Reuse Enablement System (RES) Use Cases

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Software Reuse Working Group

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Executive Summary

As the number of Earth observing instruments and captured data volume increase, so do the complexity and costs associated with software development in support of data transformation, analysis, processing, management, and end-product implementation. Software development costs can be high and the time needed to develop new applications can be considerable. The Earth Observing missions have aided in amplifying knowledge of the Earth system by generating many useful scientific data. To maximize the use of these data, the Earth science community must be able to spend less time, money, and effort on software development and more on scientific work. Reusing software, including open source software, has many benefits such as increased productivity, reduced schedule, and improved quality. However, realizing these benefits for Earth science has been challenging.

Our survey of the Earth science community has indicated that lack of a centralized domain-specific software repository or catalog system addressing the needs of the Earth science community is a major barrier to software reuse within the community. The Software Reuse Working Group performed a trade study that examined a variety of sites as potential platforms to enable software reuse for the Earth science community. As presented in the Reuse Enablement System (RES) Trade Study document dated November 17, 2005, the results of our study showed that none of the evaluated repository or catalog systems can satisfy the needs of the community. Therefore, the Working Group has recommended that NASA provide the necessary support for a reuse enablement system dedicated to the Earth science community that could be expanded to include the space science community. The Working Group will evaluate the technology options for the provision of a reuse enablement system and perform a more detailed architecture study to determine the most expeditious and cost-effective solution for such a system.

One step in the development of the RES was the development of use cases for the envisioned system. These use cases were created by collaboration of the Working Group members over a period of several months during 2004. This report documents those use cases, which were used to help derive the functional system requirements.

Background

To address the technical issues required to enable and facilitate reuse of software assets within NASA's Earth Science Enterprise (ESE), the NASA Earth Science Software Reuse Working Group was created as part of the Earth Science Data System (ESDS) Working Group. This was the result of one of the recommendations from the NASA HQ-commissioned Strategic Evolution of ESE Data Systems (SEEDS) Study; the SEEDS activity became the ESDS Working Group activity. The Software Reuse Working Group was chartered to oversee the process that will maximize the reuse potential of such software components in order to: (1) drive down the cost and time of system development and reduce/eliminate unnecessary duplication of effort; (2) increase flexibility and responsiveness relative to Earth science community needs and technological opportunities; and (3) increase effective and accountable community participation.

The Working Group recommends and supports activities that help increase awareness of available software components, increase awareness of the value of reuse, provide needed processes and mechanisms, disseminate successful reuse strategies, and address related intellectual property and policy issues. In the process of fostering greater software reuse across the Earth science systems, the Working Group is considering a wide variety of approaches to help meet differing needs and priorities. One such approach has been the creation of the Software Reuse Working Group portal web site at http://softwarereuse.nasa.gov/. It contains information on reusable assets, resources such as events and publications, open source software in general, and funding opportunities as well as some information about the Working Group's projects. Thus, it provides users with a central location for finding information about software reuse.

The goal of the software reuse project is to encourage software developers to make use of existing software assets, including open source software, to provide them with a convenient way to locate and obtain such assets, and to encourage them to develop products for reuse by others. The process of creating a new software product by reusing existing components can be likened to the building of a house. The consumers will be able to buy a completed house, but it is the builders who create the house from a variety of pre-fabricated components such as the frame, windows, and plumbing. By using tools, parts, and methods that have been tested over time and are known to work well, it becomes easier and more efficient for them to build the house. Likewise, if software developers can make use of existing software components, it will be easier and more efficient for them to create new products.

Software released under an open source license is publicly available and other software developers can read, modify, and redistribute the source code. The Working Group has recommended greater use of open source licensing as an important enabler for software reuse. The simpler licensing mechanism of open source, compared to traditional software licensing, eliminates a significant barrier to code sharing and thus helps to encourage and promote reuse. However, open source licensing is not appropriate for all types of software and traditionally licensed software can still be reused. Therefore, an effective reuse program has to accommodate both open source and non-open source software.

