Software Requirements Specification
Document Number A001
Project Name: KMCM

Revision History

Date	Revision	Description	Author
03/06/2019	1.0	Initial Version	Brett Favre
03/17/2019	2.0	Revised Draft	Aaron Rodgers
03/21/2019	3.0	Final Draft	Sean McGuire

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1. Introduction

1.1 Purpose

Widgets Inc relies heavily on its PLM systems throughout its product development process. The inherent complexity of these systems often leads systems administrators to have to troubleshoot many issues that limit system availability for engineers and delay the design and implementation tasks that are the core business of the company. Although troubleshooting and supporting the engineers is part of the administrator's responsibilities they are also a valuable asset to the organization in helping with process improvement. In order to allow engineers to focus more time on process improvements we are developing Knowledge Management (KM) and Change Management (CM) systems to help accelerate the troubleshooting process to allow administrators to focus on more value added tasks for the organization. Implementation of a KM system should also allow engineers to be self-sufficient in getting help using some features of the PLM system, because their initial training was inadequate or out of date. Providing a knowledge system also has a beneficial side effect of allowing new engineers to train themselves.

This Software Requirements Specification will provide a technical specification for design, test and validation as it relates to the KMCM project for Widgets Inc. All of the requirements for the system are described and the project will only be considered complete when all of these requirements are met.

1.2. Scope

This document describes the requirements for version 1 of the KM and CM systems. All of the features and requirements of each system are covered. Currently, there are no planned versions of these systems past version 1.

Version 1 of the KM application will support the documentation and retrieval of system issues encountered by both administrators and PLM system end users (engineers). It will also provide the ability to document standard work instructions and operating procedures to be made available to all end users in one centralized location accessible from the company's intranet.

Version 1 of the CM application will provide systems administrators with the means to document systems changes for reference by other systems administrators. This will also allow the business to keep the current system configuration available for reference when needed. When one component is modified, the CM system will remind administrators that a dependency was affected.

1.3 Assumptions and Dependencies

KMCM will utilize many IT technologies that are currently deployed at Widgets Inc. The system will be running on the existing VMware vSphere infrastructure that is currently deployed across a number of existing HP Blade servers. The VM will be running a Ubuntu 18.04 operating system. The database will be a Postgres database instance running on the existing database server, so adequate system resources must be available.

2. Software Product Overview

The PLM Knowledge and Change Management System (KMCM System) is a new suite of applications that will focus on reducing the systems administrators' time spent away from value added tasks allowing for increased time in creating process improvements for the PLM systems. This product is called KMCM because it combines Knowledge Management (KM) with Configuration Management (CM) into a single product. With dedicated support from administrators, process improvements can be designed and put into place faster. The Knowledge Management functions will support the documentation and retrieval of PLM system issues encountered by both administrators and end users (engineers). The KM portion of the system will also provide the ability to document standard work instructions and operating procedures to be made available to all end users in one centralized location accessible from the company's intranet.

The Change Management feature will provide systems administrators with the means to document PLM Systems changes for reference by other systems administrators. This will also allow the business to keep the current system configuration available for reference when needed. PLM systems utilize a number of technologies that are dependent upon one another and it is important to be able to manage the system configuration for troubleshooting and management purposes. When one component is modified, the CM system will remind administrators that a dependency was affected.

The use of the KMCM system will allow Widgets Inc and their employees to focus on value added tasks that contribute to their organizational goals. With a successful implementation, the systems administrators can focus on improving processes to reduce product development time and at the same time improve product quality. With the reduced development time it will allow for the company to take on more opportunities and sell more product. Additionally, with the KM product, administrators will be able to provide faster and higher quality technical support, which means less down-time for the engineers involved in the product development process. Standardized documentation practices will reduce the ramp-up time for new employees and minimize the risk from the loss experienced personnel. Details related to targeted sales growth can be found in section 2.1.

2.1 System Scope

Widgets Inc has a number of knowledge management systems in place to support other aspects of the business (tech support, sales, finance, etc) but none of them are easily modifiable to accommodate the system requirements defined in this document. KMCM will be a stand-alone system that will have simple interfaces with the corporate email system. It will share hardware with some other database and web applications but other than the simple email interface there is no additional system integration.

2.2 System Architecture

2.2.1 External View of Software Product

The below figure illustrates the different systems that are involved to comprise the KMCM system. An email server will be responsible for sending alerts to users while the database and application server will house the database and the software respectively. Admins and engineers will use their computers to interact with the system using a web-based application.
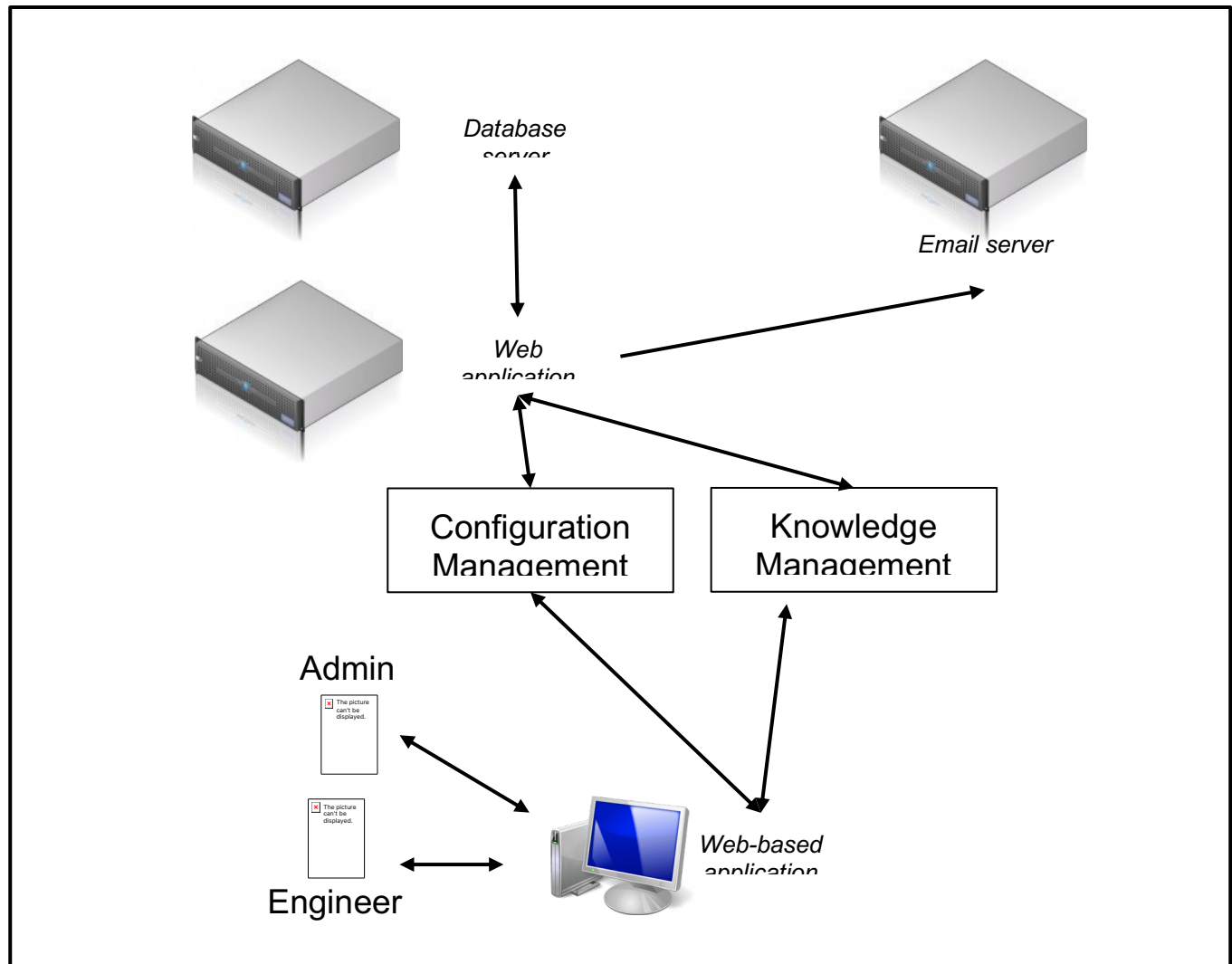
Figure 1. External view of product

2.2.2 Internal View of Software Product
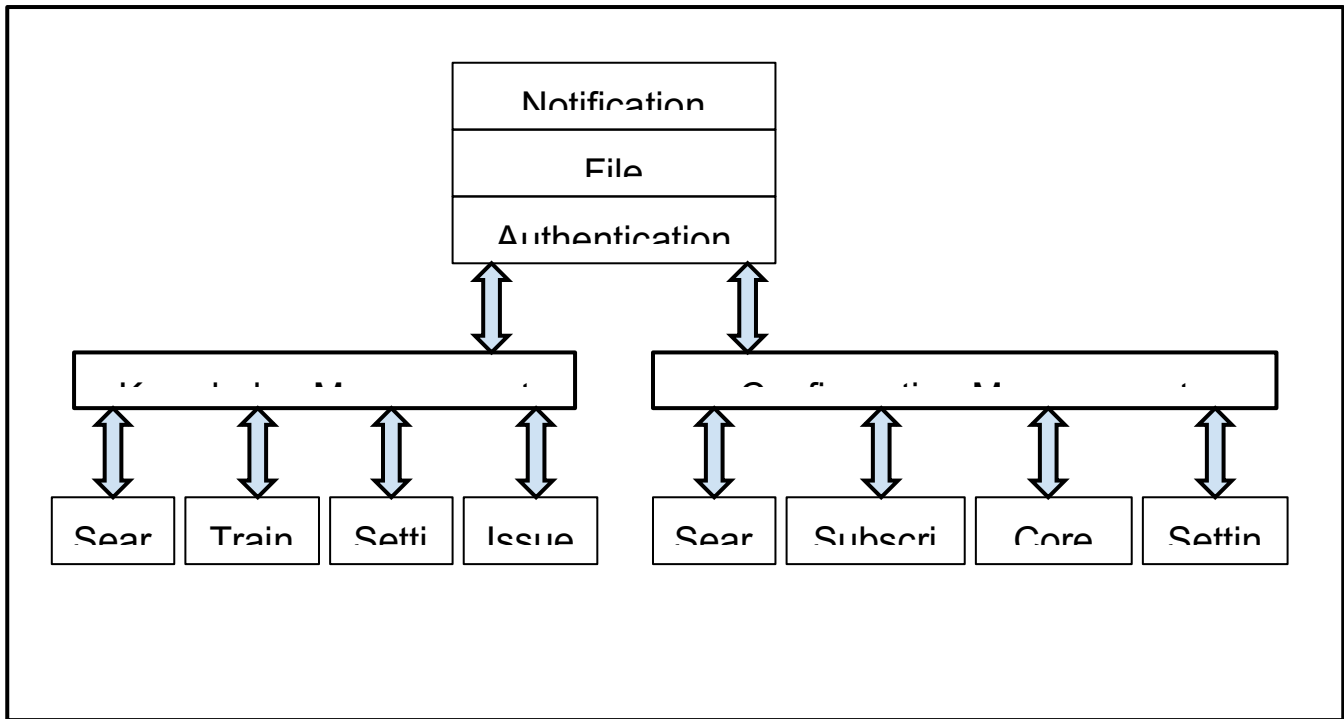
Figure 2. Software product component diagram

Figure 2 shows modules shared between the KM and CM applications - these modules house functionality common to both applications and assist with code reuse and which in turn helps limit growth of the code base. The modules that have the same name but are not shared between the KM and CM applications have distinct functionality for each module - for example, searching a CM system will have different inputs/outputs than a KM search system.
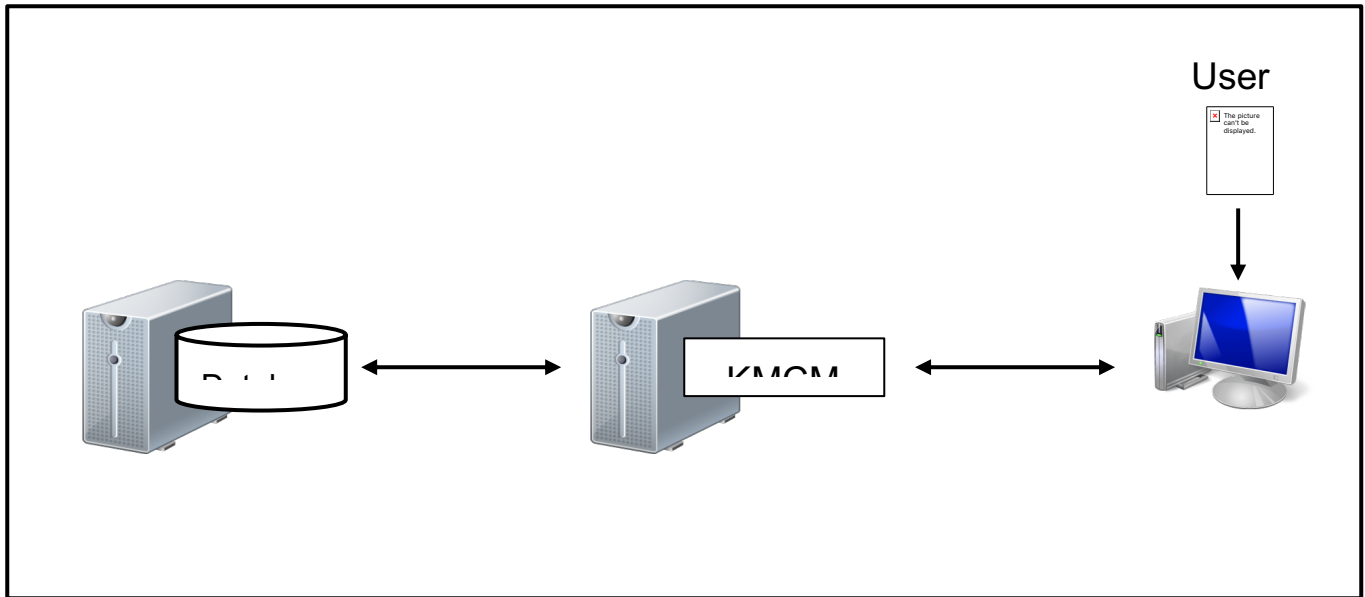
Figure 3. Hardware deployment diagram

The hardware deployment diagram above illustrates the basic system setup that will be used to run the KMCM system. In future revisions, it would be prudent to add load balancing for the KMCM system as well as the database. This will enable active failover and redundancy functionality that will not exist in the first version of the application.

