be changed or inquired about.</td>
</tr>
</tbody>
</table>

Step 9-3-1 – Gather Business Rules Requirements:
In this sub-step, in an effort to capture “the process guiding business rules” relevant to the ESLM project, Business Analysts documented business rules requirements. Applicable rules were located in the Business Rules Requirements Repository. No project specific business rules were identified at that stage. Corresponding business rules requirements were created in IBM Rational ReqPro within the previously created “High-Level Business Model.hbm” document and used the “BUR” requirement ID as documented in Figure 4. Traceability relationships between business rules and other requirements (including business or functional, non-functional, use cases, location, organization, process, and workflow rules requirements) were then established and documented by Business Analysts within IBM Rational ReqPro. The list of business rules requirements created by Business Analysts is as follows:

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUR1</td>
<td>Protect sensitive customer information (traced from Business Rules Requirements Repository).</td>
</tr>
</tbody>
</table>

**Step 9-3-2 – Gather Workflow Rules Requirements:**

In this sub-step, an effort was made by Business Analysts to capture “the process guiding business workflow rules” relevant to the ESLM project. No specific requirements were identified as a result of this step as indicated in the table below.

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WFRs</td>
<td>No workflow rules requirements identified.</td>
</tr>
</tbody>
</table>