To facilitate the software reuse process, developers need to be able to easily locate and evaluate the available reusable artifacts. These were identified as important factors in a survey (OMB #2700-0117) conducted by the Working Group to determine the reuse practices of the Earth science community. See Appendix A for additional information about the survey.[1] The results showed that when people did not reuse software, the primary reasons were because they did not know where to look and they did not know such reusable software existed. In addition, the survey revealed that a catalog or repository for reusable artifacts is the best means of increasing software reuse within the Earth science community. For this reason, the reusable artifacts should be classified and made available through an appropriate reuse enablement system (e.g., libraries, catalogs, repositories) that can facilitate searching and indexing. These systems are an essential ingredient in transforming ad-hoc reuse (which is largely dependent on personal knowledge and word of mouth dissemination of information about the availability of reusable artifacts) to systematic reuse as an integral part of the software development process.

To achieve the above goal, the Working Group was tasked to research and evaluate existing software catalog and repository systems within NASA, specifically the GCMD and the NASA Open Source Agreement site, as possible alternatives to: (1) hosting software assets for the Earth science community and/or (2) developing an Earth science Reuse Enablement System by using existing enablement system reusable infrastructure software components. See Appendix B for the Working Group's original recommendation and NASA HQ's response. As presented in the Reuse Enablement System (RES) Trade Study document dated November 17, 2005, the results of our study, which also included non-NASA sites, showed that none of the evaluated repository or catalog systems can satisfy the needs of the community of Earth science software developers. Therefore, the Working Group has recommended that NASA provide the necessary support for a reuse enablement system dedicated to the Earth science community that could be expanded to include the space science community. The Working Group will evaluate the technology options for the provision of a reuse enablement system and perform a more detailed architecture study to determine the most expeditious and cost-effective solution for such a system.

This report is the first step in the development of the architecture study and provides the functional requirements, identified by the Working Group, that are necessary for a software repository or catalog system to meet the needs of the community for storing and locating reusable software assets. This document outlines the evolution of these requirements, from the initial use cases created by the Working Group, to the descriptive requirements included in the Trade Study document, to the final, formal requirements statements provided here.

Applicable and Supporting Documents

- Reuse Enablement System (RES) Trade Study (November 17, 2005)

[1] See also the Proceedings of the 2004 IEEE International Geoscience and Remote Sensing Symposium, vol. 3, pp. 2196-2199; "Strategies for Enabling Software Reuse within the Earth Science Community" by Samadi et al. for preliminary results from an earlier, almost identical survey or the Proceedings of the 2006 IEEE International Geoscience and Remote Sensing Symposium, in preparation, "Software Reuse Within the Earth Science Community" by Marshall et al. for initial results from the most recent survey.

Reuse Enablement System Use Cases

Summary of Use Cases

Over several months in 2004, members of the Software Reuse Working Group collaborated to develop an initial set of use cases for a software Reuse Enablement System (RES). They were refined through weekly and monthly telecons and finalized during a review at the October 2004 Data Systems Working Group meeting. The use cases describe the envisioned functions of the system and provide information about the flow of events for each use case. These use cases provided the basis for the development of the functional system requirements for the RES. A very brief description of each use case is provided here in Table 1, and the full text of each use case follows. Definitions of terms used here can be found in Appendix C.

Table 1 – Use Case Summary

Use Case	***Description***
Use Case 001 – Register User	This Use Case allows a Consumer or Provider to register as a user of the system.
Use Case 002 – Contribute Asset	This function allows the Provider to submit an asset profile along with the actual asset or a link to it.
Use Case 003 – Update Asset	This function allows the Provider to update an asset profile and/or the actual asset.
Use Case 004 – Provide System Feedback	This Use Case allows a user of the system to provide feedback to its custodians on his/her experience of using the system.
Use Case 005 – Subscribe Event	This Use Case allows a user of the system to subscribe to or unsubscribe from system or asset events.
Use Case 006 – Discover Assets	This Use Case allows the user to find reuse assets offered through the Reuse Enablement System (RES), information about those assets, as well as information about the providers. Discovery returns information about the RES holdings and sets the context for further browsing, results analysis, acquisition, and use.
Use Case 009 – Register Asset Usage	This Use Case allows a consumer to register the usage of an asset by his/her project. NASA can later use this information to generate various metrics associated with reuse of the asset and to keep users informed of asset enhancements, bug fixes, or other similar events.
Use Case 010 – Provide Asset	This Use Case allows a user of the system to provide feedback on