2.3 Feature Overview

FEA_KM1 - Secure Login

Administrator logs into the system securely to enable additional documentation and configuration capabilities.

FEA_KM2 - Document Issues and Resolutions

Administrator describes and formally captures a description of the problem, the steps that lead to its occurrence, the actions taken to remediate it, and how it may be prevented from occurring in the future.

FEA_KM3 - Search for Issue Resolutions

Administrator is able find resolutions to previously solved issues that are most similar to a given issue, within a similar family of applications or systems. Search criteria will encompass all attributes available for issue entry as well as a full text search for text string attributes.

FEA_KM4 - Filter/Sort Search Results

Administrator will be able to sort results by each column in ascending or descending order. They can also further refine their search by filtering specific attributes instead of having to start a new search.

FEA_KM5 - Display All Issue Resolutions

Allow the administrator to display all issues and their resolutions without searching.

FEA_KM6 - Create Troubleshooting Documentation

Administrators create documentation, appropriate for a junior administrator, that describes how to resolve some commonly reoccurring issue and answers some frequently asked questions about the use of PLM application.

FEA_KM7 - Create Self Paced Training Material

Administrators create training material to help new engineers ramp up their PLM skills faster, provide refresher training for engineers and provide a low cost and self paced way for users to learn about the systems and applications.

FEA_KM8 - Search for Issue Resolutions (Engineers)

Engineers are able to answers their own questions by searching by error messages or keywords and having a set of possible resolutions returned to them.

FEA_KM9 - Rate Search Results (Engineers)

Engineers can rate the usefulness of the materials they find, which will help to return relevant data to other users searching for similar topics.

FEA_KM10 - Search for Self Paced Training Material (Engineers)

Engineers are able to search for self paced training material that has been created for their reference.

FEA_CM1 - Configure Change Management Application

Administrators will create the basic attributes that will be used for the CM application. This will be how the CM infrastructure and application lists will be configured to be usable in a change. They will build lists of Application names, server names, and other objects similar to building a custom list in a google search.

FEA_CM2 - Create Baseline System Configuration

Administrators will formally document a baseline configuration of an application or system. During the deployment of a PLM application there are many configuration settings that need to be documented. All of the details of the installation and configuration process that are modified from the Out Of The Box (OOTB) settings will be recorded.

FEA_CM3 - Display System Baseline

System will prepare a report of baseline information suitable for inclusion in a disaster recovery and continuity of operations plan.

FEA_CM4 - Document System Restoration Information

System can capture non-functional requirements that would be needed to recreate or restore to an entirely new system, such as minimum hardware specs, location of installation media, etc.

FEA_CM5 - Document System Configuration Changes

Administrators record all changes made to an application or system, during its lifetime. This includes any changes related to data models, site preferences, environment variables, custom code, etc.

FEA_CM6 - Attach files related to Systems Changes

The administrator will be able to attach files and additional artifacts to new and existing documented system changes.

FEA_CM7 - Subscribe to System Changes

Administrators will be able to register or remove themselves as being associated with a system or application. This will allow alerts to be communicated to the proper administrators when changes are made.

FEA_CM8 - Alert Subscribers of System Changes

Administrators will receive an alert when a change is entered for one of the systems or applications that they have subscribed to.

FEA_CM9 - Search for systems changes based on Application Name

System will allow the administrator to search for changes to PLM applications by name and review the change(s) that were applied to those applications.

FEA_CM10 - Roll-back a change entry

System will allow the administrator to roll-back the submitted change in the event that it caused unwanted effects and the changes were rolled-back in the PLM system. This will allow the system to maintain a true lifeline of the changes, noting that a previous change has been rolled back. The system will automatically alert the subscribed users.

FEA_CM11 - Review System Configuration Changes "Lifeline"

In the event of unexpected issue, any administrator can retrace the set of actions that led to system failure. Any administrator would have the necessary information to roll-back those changes, and would be aware of the impact of doing so.

FEA_CM12 - Display recent system changes

The administrator will be presented with a chronological list of the last 10 previously applied changes for all PLM Systems.

Administrators can see to what systems a particular category or grouping of changes has been applied to.

3. System Use

3.1 Support For User Workflows

Engineer	Senior	Junior	HR
Ask for support	Provide solution to		
Receive solution to	Informal notification to other admins of the problem		
New engineer			Provide training
Basic understand			Hire new engineer
	Hold ad-hoc knowledge transfer	Obtain knowledge transfer from	
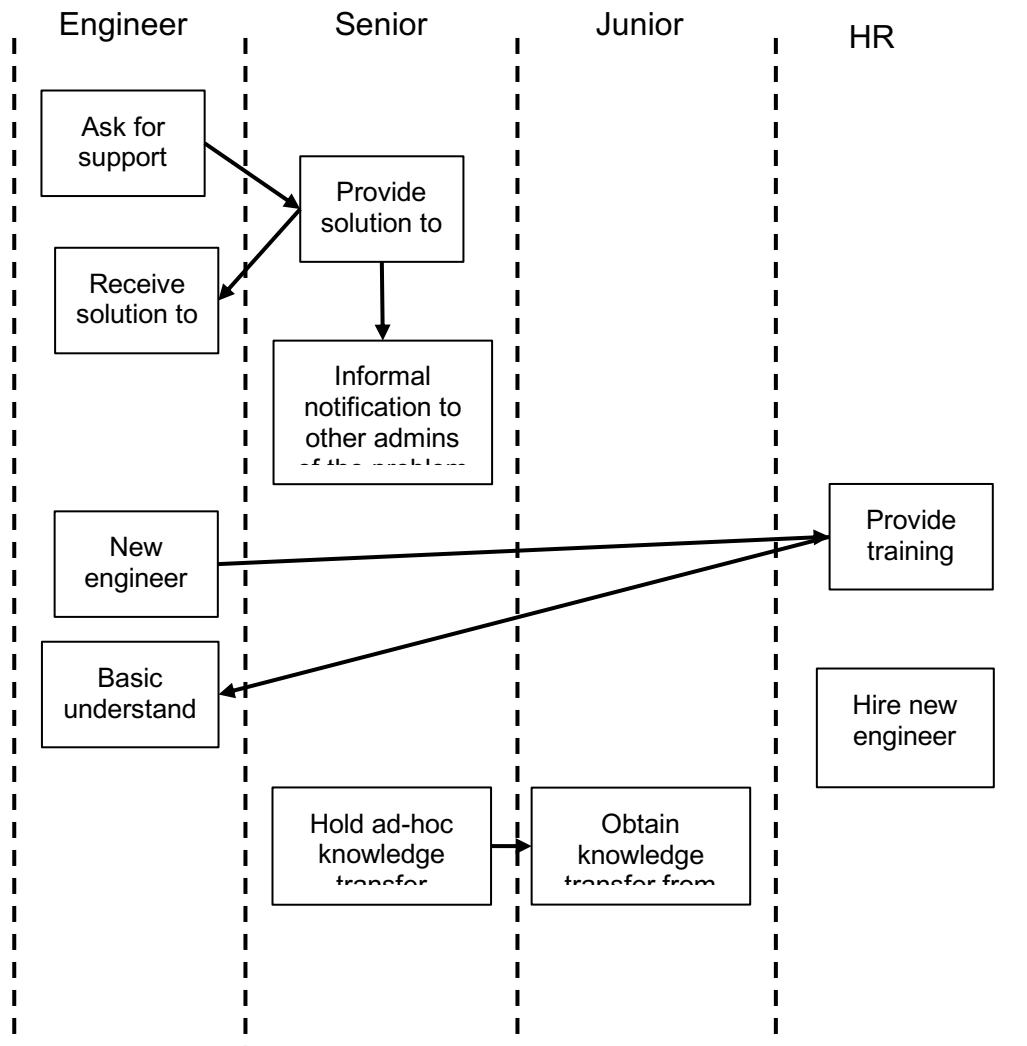
Figure 4. Business-level activity diagram

The above figure displays essential user workflows that occur on a day-to-day basis. The most used workflow is the first one where an engineer asks an administrator for assistance. It should be noted that Junior and Senior administrator was broken into two separate swimlanes so the knowledge transfer workflow could be easily illustrated. While engineering management has a vested interest in hiring and training new employees, they have not been displayed in this figure.

3.2 Actor Survey

Systems administrators (also called admins) often receive numerous help requests related to troubleshooting issues with PLM systems or related to training and support of PLM systems. While these activities are useful to the end users they limit the time that admins can spend developing process improvements and enhancements to support the business. Globally distributed environments make it difficult for admins to share knowledge related to issue resolutions and troubleshooting techniques. It is also difficult for all of the admins to be aware of system changes that at times can be causing some of the issues they are required to support. Upgrades to the PLM Systems are often time consuming because the admins are required to interrogate the systems to document the current configuration to do the proper QA testing and planning for the upgrades. End users often require routine follow-up training after initial training sessions and this is often performed by an admin. The time spent providing training (on material that they have already presented) is a duplication of effort and again keeps them from providing valuable contributions to the business in the form of process improvements.

- **Engineering Systems Administrators** are Information Technology (IT) professionals. They typically possess degrees in fields such as Information Technology (IT), Computer Science (CS) and/or Mechanical Engineering (ME). Administrators must possess a strong understanding of NPDI processes and procedures. They are expected to achieve and maintain certifications in a variety of technologies and 3rd party applications. Many administrators are recent college graduates. Administrators who have at least 5 years of experience and have demonstrated leadership capabilities are considered senior-level personnel and are expected to coordinate the training and career development of junior-level employees. The primary responsibility of all administrators is to provide end user support and issue resolution for PLM systems. Administrators must provide quick troubleshooting by identifying system changes that could impact users, but many are not diligent about documenting the changes they make, and so key knowledge is not being shared between administrators. Administrators often find themselves having to provide engineers with instructions for using the PLM systems, which impedes their primary responsibilities of rapid issue resolution and preventative system maintenance. Administrators' performance is measured by standard IT metrics such as system availability and mean time between failures. Administrators are also assessed qualitatively through satisfaction surveys sent to end-users after any supported is provided. The IT department's goal is to achieve no more than 9 hours of unscheduled downtime per year (or approximately 99.9% availability). Management will allow for 1 hour of scheduled off-hour maintenance per month.

- **Engineering Management** are the individuals responsible for managing the new product development process. They leverage PLM systems to reduce the time to market and increase product quality by standardizing processes. They typically have advanced degrees in engineering and manufacturing fields and many have MBAs. Many managers are drawn from the ranks of the company's engineers, so they are intimately familiar with the challenges faced by the people they manage. Any issues with the PLM systems can have serious repercussions for the product design and manufacturing process, leading to schedule slips and potentially broken commitments to customer, situations must be minimized to achieve the greater organization business goals that engineering management is held to. Engineering management would like to save money by hiring entry-level engineers and so need a way to bring new people up to

speed and utilize their skills without delay. Engineering management is measured by the metrics of relative time-to-market, quality issue reduction, and year-over-year sales growth.

- **Engineers** are the day-to-day users of the PLM systems. They require support to resolve errors in the application and frequently request information on how to use particular aspects of the system from the administrators. Engineers have degrees in fields such as electrical and mechanical engineering, and often subject matter experts for a particular product or vendor niche. Engineers want to minimize the time they spending teaching each other or asking the administrators for help with the PLM system. Engineers feel refresher training is too infrequent and wastes time because it may cover topics that don't require re-training. Engineers, especially the senior-level employees, would also like get new employees ramped up sooner so they can assist senior engineers with the product design process.

- **Human Resources** are responsible for hiring and coordinating training for engineers and administrators. They want to minimize disruptions from the loss of skilled personnel and ease the transition of new employees. Human resources has the difficult task of quickly locating, interviewing, and hiring employees that can replace former administrators - if they exist at all. In the current cultural environment of the company it is difficult for new employees to "ramp-up" their knowledge of the IT domain and their productivity lags behind more experienced personnel. Human resources must find potential employees with the unique skills sets to succeed in this unique environment and struggles to retain those employees after hiring. Lower than desired employee retention rates further exacerbate the problem as 'tribal knowledge' is frequently lost before it can be disseminated. Human resources has found in yearly performance reviews and interviews that engineers receive initial training on how to use the PLM systems but later struggle to use features that were not part of their previous job duties or were used very infrequently. It is too difficult to determine where each individual engineer needs specialized training, so periodic refresher training is given to all engineers. This is wasteful of much of the engineer's time and expensive to prepare and present, which human resources is responsible for doing.

3.2 Use-Case Model and System Events
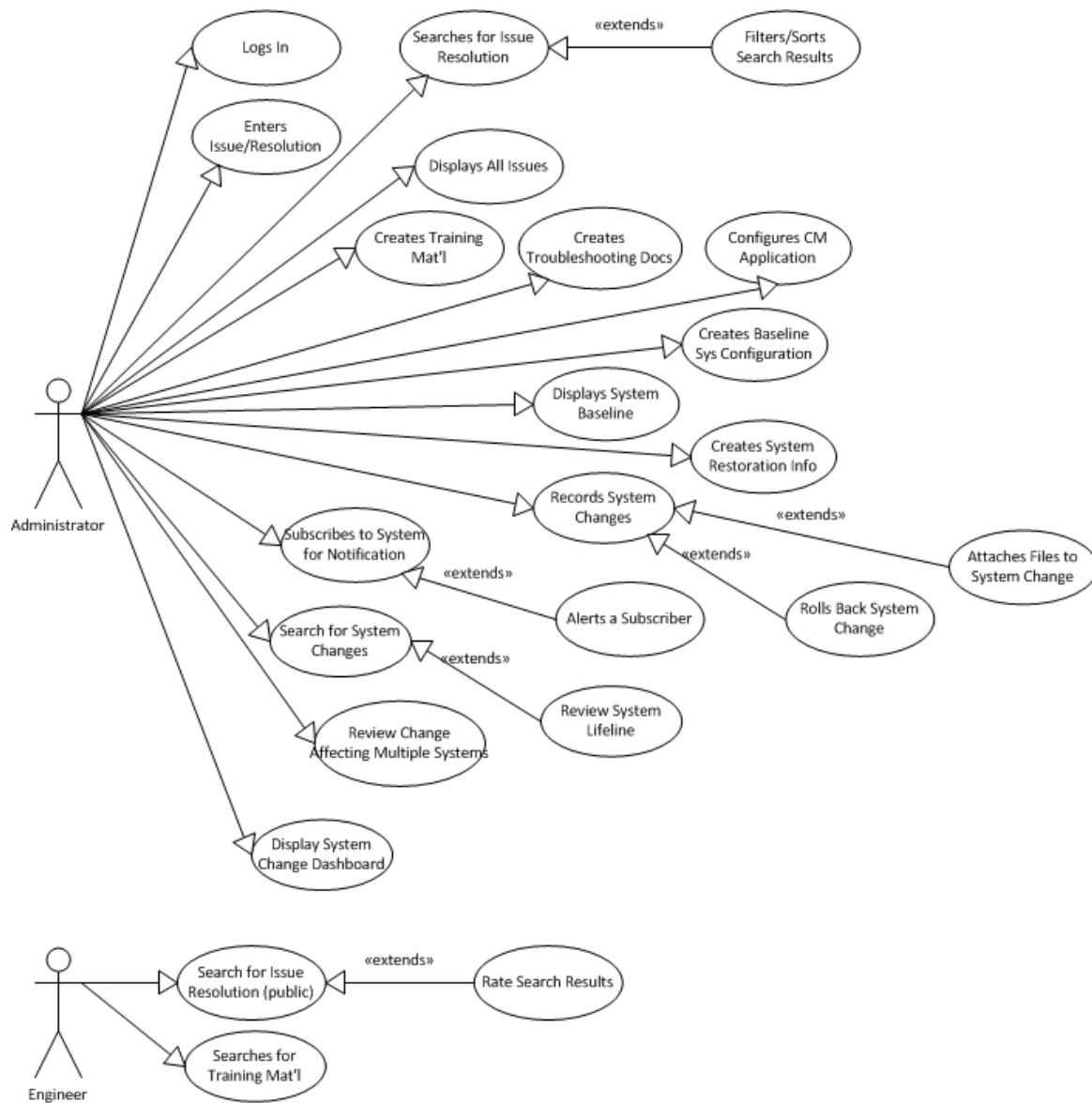
Figure 5. Use Case Diagram

The above figure displays the use cases that the administrators and engineers will engage in while working with KMCM. The system focuses on making the administrator more efficient which is why the administrator is included in a majority of the use cases.

Business Event	Applicable Use Case(s)	System Inputs	System Outputs
Engineers need assistance with PLM system error	KM08 Search for issue resolution (public) KM03 Search for issue resolution KM04 Filter/sort search results	Description of problem	List of issues resolution articles, sorted by relevancy
Engineers need non-critical assistance or training	KM10 Searches for training materials KM07 Create training materials	Training topic area	List of training materials, sorted by relevancy
Administrator identifies PLM system error	KM03 Search for issue resolution KM04 Filter/sort search results	System or application name Description of problem	List of issues resolution articles, sorted by relevancy
Administrator finds existing solution	KM03 Search for issue resolution KM04 Filter/sort search results CM09 Search for system changes CM11 Review system lifeline CM13 Review change affecting multiple systems	System or application name Description of problem	Issue resolution article that solves problem Lifeline of system changes Other systems affected by changes
Administrator fails to find solution, troubleshooting performed	KM03 Search for issue resolution KM04 Filter/sort search results	System or application name Description of problem	Administrator creates troubleshooting documentation (outside of system)
Administrator finds new solution and has resolution information	KM02 Enter issue/resolution KM06 Administrator Creates Troubleshooting Documentation	System or application name Description of problem Troubleshooting documentation	New issue resolution article

Issue resolution changes system configuration	KM02 Enter issue/resolution CM05 Record system changes CM06 Attaches files to system change CM08 Alerts a subscriber	System or application name Description of change(s) Supporting artifacts	New configuration change Emails sent to subscribed administrators
Administrators must be notified of configuration changes	CM07 Subscribes to system for notification CM08 Alerts a subscriber	System or application name	Subscription list updated Emails sent to subscribed administrators
Administrator creates training materials for Engineers	KM07 Create training material	Training materials	New training article visible to engineers
Administrator needs to document system baseline and restoration information	CM02 Creates baseline system configuration CM03 Displays system baseline CM04 Creates restoration information	System name Hardware configuration (IP, specs, OS, etc) Supporting files (scripts, dll's, patches, etc)	System baselines created System restoration information created

The process flow diagram shown below illustrates the many different processes that are involved in the creation of a product using a PLM system. The diagram shows that main actors are the administrators and engineers. The CAD/CAM PLM tool is also heavily used by the main actors and a Manufacturing employee to create product, making it difficult to change this part of the system. Documentation is also shared amongst two different actors, but there is a distinction between the documentation that the administrator and engineer use. Administrators and engineers both use documentation. This key target area will allow for a solution that can be shared amongst the groups when applicable but can also be tailored to fit each audience when needed. As the two different distinct user groups perform two different functions, it is also important to note that the presentation of the search data will be different between an administrator and engineer. Both groups of users should be able to customize what they see on their screen to suit their needs. Administrators will want to see more specific technical items in their searches while engineers would prefer to have their results trimmed down to display only relevant information from their search.

Although an ill employee may stop knowledge transfer, an administrator/engineer still may provide education via email while the employee is out. This may create strain for the employee as they return to work so this process can be improved upon as part of the system solution. Although there is only a single line from the administrator to system change, keep in mind that many administrators are making many system changes each day. More weight should be applied to any solution that touches system change as it will magnify the good or bad that comes from it.
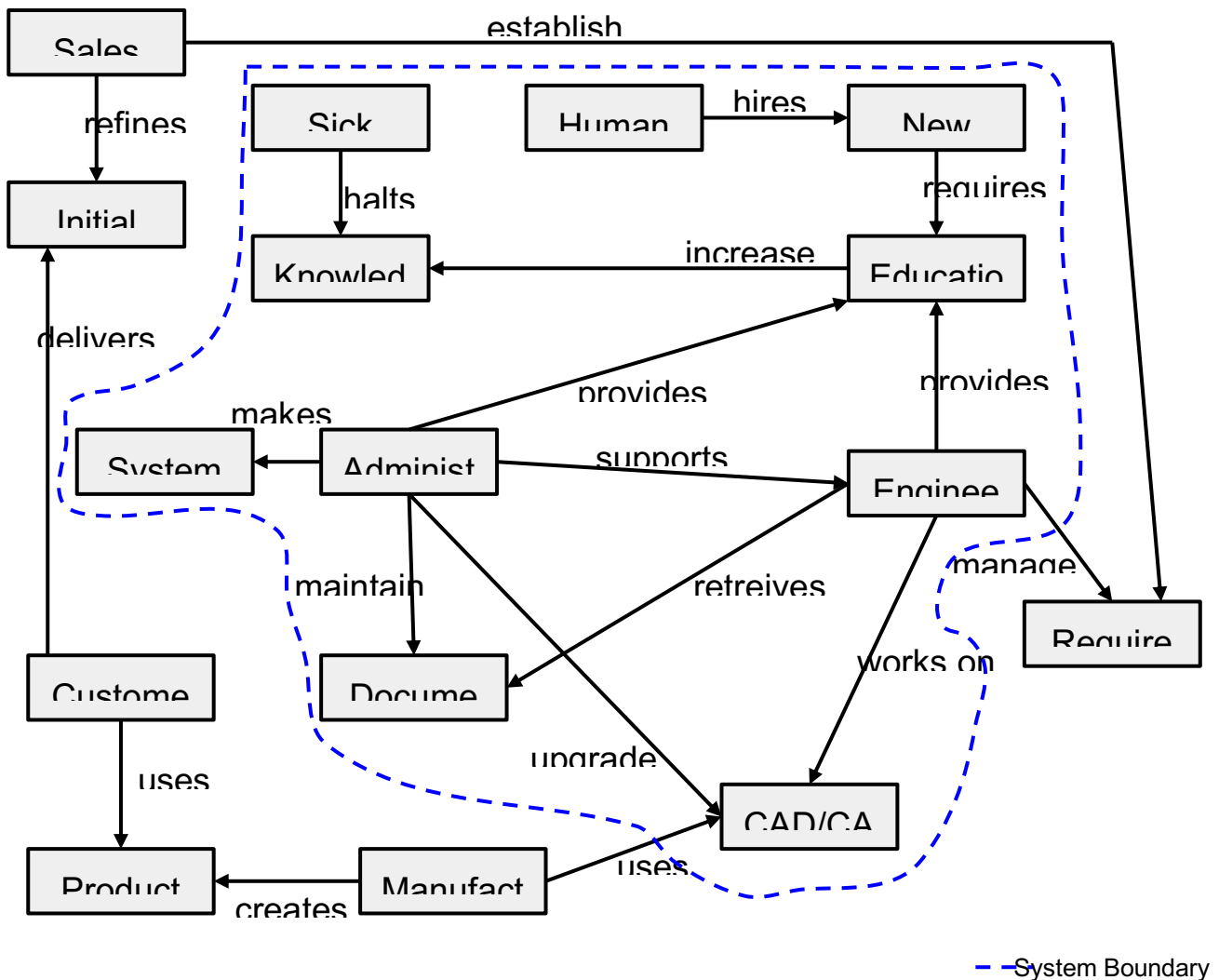
Figure 6. Business Process Flow Diagram