Use Case	***Description***
Feedback	his/her experience of using an asset from the system.
Use Case 012 – Acquire Asset	This Use Case allows a consumer to acquire an asset for evaluation purposes or for use by his/her project. If the asset is stored by the system, the consumer will download the artifacts associated with the asset. Otherwise, the user will be redirected to the relevant repository where the assets are stored.
Use Case 013 – Update User Profile	This Use Case allows a Consumer or Provider to update their profile information.
Use Case 015 – Manage User Account	This Use Case allows review and modification of user account information.
Use Case 016 – Monitor System Feedback	This Use Case allows the administrator of the system to review feedback from users on their experience of using the system.
Use Case 018 – Monitor Asset Feedback	This Use Case allows a user of the system to review feedback on other users' experiences of using an asset from the system.
Use Case 019 – Approve Asset Submission	This function allows the Content Manager to approve submitted asset profile information and/or the actual asset.
Use Case 020 – Cleanup Assets	This Use Case allows the Administrator to review assets and deprecate those which are no longer of interest to the community. The ultimate decision on which assets to deprecate will be up to the Administrator, but the assets deprecated are likely to be those that have received poor reviews, had very few downloads, or have been outdated by newer alternatives.
Use Case 022 – Capture Asset Needs	This Use Case allows the Administrator to review system activity to identify asset needs that are not currently being met by existing assets.

Use Case 001 – Register User

Roles: Consumer, Provider, Administrator

Brief Description: This Use Case allows a Consumer or Provider to register as a user of the system.

Unique Features: None

Goal: A new user is registered with the system.

Precondition: User has successfully accessed the system.

Assumptions: None

Flow of Events:

1. Use case begins when user is ready to submit user information.
2. User enters user information: user name, password, type of access requested (Consumer and/or Provider), personal identification details, contact details, user organization, project and project role.
3. The system records the new user information and sets the user status to *new applicant*.
4. The system sends an e-mail to the system Administrator notifying him/her of the user request.
5. The system confirms to the user that the request for registration has been recorded.
6. The Administrator logs onto the system and reviews the list of pending user registration requests.
7. The Administrator reviews the user information for each user registration request.
8. The Administrator accepts or rejects each user registration request. The system updates the user status to *accepted* or *rejected,* as appropriate.
9. The system sends an e-mail to the user notifying him/her of the request status.
10. Use case ends when the Administrator determines that s/he has finished reviewing user registration requests.

Post Conditions: A record of each new user has been recorded by the system.

Special Requirements: None

Scenarios:

- User requests registration and is approved by Administrator.
- User requests registration and is rejected by Administrator.
- User requests registration but Administrator neither approves nor rejects the request.
- User abandons registration prior to completion.

Issues:

- Need to decide what information we would like to capture about each user and how much of this is going to be mandatory. Is this different for Consumer and Provider?

Decisions: None

Use Case 002 – Contribute Asset

Roles: Provider

Brief Description: This function allows the Provider to submit an asset profile along with the actual asset or a link to it.

Unique Features: This use case gives the Provider an opportunity to submit information regarding an asset profile such as a name and a short description, as typically found in a catalog, links to other useful supporting documents that exist in the RES (e.g., feedback) or outside of the RES (e.g., websites), and other sets of more extensive metadata to give the user specific information about the product, how it is related to other assets, how it was created, verified, etc. In addition, the Provider can upload a software asset or provide a link to where a user can find the software asset.

Goal: A new asset has been made available to the community.