3. 3 System Interfaces

The following diagrams describe the primary KM and CM system interfaces, detailing user interaction flows and user-screen navigation paths. Figure 3 shows the business events that drive the interactions of the administrators and engineers with the KM and CM systems. The business events are mapped to use-cases and the system input/outputs in section 3.2. Figures 4 and 5 show how users will navigate between screens, and how the functionality of each use-case is achieved by the application.
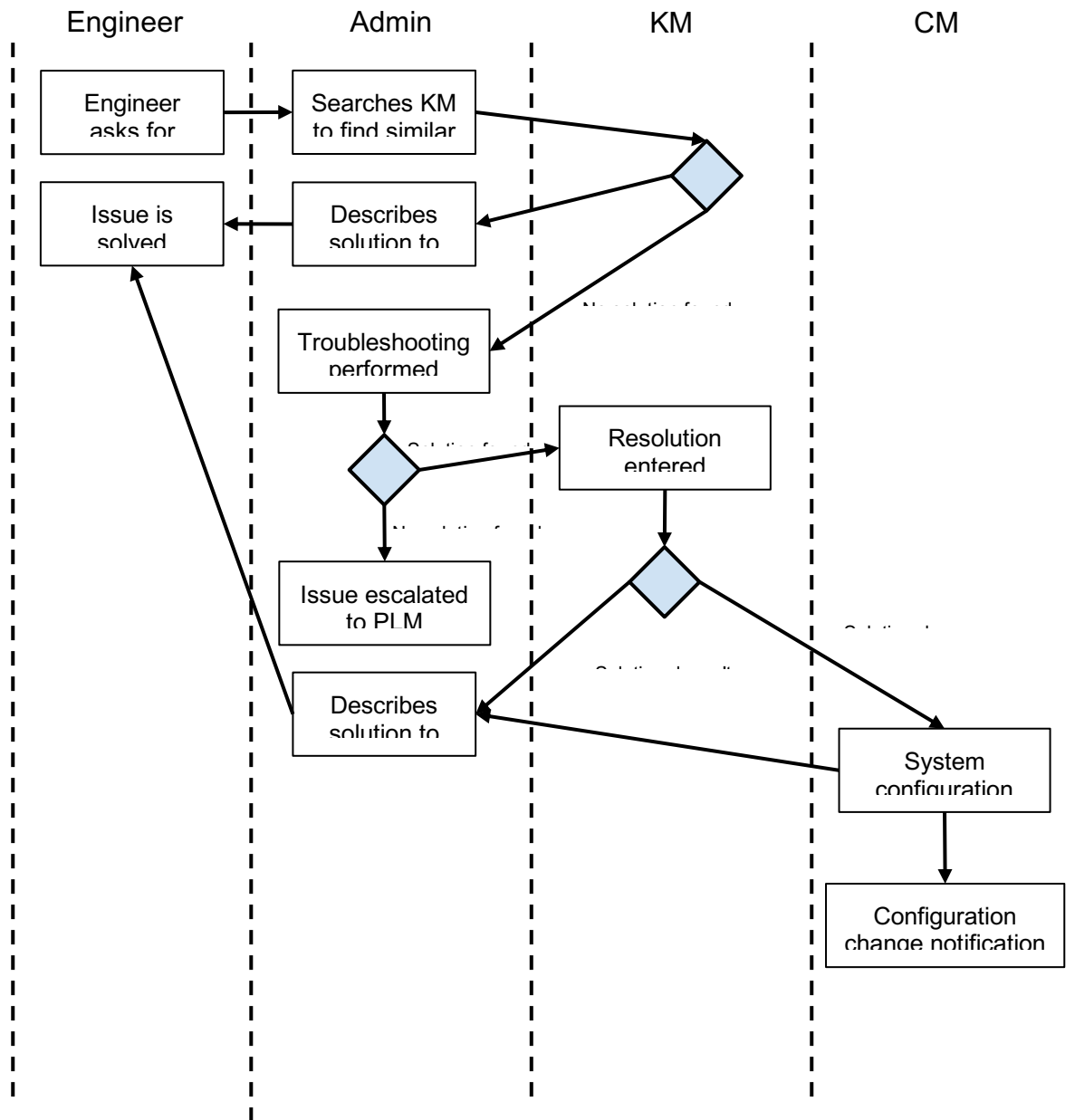
Figure 7. User system interface sequence diagram

Figure 7 illustrates the flow through one of the main use cases of the system. An engineer begins by asking an administrator for help to resolve an issue. The administrator will look through the knowledge base in the KM system to find a similar issue; if found a resolution will be provided to the engineer. When an issue is not found, troubleshooting will occur by the administrator. Although time will be lost during the troubleshooting phase, a solution will be documented in the KM system so that the time can be saved in the future if a similar issue arises. If a configuration change occurs, all users that have elected to receive a notification will receive an email.
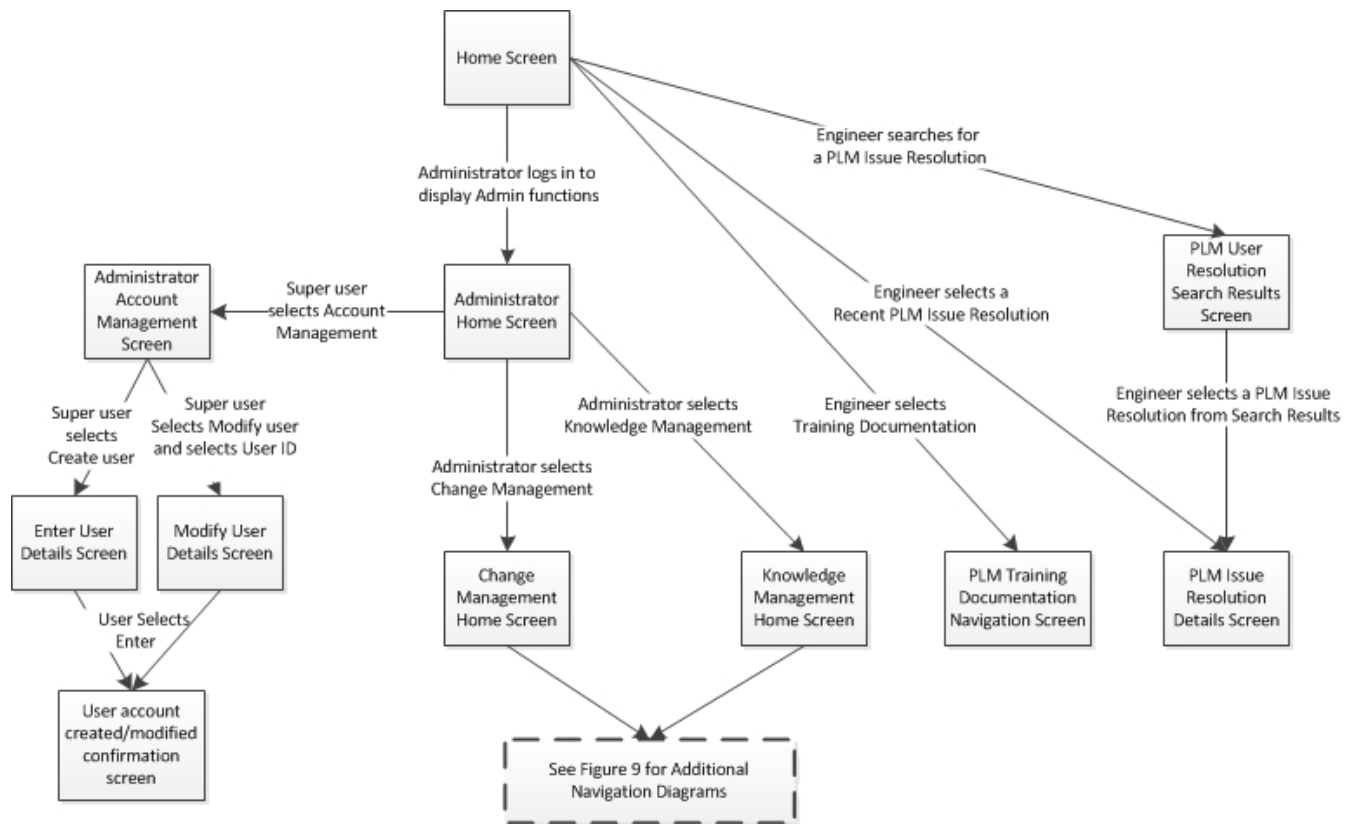
Figure 8. User Navigation Diagram Overview

The figure above walks through the different layers of user navigation. The main flow comes from the change management and knowledge management screens and is shown below in Figure 9.
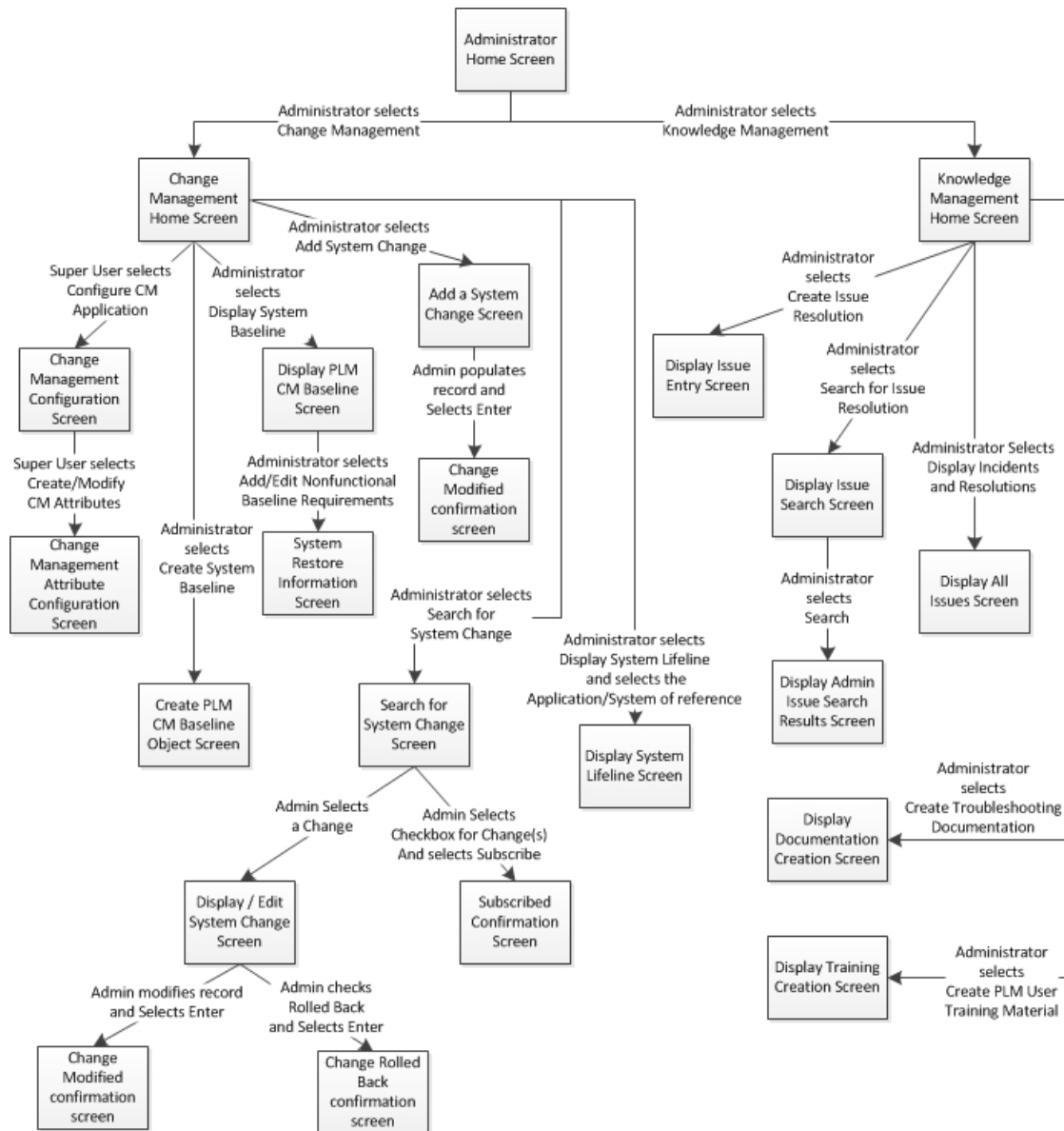
Figure 9. User Navigation Diagram Details

Figure 9 shows the most important components of the KMCM system. The concept behind this navigational flow was to keep things simple and restrict the number of clicks a user will need to perform in order to complete a task.

4. Specific requirements

4.1 System Use-Cases

Knowledge Management Use Cases

Use Case KM01: Administrator Logs Into KMCM

Use-case name	KM01 Administrator Logs Into KMCM
System or subsystem	KMCM
Actors	Administrator
Brief Description	This UC describes how the Administrator will log into the KMCM system to enable access to many of the features.
Basic flow of events	Basic flow begins when an administrator needs to access functionality in the KMCM system. 1. The administrator will open a web browser window and connect to the KMCM web site. 2. The system will present the basic UI for all general users (engineers) to find public documentation but also display username/password fields to allow an administrator to login 3. Administrator enters their username/password and selects if they would like to cache their login info for 2 hours. They then select the *Login* button to process their credentials.
Alternative flow of events	Login attempt failed: 1. The user entered in an incorrect username or password 2. The system presents the user with an error screen telling them if the password was incorrect or if a user with that name does not exist. The error screen will notify the user how many login attempts are remaining before their account is locked. 3. The error screen also has fields for the user to re-enter their information and attempt a login

	again.
	KMCM database is offline
	1. If the database is not available a message will be returned to the user that the system is currently unavailable.
	2. The web service will log the database availability issue and notify a responsible IT person via email to prompt their investigation.
	Login information is already cached
	1. If the user has previously logged into the KMCM system their browser will cache their session information for a maximum of 2 hours of inactivity (if checked during login).
	2. If the user navigates back to the KMCM home page they will not be prompted for another login.
	3. The system passes them right to the KMCM administrator dashboard without requiring another login.
Special requirements	<u>Performance</u>: Login response time must be no more than 5 seconds from the time the user selects "*Login*".
Pre-conditions	Administrator must be on the Widgets Inc LAN (or logged into VPN). The Administrator must have an account in the KMCM system and know their login information. The Administrator must start this process at the KMCM home page.
Post-condition(s)	The Administrator is presented with the Administrator dashboard. From this screen they can see an overview of unresolved KM issues, recent system changes, etc. After this use case is completed all use cases that involve the administrator can be initiated.
Extension points	

Use Case KM02: Administrator Enters Issue and Resolution

Use-case name	KM02 Administrator Enters Issue and Resolution
System or subsystem	Knowledge Management
Actors	Administrator
Brief Description	This UC describes how the Administrator will enter detailed issue and resolution information into KMCM in a method that will be search-able to enable other use cases.
Basic flow of events	Basic flow begins when the Administrator wants to record a PLM system issue and resolution. 1. Administrator selects the "Create Issue Resolution" link in the Navigation Pane. 2. The administrator is presented with a form with many required attributes related to the issue and related systems that must be filled out prior to saving the record to ensure that (at a minimum) the issue can be found based on certain criteria even if they don't fully document the resolution during the creation of the record. 3. After the required attributes are entered the system will allow access to the detailed fields for documenting the issue and resolution. The administrator now enters the details related to the issue and the resolution process. The system also automatically saves the new record once the required details are entered. 4. The Administrator will upload any supporting files (scripts, dll, patches, etc) 5. The administrator will then save the record.
Alternative flow of events	If the administrator attempts to leave the record (closing the window, clicking another link) without saving the system will prompt them to save or continue without saving and all changes will be lost. If the administrator wishes to make the issue resolution public to allow engineers to search for the resolution they will check a "public" box before saving the record. One administrator may begin the initial issue documentation but a

	different administrator may resolve the problem.
	1. If an issue has been entered and saved in the KM system another administrator can login and document the resolution to the issue.
	2. The administrator that resolves the issue will login to the KMCM system and review the open issues on the Administrator Dashboard to find the issue or search for the issue.
	3. They will then document the resolution and continue from step 4 above.
Special requirements	
Pre-conditions	Administrator must be logged into KMCM. Administrator must have enough details of the issue to populate the required attributes.
Post-condition(s)	After this use case is completed the issue resolution record can be updated and searched for at any later date. It can also be flagged as Obsolete if the issue was caused by a bug that was later patched.
Extension points	

Use Case KM03: Administrator Searches for Issue Resolution

Use-case name	KM03 Administrator Searches for Issue Resolution
System or subsystem	Knowledge Management
Actors	Administrator
Brief Description	This UC describes how the Administrator will search for resolution information in KMCM.
Basic flow of events	Basic flow begins when the Administrator selects the "Search for Issue Resolution" link in the Navigation Pane. 1. The administrator is presented with a search form with all of the Issue Resolution attributes

	displayed.
	2. The administrator enters their search criteria (at least one attribute) and executes the query.
Alternative flow of events	The administrator wants to review all issues/resolutions and the system directs the administrator to use a different feature of the system to avoid performance issues:
	1. The administrator does not enter any attributes and executes a query.
	2. The system displays a warning telling the administrator that they didn't enter any search criteria and if their intent was to search for all issues they should use the "Display Incidents and Resolutions" from the navigation menu. Searching for all objects in the system can performance issues due to an extended execution of a query.
	3. The administrator selects OK to return to the search screen and follows UC 5 for the process to display all records.
Special requirements	Performance: The system will not allow a complete wild card search, a search without any criteria. Searching the database for all attributes could cause performance issues in the DB for a short period of time.
Pre-conditions	Administrator must be logged into KMCM. Administrator must have some information related to the issue he is trying to resolve.
Post-condition(s)	After this use case is completed the results will be displayed for further sorting and review.
Extension points	

Use Case KM04: Administrator Filters and Sorts Search Results

Use-case name	KM04 Administrator Filters and Sorts Search Results
System or subsystem	Knowledge Management
Actors	Administrator
Brief Description	This UC describes how the Administrator will filter and sort search results to enable further refinement of results and display relevant data for the administrator. The will also be able to retain the filter and sort settings for future searches.
Basic flow of events	Basic flow begins after the Administrator executes a query in the KM system. 1. The results are presented with titles and short descriptive text. 2. The administrator can then use the dynamic search fields at the top of the page to either change or add search criteria. 3. When criteria is added or changed the system will automatically update the query. 4. The result columns can be sorted by clicking on the hyperlinked heading. 5. If further sorting is needed the administrator can click on the "Advanced Sorting" link and specify the order that he would all of the columns sorted in. 6. The administrator can choose to save their filter and sort configuration by selecting "Save Filter/Sort View" and specifying a name. The default view will be replaced with their new view and can be changed by selecting a different view from the drop down "view" menu on the search results page.
Alternative flow of events	If the administrator selects the option "disable dynamic update" the query will not automatically update (to save time re-querying if they are making a lot of changes). 1. The administrator will have to select "refresh query" in order to get updated results.

	2. Sorting can be done by following 4 and 5 above.
Special requirements	<u>Performance</u>: Due to the nature of the performance requirements of a dynamic update during filtering users must be aware that a query is being run after each change. They will want to be aware of this and it may be decided to set the default to "disable dynamic update"
Pre-conditions	Administrator must be logged into KMCM. Administrator must have executed a search in order to sort/filter.
Post-condition(s)	After this use case is completed the issue resolution record can be selected and viewed.
Extension points	

Use Case KM05: Administrator Displays All Issues and Resolutions

Use-case name	KM05 Administrator Displays all Issues and Resolutions
System or subsystem	Knowledge Management
Actors	Administrator
Brief Description	This UC describes how the Administrator will display all issues and resolutions in KMCM.
Basic flow of events	Basic flow begins when the Administrator selects the "Display Incidents and Resolutions" link in the Navigation Pane. 1. The system will display the Issues and Resolution in a format that is similar to query results. All records will be shown in descending chronological order in pages of 10 (that can be configured to show 10, 50 or 100 records per page) to limit the time that it takes to display the

	page and avoid a long scrolling page.
	2. The system displays filtering criteria in the same manner as the search results filtering.
	3. The administrator can set his default filter and sorting view by using the same custom views created in the search customization UC.
Alternative flow of events	
Special requirements	
Pre-conditions	Administrator must be logged into KMCM. Administrator must have some information related to the issue he is trying to resolve.
Post-condition(s)	After this use case is completed the results will be displayed for further sorting and review.
Extension points	

Use Case KM06: Administrator Creates Troubleshooting Documentation

Use-case name	KM06 Administrator Creates Troubleshooting Documentation
System or subsystem	Knowledge Management
Actors	Administrator
Brief Description	This UC describes how the Administrator will publish documentation to support new administrators in learning how to troubleshoot Widgets Inc's systems.
Basic flow of events	Basic flow begins when the Administrator selects the "Create Troubleshooting Documentation" link in the Navigation Pane. 1. The administrator is presented with a form with

	required attributes to ensure that the documentation is displayed in the proper location in the documentation display hierarchy. 2. After the required attributes are entered the system will allow access to the detailed fields for documenting the troubleshooting information. The administrator now enters the details related to the issue and the resolution process. The body of the document is a rich text editor that can accept standard font and paragraph formatting, in-line images and Flash video. 3. The Administrator will build the document in a clear and simple to follow format, pasting images and video as needed to ensure all details related to the topic are displayed and easily understood.
Alternative flow of events	If the administrator attempts to leave the record (closing the window, clicking another link) without saving the system will prompt them to save or continue without saving and all changes will be lost. If the administrator has documentation created in an external application (MS Word, Wordpad, Open Office Writer, Google Docs) they have the option to import the rich text by using the import option in the text editor.
Special requirements	
Pre-conditions	Administrator must be logged into KMCM. Administrator must have permission to create documentation, only senior level admins will have this capability.
Post-condition(s)	After this use case is completed the issue documentation can be updated and searched for at any later date.
Extension points	

Use Case KM07: Administrator Creates Self Paced Training Material

Use-case name	KM07 Administrator Creates Self Paced Training Material
System or subsystem	Knowledge Management
Actors	Administrator
Brief Description	This UC describes how the Administrator will publish online (self paced) training material for engineers to utilize for refresher training or new user ramp up.
Basic flow of events	Basic flow begins when the Administrator selects the "Create PLM User Training Material" link in the Navigation Pane. 1. The administrator is presented with a form with required attributes to ensure that the documentation is displayed in the proper location in the documentation display hierarchy. The system will automatically organize the documentation based on these attributes to make it easy for the Engineers to browse the material 2. After the required attributes are entered the system will allow access to the detailed fields for documenting the training topic. 3. The Administrator will build the document in a clear and simple to follow format, pasting images and video as needed to ensure all details related to the topic are displayed and easily understood. The body of the document is a rich text editor that can accept standard font and paragraph formatting, in-line images and Flash video. 4. The administrator will now attach any files that may be referenced in the training (CAD sample parts, hotkey tip sheets, etc) by selecting the *Attach Supporting Files*. 5. After the content is created the administrator saves the training document.
Alternative flow of events	If the administrator attempts to leave the document (closing the window, clicking another link) without saving the system will prompt them to save or continue

	without saving and all changes will be lost.
Special requirements	
Pre-conditions	Administrator must be logged into KMCM. Administrator must have enough experience to know what material needs to be documented and be an experienced technical trainer to present the information in a beneficial format for the engineers.
Post-condition(s)	After this use case is completed the engineers are able to view the training material in the public site.
Extension points	

Use Case KM08: Engineer Searches for Issue Resolution

Use-case name	KM08 Engineer Searches for Issue Resolution
System or subsystem	Knowledge Management
Actors	Engineer
Brief Description	This UC will explain how an engineer will search for similar PLM system issues in the KM application to resolve the issue without the help of an administrator.
Basic flow of events	The basic flow begins when the engineer has an issue in the PLM system and browses to the KMCM public website: 1. The system presents the last 10 publicly resolved issues along with a basic search function. 2. The engineer enters a string of text and/or selects a specific PLM application (CAD, Engineering Change Management, etc) 3. Resolution results will be presented in order of relevancy, as determined by search term match and the ratings of users who performed similar searches. 4. The engineer selects one or more resolution

	articles for review
Alternative flow of events	
Special requirements	
Pre-conditions	Administrators have populated the system with resolution articles (otherwise, there is nothing to search for and review)
Post-condition(s)	Engineer has one or more resolution articles available to review
Extension points	KM09 Engineer Rates Search Results

Use Case KM09: Engineer Rates Search Results

Use-case name	KM09 Engineer Rates Search Results
System or subsystem	Knowledge Management
Actors	Engineer
Brief Description	This UC describes how engineers can rate the usefulness of the materials they find

Basic flow of events	The basic flow begins after an engineer has read through an issue resolution article
	
	1. Engineer selects a rating from 1-5:
	   a. 1 - Not helpful at all
	   b. 2 - Minimal help, resolution in another article
	   c. 3 - Some help, in combination with supporting articles
	   d. 4 - Almost fully helpful, one or two unanswered questions
	   e. 5 - Very helpful, answers all questions
	