Precondition: The Provider has to be registered in the RES and the system has information about the Provider.

Assumptions:

1. Provider is a member of the Earth science community.
2. Provider has sufficient Earth science and software expertise to be able to identify and/or develop assets which will be of value to the community.
3. Provider has the authority to make the asset available to the community.

Flow of Events:

1. Provider selects Provider Login Page navigated from the main page or Provider has bookmarked the URL and can get to it directly.
2. Provider logs in to the RES Provider page.
   a. Option: Provider chooses to view more descriptive information. System responds with description information.
   b. Alternative 1: Provider is not a registered user and will be directed to register prior to logging in.
   c. Alternative 2: Provider does not remember user name and password and will be directed to another page for further instructions.
3. The RES displays information/direction/form on how to enter asset profile information (keywords such as asset type, date of creation, provider name, standard, protocol, language, etc.) and Provider enters all required information.
   a. Alternative: Provider does not fill out asset profile information and defers it for later.
4. Provider uploads data assets of interest.
   a. Alternative 1: Provider enters instructions on how to obtain the asset.
   b. Alternative 2: Provider enters a link to the asset.
5. System will respond with information on when/how the asset will be available to the public.
6. Provider will log off or navigate to other pages.
   a. Alternative: RES will expire the Provider’s session after a pre-defined time limit.

Post Conditions:

1. Software asset and asset profile have been stored in a location for content manager approval.
2. An e-mail is sent out to the content managers informing them of this activity.
3. A “thank you” e-mail is sent out to Provider with information/instruction regarding asset upload, etc.

Special Requirements:

1. Any browser requirements (e.g., Java enabled)?
2. Provider must be a registered user in order to use this system.
3. Metrics collection.

Scenarios:

- User uploads new asset.
- User abandons process before uploading asset.
- User saves process in the middle and resumes some time period later. (???)

Issues:

- Do we need to get the Provider to accept some sort of disclaimer saying that s/he has the authority to make the asset available?
- What other disclaimers (e.g., privacy, what usage is allowed for what is being uploaded) must be dealt with?

Decisions: New asset submissions need to be approved by the Content Manager before they are made available to the community.

Use Case 003 – Update Asset

Roles: Provider

Brief Description: This function allows the Provider to update an asset profile and/or the actual asset.

Unique Features: This use case gives the Provider an opportunity to update information regarding an asset profile such as a name and a short description, as typically found in a catalog, links to other useful supporting documents that exist in the RES (e.g., feedback) or outside of the RES (e.g., websites), and other sets of more extensive metadata to give the user specific information about the product, how it is related to other assets, how it was created, verified, etc. In addition, the Provider can upload a software asset or provide a link to where a user can find the software asset.

Goal: The system is updated with the most up-to-date and accurate information about an asset.

Precondition:

1. The Provider is registered in the RES and the system has information about the Provider.
2. The asset has previously been submitted to the system.
3. The asset being updated was originally submitted to the system by the user making the update.

Assumptions: None

Flow of Events:

1. Provider selects Provider Login Page navigated from the main page or Provider has bookmarked the URL and can get to it directly.
2. Provider logs in to the RES Provider page.
   a. Option: Provider chooses to view more descriptive information. System responds with description information.
   b. Alternative 1: Provider is not a registered user and will be directed to register prior to logging in.
   c. Alternative 2: Provider does not remember user name and password and will be directed to another page for further instructions.
3. The RES displays information/direction/form on how to edit asset profile information (keywords such as asset type, date of creation, provider name, standard, protocol, language, etc.) and Provider enters all required information.
   a. Alternative 1: Provider deletes the asset and all related information.
   b. Alternative 2: Provider deletes just the asset, but keeps the profile.
   c. Optional: Provider uploads data assets of interest.
      i. Alternative 1: Provider enters instructions on how to obtain the asset.
      ii. Alternative 2: Provider enters a link to the asset.
4. System will respond with information on when/how the asset will be available to the public.
5. Provider will log off or navigate to other pages.

a. Alternative: RES will expire the Provider's session after a pre-defined time limit.