	2. Rating is combined with previous ratings to return relevant data to other users searching for similar topics (new ratings are weighted higher

	than older ratings)
Alternative flow of events	
Special requirements	
Pre-conditions	Engineers has read through entire article (if not, usefulness of rating is minimal)
Post-condition(s)	Rating is captured, cumulative ranking is updated and incorporated into future searches
Extension points	

Use Case KM10: Engineer Searches for Self Paced Training Material

Use-case name	KM11 Engineer Searches for Self Paced Training Material
System or subsystem	Knowledge Management
Actors	Engineer
Brief Description	This UC will explain how an engineer will search for training materials in the KM application
Basic flow of events	The basic flow begins when the engineer requires training in some area and browses to the KMCM public website: 1. The engineer enters a string of text and/or selects a specific training topic 2. Training materials will be presented in order of relevancy, as determined by search term match 3. The engineer selects one or more resolution articles for review
Alternative flow of events	
Special requirements	
Pre-conditions	Administrators have populated the system with training materials (otherwise, there is nothing to search for and view)

Post-condition(s)	Engineer has training material(s) to view
Extension points	

Change Management Use Cases

Use Case CM01: Administrator Configures Change Management Application

Use-case name	CM01 Administrator Configures Change Management application
System or subsystem	Change Management
Actors	Administrator
Brief Description	This UC describes how the Administrator will configure the Change Management portion of the KMCM system. This will allow the administrator to develop the proper attributes in the CM system to track their system changes at the appropriate level of detail.
Basic flow of events	Basic flow begins when the Administrator selects the "*Configure CM Application*" link in the Navigation Pane. 1. The system will enter the CM configuration mode to enable the administrator to build the detailed infrastructure hierarchy of their PLM application. 2. The system will present the administrator with a configuration screen that allows them to enter key areas of the PLM system that need to be tracked. This can include items like Hardware entities, software modules, data models, security models, databases, system preferences, application servers, etc. This looks similar to the way that a MS Sharepoint list would be built. 3. After the attributes are configured the administrator can build some high level dependencies that relate these attributes to one another. For example the Database will be dependent on the Database Server Hardware. This will help identify possible affected systems when changes are submitted for an object like the Database Server Hardware. This is done by

	selecting the parent object and selecting the dependent objects from the list of previously configured objects.
Alternative flow of events	If the administrator is not a super user in the KMCM system they will get a notification that they are not permitted to use the "*Configure CM Application*" tool. If dependent objects have already been created before the parent objects the administrator can create the dependencies during the initial object creation.
Special requirements	
Pre-conditions	Administrator must be logged into KMCM. Administrator must have enough details of the PLM infrastructure and configuration to populate the required attributes.
Post-condition(s)	After this use case is completed the Change Management application can be used to document the system baseline.
Extension points	

Use Case CM02: Adminstrator Creates a Baseline System Configuration

Use-case name	CM02 Administrator Creates a Baseline System Configuration
System or subsystem	Change Management
Actors	Administrator
Brief Description	This UC describes how the Administrator will enter the baseline configuration info the for the CM portion of KMCM.
Basic flow of events	Basic flow begins when the Administrator selects the "Create System Baseline" link in the Navigation Pane.

	1. The system will enter the CM Baseline Configuration mode to enable the administrator to build the initial configuration of their PLM applications.
	2. The system will present the administrator with a window that will prompt them to enter configurations that they made to their hardware (IP addresses, Host IDs, OS Version, Patches, etc). If there are no configurations or customizations they can select the OOTB attribute that will identify the object as having not configurations.
	3. The Administrator will upload any supporting files (scripts, dll, patches, etc) to each of the configuration records for future reference by selecting "*Add Supporting Files*".
	4. The administrator will *Accept* the entry for each hardware object and the system will prompt for additional hardware entries.
	5. If the administrator selects "*Add Additional Hardware*" they will repeat steps 2-4. If the administrator selects "*No Additional Hardware*" the system will prompt for the next configuration object. These steps will repeat through all of the configured areas defined in CM01.
Alternative flow of events	If the administrator attempts to skip one of the configuration areas they will be warned that they will not be able to enter changes against that area until the basic configuration is entered.
Special requirements	
Pre-conditions	Administrator must be logged into KMCM. Administrator must have enough details of the PLM system configuration to populate the required attributes.
Post-condition(s)	After this use case is completed the Change Management application can be used to document the system baseline.
Extension points	

Use Case CM03: Administrator Displays System Baseline

Use-case name	CM03 Administrator Displays System Baseline
System or subsystem	Change Management
Actors	Administrator
Brief Description	This UC describes how the Administrator will display the baseline configuration info the for the CM portion of KMCM.
Basic flow of events	Basic flow begins when the Administrator selects the "Display System Baseline" link in the Navigation Pane. 1. The system will present the administrator with a listing of all their hardware configurations and associated information (IP addresses, Host IDs, OS Version, Patches, etc) 2. The Administrator will view any supporting files (scripts, dll, patches, etc) for each configuration selecting "View Supporting Files".
Alternative flow of events	
Special requirements	
Pre-conditions	Administrator must be logged into KMCM. Administrator must have previously populated the PLM system configuration (or no information is displayed)
Post-condition(s)	After this use case is completed the Change Management application will display the documented system baseline.
Extension points	

Use Case CM04: Administrator Creates System Restoration Information

Use-case name	CM04 Administrator Creates System Restoration Information
System or subsystem	Change Management
Actors	Administrator
Brief Description	This UC describes how the Administrator will document the nonfunctional requirements for use in the event that all (or a portion) of the PLM Environment needs to be rebuilt.
Basic flow of events	Basic flow begins when the Administrator selects the "Display Baseline Configuration" link in the Navigation Pane. 1. The administrator is presented with screen that lists the entries made during CM02. 2. The administrator selects the link to "*Add/Edit Nonfunctional Baseline Requirements*". 3. The system presents a screen that is very similar to what is used in KM06 to build the details of the Hardware and other nonfunctional requirements.
Alternative flow of events	
Special requirements	
Pre-conditions	Administrator must be logged into KMCM. Administrator must have enough details of the nonfunctional requirements to populate the document.
Post-condition(s)	After this use case is completed the restoration information can be updated and searched for at any later date.
Extension points	

Use Case CM05: Administrator Records System Configuration Changes

Use-case name	CM05 Administrator Records System Configuration Changes
System or subsystem	Change Management
Actors	Administrator
Brief Description	This UC describes how the Administrator will configure record the proper attributes in the CM system to track their system changes at the appropriate level of detail.
Basic flow of events	Basic flow begins when the Administrator selects the "Record System Configuration Changes" link in the Navigation Pane. 1. The administrator selects the key areas of the PLM system to which the changes apply (hardware, software, database, security, etc). 2. Administrator enters a textual description of the changes that were applied, along with an associated date and timestamp
Alternative flow of events	
Special requirements	
Pre-conditions	Administrator must be logged into KMCM. The CM application has been configured and high-level dependencies between systems have been established
Post-condition(s)	After this use case is completed the Change Management application can be used to document the full history of applied system configuration changes
Extension points	CM06 Administrator Attaches files to System Change

	CM10 Administrator Rolls Back a System Change

Use Case CM06: Administrator Attaches Files to System Change

Use-case name	CM06 Administrator Attaches files to System Change
System or subsystem	Change Management
Actors	Administrator
Brief Description	This UC describes how the Administrator will attach files and additional artifacts to new and existing documented system changes in the CM system to track their system changes at the appropriate level of detail.
Basic flow of events	Basic flow begins when the Administrator selects the "Record System Configuration Changes" link in the Navigation Pane. 1. The administrator selects the key areas of the PLM system to which the changes apply (hardware, software, database, security, etc). 2. Administrator select files and additional artifacts through the document upload dialog 3. The file is successfully uploaded into the CM application and a link to view the file is added to the system change screen
Alternative flow of events	If the file is not successfully uploaded (eg, corrupt file or unrecognized extension) then a description of the error is presented to the administrator and they may attempt to upload the document again
Special requirements	
Pre-conditions	Administrator must be logged into KMCM. The CM application has been configured and high-level dependencies between systems have been established The server hosting the CM application has been configured to accept file uploads

	The document that administrator is attempting to upload must not exceed the maximum file upload size and be one of the allowed file types
Post-condition(s)	After this use case is completed the Change Management application can be used to retrieve all supporting documentation for system configuration changes
Extension points	

Use Case CM07: Administrator Subscribes to a System for Change Notifications

Use-case name	CM07 Administrator Subscribes to a System for Change Notification
System or subsystem	Change Management
Actors	Administrator
Brief Description	This UC describes how the Administrator will be able to register or remove themselves as being associated with a system or application. This will allow alerts to be communicated to the proper administrators when changes are made.

Basic flow of events	Basic flow begins when the Administrator is either viewing the configuration for a particular system or is viewing the list of all systems
	
	1. Administrator selects the "Modify Subscriptions" link next to the system's name
	2. Administrator chooses to:
	    a. receive immediate notifications for all changes
	    b. receive a daily or weekly digest summarizing all changes
	    c. stop receiving any notifications of changes
	3. The CM system sends an e-mail confirmation to the administrator notifying them that their

	subscription(s) have changed
Alternative flow of events	
Special requirements	
Pre-conditions	Administrator must be logged into KMCM.
	The CM application has been configured and high-level dependencies between systems have been established
	The server hosting the CM application has been configured to act as or connect to a mail server
	The CM application has been configured with all of the administrators email addresses
Post-condition(s)	The administrator's change in notification preferences has been saved and all future alerts will comply with those preferences
Extension points	CM08 Administrator Enters a Change Alerting a Subscriber

Use Case CM08: Administrator Enters a Change Alerting a Subscriber

Use-case name	CM08 Administrator Enters a Change Alerting a Subscriber
System or subsystem	Change Management
Actors	Administrator
Brief Description	This UC describes how administrators will receive an alert when a change is entered for one of the systems or applications that they have subscribed to
Basic flow of events	Basic flow begins when an administrator submits a change for a system 1. The application compiles a list comprised of the directly affected system and any systems with

	established dependencies
	2. The applications aggregates a list of all administrators who have subscribed to change notifications for those systems
	3. The application sends email alerts, in compliance with each administrators preference for receiving the notifications, containing a textual description of the change, date/time applied, other potentially affected systems, and a link to the full system configuration change history
Alternative flow of events	If emails cannot be sent due to a problem with the mail server, the CM application displays an error alert in the dashboard that is visible to all administrators If an email cannot be sent to a particular user (eg, because their mailbox is full), then an email is sent to the CM application administrator notifying them of the problem. The application will attempt to resend the emails after the administrator has indicated that the problem is resolved or another alert is due to be sent, whichever comes first
Special requirements	
Pre-conditions	Administrator must be logged into KMCM. The CM application has been configured and high-level dependencies between systems have been established The server hosting the CM application has been configured to act as or connect to a mail server The CM application has been configured with all of the administrators email addresses
Post-condition(s)	Email alerts are sent to the interested parties A general email failure is noted in the application dashboard and must be fixed by the administrator The CM application administrator is notified of a user email failure - the system will not attempt re-send until either the next alert or the problem is indicated as fixed,

	depending on what happens first
Extension points	

Use Case CM09: Administrator Searches for System Changes by Application Name

Use-case name	CM09 Administrator Searches for System Changes by Application Name
System or subsystem	Change Management
Actors	Administrator
Brief Description	This UC describes how an administrator will search for changes to PLM applications by name and review the change(s) that were applied to those applications
Basic flow of events	The basic flow begins when the administrator selects "Search for Changes" from the navigation pane 1. The administrator will enter the name of a systems or multiple names separated by spaces 2. System will use a soundex phonetic search algorithm so that minor misspellings or typos in the system name(s) do not prevent the system(s) from being found 3. The system will present a list of found systems, sorted by last modified date then system name 4. Administrator may click on any of the names to view the full configuration change history, per CM11
Alternative flow of events	If no systems are found by the search terms, the user may re-attempt their search
Special requirements	
Pre-conditions	The CM application has been configured and loaded with system names
Post-condition(s)	A listing of matching system names is presented to the user who may view their change histories

Extension points	CM11 Administrator Reviews a System Change Lifeline

Use Case CM10: Administrator Rolls Back a System Change

Use-case name	CM10 Administrator Rolls Back a System Change
System or subsystem	Change Management
Actors	Administrator
Brief Description	This UC describes how an administrator can roll-back a submitted change
Basic flow of events	The basic flow begins when an applied changes causes unwanted effects and the changes are rolled-back in the PLM system 1. The administrator finds the appropriate system(s) using the search mechanism described in CM09 and clicks on the name of affected system(s) 2. Administrator visually scans the timeline of changes to find the change must be rolled-back and selects the "Undo this change" link 3. Administrator is prompted for an explanation why the change had to be reverted and clicks "Submit" 4. Application updates timeline of the changes, noting that a previous change has been rolled back 5. Subscribed users are automatically notified, as in CM08, and the roll-back explanation is additionally included
Alternative flow of events	If the administrator attempts to leave the change explanation window (closing the window, clicking another link) without saving the system will prompt them to save or continue without saving and all changes will be lost.
Special requirements	
Pre-conditions	Administrator must be logged into KMCM. The CM application has been configured and loaded with

	system names
	At least one change has been applied to the system (or there is nothing to roll-back)
Post-condition(s)	The affected system(s) change timeline is updated
	Email notifications are sent
Extension points	

Use Case CM11: Administrator Reviews a System Change Lifeline

Use-case name	CM11 Administrator Reviews a System Change Lifeline
System or subsystem	Change Management
Actors	Administrator
Brief Description	This UC describes how in the event of an unexpected issue, any administrator can retrace the set of actions that led to system failure
Basic flow of events	The basic flow begins after the administrator has completed the steps described in CM09 1. Administrator can scroll through chronological listing of all applied or rolled-back changes to retrace the set of actions that led to system failure. 2. Administrator can click on any change to view the full set of stored information (dependent systems, stored files/artifacts, etc) to roll-back those changes if necessary, and would be aware of the impact of doing so. 3. Administrator can click the "Download offline copy" to save the change information in PDF format, in case the information is needed for a system that is physically separated from the computer the administrator is currently using
Alternative flow of events	

Special requirements	
Pre-conditions	Administrator must be logged into KMCM.

The CM application has been configured and loaded with system names and at least one change has been applied to the system (or there is nothing to review) |
| Post-condition(s) | Administrator possess historical change information in online and/or offline formats |
| Extension points | |

Use Case CM12: Administrator Displays System Change Dashboard

Use-case name	CM12 Administrator Displays System Change Dashboard
System or subsystem	Change Management
Actors	Administrator
Brief Description	This UC describes how the Administrator will enter the Change Management application and display recent system changes to save time when searching for changes that may have caused recent issues.
Basic flow of events	The basic flow begins when the administrator selects "Change Management" from the Administrator Home Screen 1. The change management system will display the last 10 changes entered into the CM system. 2. The administrator can select a change of interest to them
Alternative flow of events	
Special requirements	
Pre-conditions	Administrator must be logged into KMCM.
Post-condition(s)	

Extension points	

Use Case CM13: Administrator Reviews Changes Affecting Multiple Systems

Use-case name	CM13 Administrator Reviews Changes Affecting Multiple Systems
System or subsystem	Change Management
Actors	Administrator
Brief Description	This UC describes how an administrator can see to what systems a particular category or grouping of changes have been applied to
Basic flow of events	The basic flow begins when the administrator is reviewing the change timeline through the steps described in CM11 and selects the "View other affected systems" link next to a change record 1. The administrator will be presented with a listing of systems in the same manner as in CM09
Alternative flow of events	
Special requirements	
Pre-conditions	Administrator must be logged into KMCM. The CM application has been configured and loaded with system names and at least one change has been applied to more than one system (or there is nothing to view)
Post-condition(s)	A listing of all systems affected by a selected configuration change is presented to the admin
Extension points	

4.2 System Functional Specification

This section provides an overview of the high-level functional processes required for the system. These are categorized by software product components provided in Figure 2: Software Product Component Diagram.

Knowledge Management Search Module (KMSM)

The KM Search Module will handle all operations pertaining to searching within the KM system.

> **KMSM1:** Main search screen.
>
> **KMSM2:** Search results screen.
>
> **KMSM3:** Filter search results.
>
> **KMSM4:** Sort search results.

Knowledge Management Training Module (KMTM)

This module contains everything necessary for creating, viewing, and searching for self-paced training materials.

> **KMTM1:** Training material view screen.
>
> **KMTM2:** New training material screen.

Knowledge Management Settings Module (KMSTM)

The KM Settings Module contains all of the storage and retrieval methods for user settings as well as a user interface for users to change their settings.

> **KMSTM1:** User settings are loaded during login.
>
> **KMSTM2:** A user settings screen that allows the settings to be changed.
>
> **KMSTM3:** When the settings are updated, they are saved to the database.
>
> **KMSTM4:** The settings will be automatically applied to every search the user performs.

Knowledge Management Issue Module (KMIM)

The KM Issue Module handles all operations for creating and displaying issues.

> **KMIM1:** Issue view screen.
>
> **KMIM2:** Issues can be resolved through the issue view screen.
>
> **KMIM3:** New issue screen.

Configuration Management Subscription Module (CMSM)

The CM Subscription Module handles subscriptions and alerts.

> **CMSM1:** Users can subscribe to systems and applications.

CMSM2: When a configuration change occurs, all users subscribed to the system will be notified of the change.

CMSM3: Users can unsubscribe in order to no longer receive notices.

Configuration Management Core Module (CMCM)

The CM Core Module contains all of the core operations for the configuration management system, such as creating baseline configurations, making configuration changes, and rolling back.

CMCM1: Configuration baseline creation screen.

CMCM2: Configuration change creation screen.

CMCM3: Configuration rollback which changes the configuration for a system to a previous state.

CMCM4: Configuration baseline view screen.

CMCM5: Configuration change view screen.

CMCM6: Configuration lifeline view screen.

CMCM7: Recent configuration changes view screen.

Configuration Management Settings Module (CMSTM)

The CM Settings Module contains all of the storage and retrieval methods for user settings as well as a user interface for users to change their settings.

CMSTM1: User settings are loaded during login.

CMSTM2: A user settings screen that allows the settings to be changed.

CMSTM3: When the settings are updated, they are saved to the database.

4.3 System Domain Models

4.3.1 Internal Domain Model

The KM and CM applications serve as knowledge and information repositories. Input comes from the administrators entering issue resolution information, troubleshooting documentation, system baselines, restoration information, configuration changes, and any supporting artifacts or documentation. The only input from Engineers is their ratings for relevancy and helpfulness, which are processed by the application to update the cumulative score for an article. The system also automatically performs system dependency searches and processes email notifications upon submission of configuration changes. In addition to email, system outputs include search results and the retrieval of any information by an engineer or administrator of information entered by an administrator.
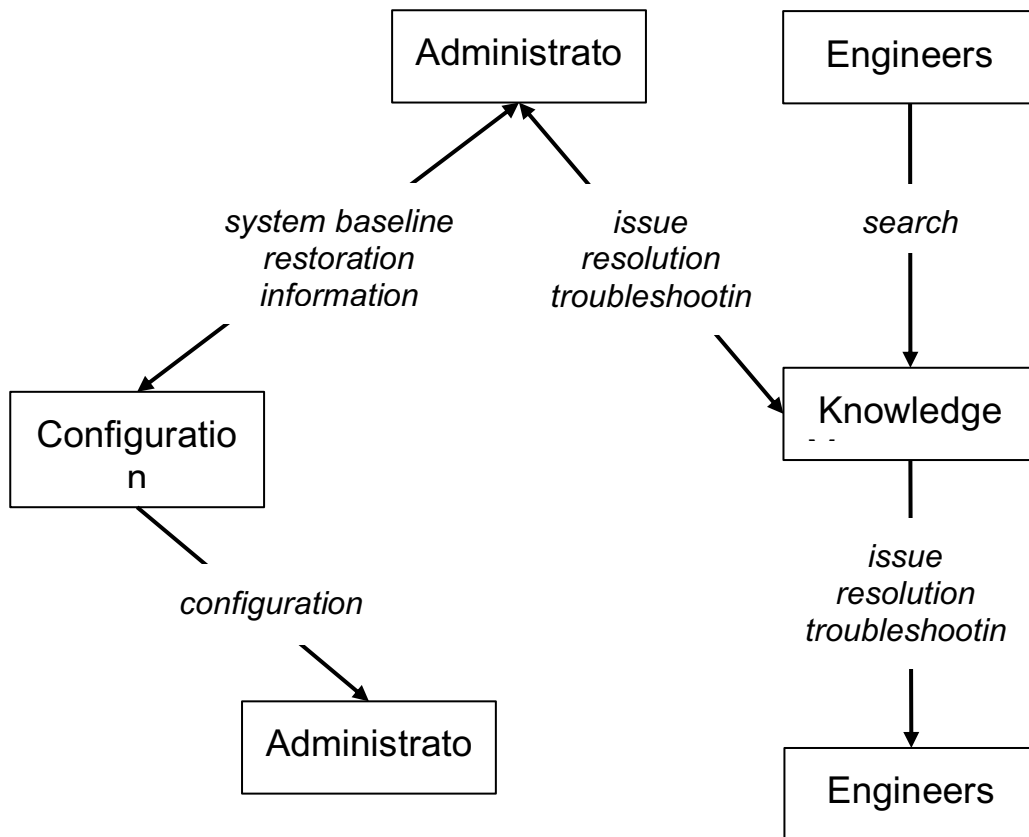
Figure 10. Internal Domain Model
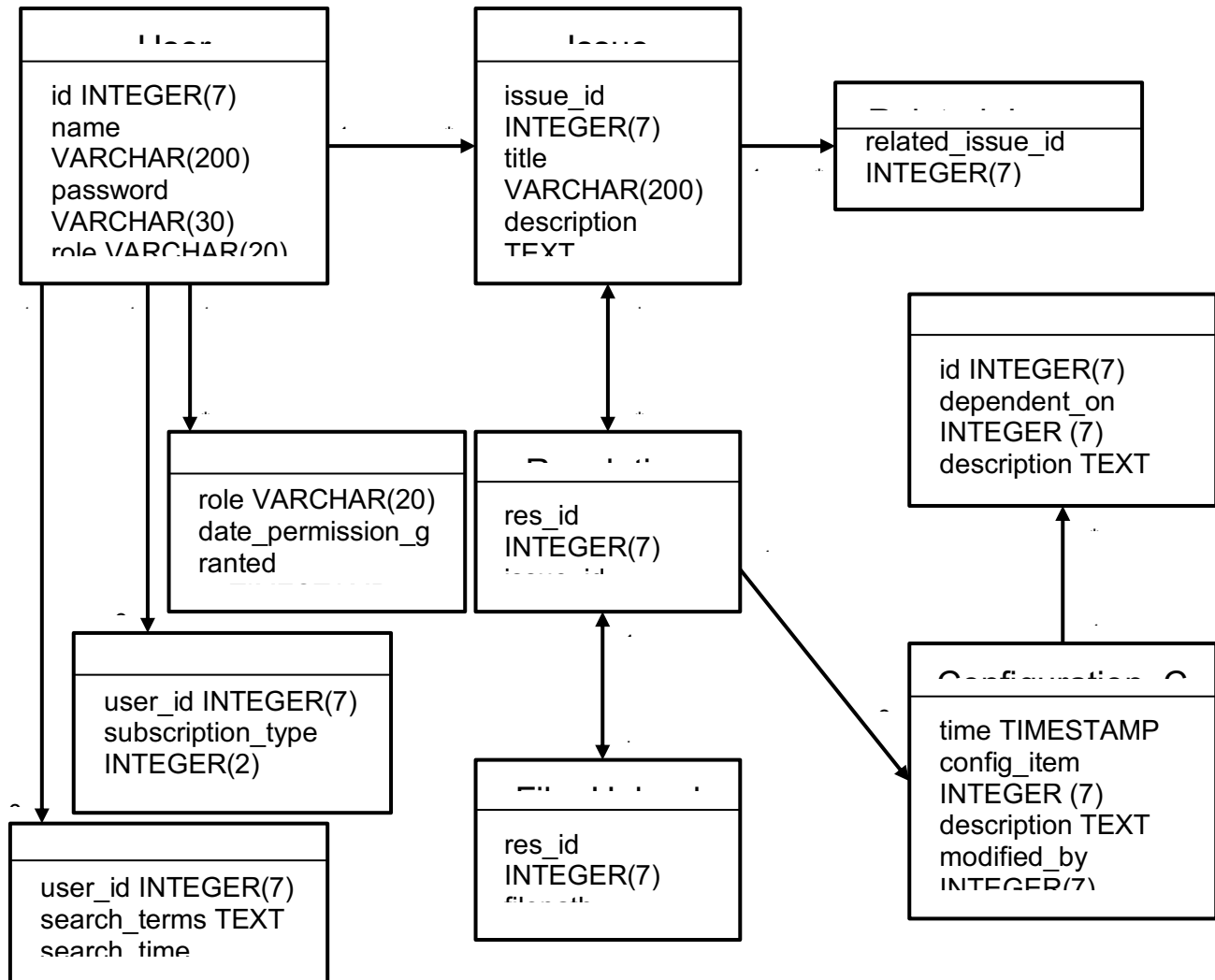
4.3.2 Class Domain Model

Figure 11. Entity Relationship Diagram

The entity relationship diagram (ERD) above shows the relationship between system entitie. An issue can have many resolutions and a resolution can be the same for many issues - thus the need for a many-to-many relationship. The search module (see Section 2.2.2) will interact with most of these entities and will record a search history in the Search_History table. The authentication module will interact with the User and Role tables. The file upload capability is shown by the relationship between a resolution and an issue. For clarity reasons, the File_Upload entity was not shown as a relationship to Issue, Configuration_Item or Configuration_Change, but these actions should also allow files to be uploaded and associated to each. The subscription module will allow for users to subscribe for email alerts for certain events via a subscription_type enumeration. The configuration management module mainly uses the Configuration_Item and Configuration_Change entities. A problem resolution can potentially modify a change to the system configuration, this is why a one to zero-or-more relationship is drawn between Resolution and Configuration_Change.

4.4 Non-Functional Requirements

4.4.1 Usability

U-NFR-1: Administrators will be expected to achieve proficiency in using the system with 1 hour of hands-on, self-led training.

U-NFR-2: The typical task time for admins to find a system by name and begin reviewing the change timeline should be less than 1 minute.

U-NFR-3: It is expected that a single administrator will be able to create of baseline and restoration information in 1 week in coordination with their normal work duties.

U-NFR-4: Administrators can expect to spend a half-hour to an hour to fully document a system configuration change.

U-NFR-5: Engineers will be expected to be productive in using the system after a half-day, instructor-led training session.

U-NFR-6: Engineers should be able to find and begin reviewing help information in less than 5 minutes.

U-NFR-7: The application will use standard web interfaces and controls (buttons, search boxes, file upload dialogs) that all employees are already familiar with - almost all training time will be spent learning new workflows.

U-NFR-8: The application will follow the usability standards (established by the U.S. Department of Health & Human Services) listed on Usablility.gov whenever and where-ever possible. These standards are intended to facilitate and encourage efficient and effective user-application interaction. The company's development history has taught us that users are best served when information is displayed in a directly usable format whose organization is very intuitive, task sequences are consistent, they are not required them to remember excessive amounts of information, and all application language is easily read by the lay user. The Usability.gov standards have proven themselves very helpful for reaching these usability goals.

4.4.2 Reliability

R-NFR-1: The application should be available 99% of the time, which allows for 7.2 hours of downtime per month.

R-NFR-2: The application should be available 24/7 but monthly scheduled maintenance may occur on the weekend before 6 am (for installing application upgrades, operating system updates/security patches, hardware repair, etc). During such downtime, a read-only mirror, using data from the last nightly backup, will be available.

R-NFR-3: Since no mathematical or financial calculations are performed by the application, there are no special requirements for accuracy.

R-NFR-4: The company has determined from its own development experience that a product reaches an acceptable level of capability maturity when bugs per kLOC (thousand Lines of Code) reaches between 1 and 5. The company will determine if found bugs are minor, significant, or critical, and will use this to prioritize resources for resolution. Critical bugs are those render the system unusable or expose security vulnerabilities, and are to be fixed immediately. Significant bugs are those with non-trivial repercussions but that do not cause the system to be unusable, and are only triggered under rare circumstances or which affect only a small percentage of users. Minor bugs affect one small piece of functionality, or may be cosmetic issues that don't inhibit usability of the application.

R-NFR-5: The expected defect rate is 5-10 bugs per KLOC. A new release should not be put into production for any defect rate larger than this.

R-NFR-6: Significant bugs that inhibit the use of the system should be repaired within 24 hours. Bugs that have a workaround in place and are detrimental to the use of the system should be resolved within 72 hours.

4.4.3 Performance

P-NFR-1: The system will have an expected user load of 50-100 employees.

R-NFR-2: A solution should not require bandwidth over 2Mbits/sec.

R-NFR-3: Under heavy load (100 employees), response times should be no more than 5 seconds. Under light load (less than 50 employees), response times should be no more than 2 seconds.

R-NFR-4: The system should be designed to handle 100 database transactions per minute.

R-NFR-5: The system need not be designed for redundancy or failover in the first two years of operation. After the system is stable, a case study should be performed to determine if load balancing or cluster techniques need to be utilized.

R-NFR-6: The system should not take more than 2GB of hard drive space and no more than 6GB of JVM heap size.

4.4.4 Supportability

S-NFR-1: This project will use the organizational coding standards that have been adopted successfully by many other projects inside the company. Coding standards support readability of code, allow for quicker comprehension of new code, and reduce mistakes by enforcing consistency.

S-NFR-2: Names for classes, methods, and variables should descriptive yet concise.

S-NFR-3: Comments should answer all questions that would be raised by another developer examining the code and should justify any deviations from common design patterns and idioms. S-NFR-4: Code should be written to minimize dependencies and interface specifications should quickly stabilize.

S-NFR-5: Code should be formatted as explicitly defined in the organization standard but in general should look like the code to which it has been added.

S-NFR-6: Code reviews, continuous builds, and automated test tools will be used to ensure code quality and perform regression and unit testing.

5.   SUPPLEMENTARY REQUIREMENTS

5.1 Project management strategy

We will begin the project by having the project team break down and organize tasks into logical groups using a Work Breakdown Structure (WBS). The team will then estimate time to completion for the project tasks and schedule them using the Program Evaluation and Review Technique (PERT). Schedule risk and task slippage can be minimized by allow the team to see how the project is progressing and if tasks are being completed on time. Project leadership will use the generated schedules to identify critical paths and develop strategies to best to manage delays, by assessing their potential impact on the project. Project management will develop a resource budgeting methodology to

allocate resources to tasks and ensure that the project does not exceed the budget. Management will utilize the company's data collection and reporting accounting system to review cost and schedule metrics. Any proposed modifications to the WBS or feature requests that would have a material impact on the schedule must go through a change control approval system. Per company policy, a monthly formal status review will be conducted with senior management present.

5.2 Systems Security and Audit

The company will mandate annual information systems (IS) security awareness training to ensure that all employees are provided with sufficient guidance to handle and secure proprietary company information. The company will appoint an individual knowledgeable of the IS features and capabilities, who will implement all security settings for proper authorization and auditing for all IS access. All personnel must read and agree to an Accepting Use Policy (AUP) stating that they will not attempt to gain access to systems for which they have not been authorized, assist others in attempting to gain unauthorized access, knowingly destroy or modify data without permission, or introduce malicious software. Because the application will be hosted on the company's existing server architecture, the same antivirus application will be used. The company's server environment uses software and hardware firewalls to prevent intrusions and provide a central method of protecting the systems, network, and data. The operating system and third-party components used by the application will be upgraded only after testing on a standalone system find any vulnerabilities or incompatibilities.

5.3 Assumptions and Dependencies

KMCM will utilize many IT technologies that are already deployed at Widgets, Inc. so it is assumed that adequate system resources are already allocated or purchased. It will be assumed that there are existing IT resources to perform patching, backups, database maintenance and management of the software and hardware used by the project, as no funding or support for those tools is included in this project. It is also assumed that Client Access Licenses (CALs) are already purchased for the end users of any necessary 3rd-party software under an Enterprise License Agreement (ELA). The company projects that the number of administrators and engineers will grow by 5% and 10% respectively over the next 5 years.

5.4 Requirements Traceability

High-Level Features Mapped onto Use-Cases

Feature	KM02	KM03	KM04	KM05	...	KMn
Configure/Save Search display criteria		X	X			
Filter/Sort Search Results		X	X	X		
Subscribe to System Changes	X					
Alert Subscribers of	X					

System Changes						
Search for system changes based on Application name		X	X			
Etc.						

Use-Cases Mapped Onto Non-Functional and Supplementary Requirements

Use Case	U-NFR-1	U-NFR-2	U-NFR-4	U-NFR-7	S1: No attempt to gain unauthorized access	...	Sn
KM02: Administrator Enters Issue and Resolution	X		X	X	X		
KM03: Administrator Searches for Issue Resolution	X	X		X			
KM04: Administrator Filters and Sorts Search Results	X	X		X			
KM05: Administrator Displays All Issues and Resolutions	X			X	X		
Etc.							

6. Online User Documentation and Help System Requirements

Administrators will be expected perform 1 hour of hands-on, self-led training in each module, after which they will achieve proficiency in using the system with. Engineers will be provided with a formal half-day, instructor-led training session, after which they will be productive in using the system. The application will use standard web interfaces and controls (buttons, search boxes, file upload dialogs) that all employees are already familiar with, so much more training time will be spent learning new workflows instead of the mechanics of using the application. Training will be created during the development process as screens and modules are finalized and will given after installation of the production into the production environment. Administrators will receive both an online and offline copy of training materials, both a PDF and a printed copy. Engineers will also receive an archived copy

of the training, both as a CD and on a network share, with a video recording of the training and copies of all handouts or slides.

The project team will document the creation and development of the system to aide developers in understanding the system in the future, and to guide the development of future enhancements. Documentation will include the project methodologies, formal requirements, supplementary requirements, and assumptions/dependencies.

7. Design Constraints

There are no environmental or technical standards to adhere to. The system should be compatible with previous versions, in that, it will provide a user with no less data than is currently provided. The only hardware constraints have been specified in previous sections and will allow for a less expensive transition to a newer system by utilizing current equipment. No porting will be required as the architecture will remain the same. In the future, the system can be offloaded to a cluster with limited variation of the code because of the application server it will run on. Providing an application server and a Java environment will allow for the code to be machine agnostic. The system will not necessarily need to be designed to scale, as the projected number of employees is not sufficient enough to cause harm. Proper procedures should be developed so that a new user will understand how to use the KMCM system. This documentation should be provided at the conclusion of the project as a key deliverable. Finally, good coding practices like cohesion and loose-coupling should be used as to allow for proper scaling and maintenance of the code in the future.

8. Purchased Components

Widgets, Inc. already has enterprise-wide licenses for the tools and software packages that will be needed in the course of development, so no additional tools will need to be purchased. Additionally, the final, production-version of the software will be deployed into the current network and server infrastructure, and so will not require outlays for new hardware or software. Widgets, Inc. will purchase additional licenses for software licensed on a per-user basis if not enough licenses are currently available inside the company.

9. Interfaces

The primary interface for a user (as discussed in section 2), is a web-based browser. This means that HTTP over SSL (HTTPS) traffic will be directed at an application server. The application server will internally call services using APIs with Python over HTTP protocols. Access of the database will be performed using socket networking traffic with standard POSTGRES ports. Email messages will be sent via the SMTP protocol.

9.1 User Interfaces

All user interfaces must only be available after the user has been properly authenticated and authorized. The application must use Python APIs. Asynchronous JavaScript and XML (AJAX) must be used whenever possible to send data to and from the application server in the background, without causing the page to block user input or frequently reload. The design of all user interfaces must follow the guidelines established by Usability.gov, as described in non-functional requirement U-NFR-8.

9.2   Hardware Interfaces

The application does not connect to any specialized hardware. The servers hosting the application will reside in the company's current data center and will be configured for the recommended number of processors, memory, hard drives, etc. based on expected user loads and data throughput. The server operating system will configured and accredited against all company policy for authorization, access, and auditing.

9.3   Software Interfaces

The application will interface with the company's email server using the Simple Mail Transfer Protocol (SMTP) as specified in internet standard RFC 5321. The application will use the Adobe PDF Library software development kit (SDK) to programmatically create PDF documents on the server that can be downloaded for offline access to information stored in the KM or CM applications.

9.4   Communications Interfaces

The KMCM application will only connect to the company's current local area network (LAN) through existing servers, switches, and firewalls. The application will not be connected to any additional, specialized, or remote devices.

10. Licensing Requirements

There are no licensing restrictions on the software that is currently being developed.

11. Legal, Copyright, and Other Notices

Widgets, Inc. will retain all copyrights for the software under development. All work produced by employees in the course of development is property of the company and said employees forfeit any rights to patents, if they arise. Any company logos or branding appearing in the software will carry the necessary trademarks and meet all acceptable brand usage standards.

12. Applicable Standards

This project does not require any DoD specifications and does not need to be ITAR complaint as the data captured by the system is not transmitted to other countries. The current system uses a mix of Linux, Windows and Mac OSX machines, therefore, a solution should not regress the ability for employees to use these operating systems.

Glossary

CAD/CAM - Computer-aided Drafting/Computer-aided Machining

KMCM - Knowledge Management Change Management System

PLM - Product Lifecycle Management