Post Conditions:

1. Software asset and asset profile have been stored in a location for content manager approval.
2. An e-mail is sent out to the content managers informing them of this activity.
3. A "thank you" e-mail is sent out to Provider with information/instruction regarding asset upload, etc.

Special Requirements:

1. Any browser requirements (e.g., Java enabled)?
2. Provider must be a registered user in order to use this system.
3. Metrics collection.

Scenarios:

- User makes simple editorial changes to asset information (e.g., corrects minor typos).
- User makes substantive changes to asset information (e.g., alters the technology readiness/maturity level).
- User adds or removes one or more artifacts from the asset package.
- User changes one or more artifacts from the asset package without substantively altering the asset (e.g., uploads a new version of the user guide).
- User makes significant changes to one or more artifacts from the asset package without substantively affecting the overall function of the asset (e.g., make a bug fix).
- User makes substantive changes to one or more artifacts from the asset package (e.g., issues a new version which changes the overall functionality of the asset or changes the interface on a component).

Issues:

- Need to decide which scenarios need approval from the Content Manager.
- Does updating an asset include removing it from the system? And if so, what happens to existing users of the asset?
- What happens when an asset that is already being used is updated (e.g., new release)? Does anyone need to notify existing users?

Decisions: None

Use Case 004 – Provide System Feedback

Roles: Provider, Consumer

Brief Description: This Use Case allows a user of the system to provide feedback to its custodians on his/her experience of using the system.

Unique Features: Feedback may include such things as bug reports, performance problems, and suggestions for enhancements. This provides the custodians of the system with information on its usability and performance, which will be useful in maintaining the system, improving system content, and planning future system development.

Goal: User opinions on system functionality and/or content are communicated to the Administrators or Content Managers.

Precondition: None

Assumptions: None

Flow of Events:

1. Use case begins when user is ready to submit feedback information.
2. User selects a link that takes him/her to a feedback page.
3. User selects a feedback type from a pre-defined list and enters feedback information.
4. User optionally enters personal identification details.
5. The system creates a new system feedback item and assigns a reference identifier.
6. The system confirms to the user that the feedback has been recorded and displays the reference identifier.
7. Use case ends when user determines that s/he has finished entering feedback.

Post Conditions: One or more feedback items have been recorded.

Special Requirements: None

Scenarios:

- User enters one or more feedback items.
- User abandons process before entering feedback.

Issues:

- Do we want to allow unregistered users to enter feedback or should this feature be restricted to registered users only?

Decisions: None

Use Case 005 – Subscribe Event

Roles: Provider, Consumer

Brief Description: This Use Case allows a user of the system to subscribe to or unsubscribe from system or asset events.

Unique Features: By subscribing to events a user can receive notifications of system or asset activities that may be of interest to him/her. For example, by subscribing to asset events, a Consumer could be notified whenever changes are made to the asset description or when a new version is uploaded to the repository. A Provider could subscribe to an asset event so that he/she could be notified when a Consumer downloads one of his/her assets.

Goal: A record of notifiable event(s) is recorded for the user.

Precondition:

1. User is a registered user of the system.
2. User has successfully logged in to the system.

Assumptions: None

Flow of Events:

1. Use case begins when user is ready to subscribe to or unsubscribe from events.
2. User selects one asset using any method that the system supports.
3. The system displays the asset details.
4. User requests a list of events for the selected asset.
5. The system displays a list of subscribe-able asset events and indicates which events the user is currently subscribed to.
6. User selects one or more asset events to subscribe to or deselects asset events previously subscribed to.
7. The system records the desired event subscriptions.
8. The system confirms to the user that the event subscriptions have been recorded.
9. Use case ends when user determines that s/he has finished entering/amending event subscriptions.

Alternate Course A: System Event Subscription

Condition: Consumer decides s/he wants to amend system event subscriptions.

A.2. Alternate course begins when the user indicates that s/he wants to modify system event subscriptions.
A.3. The system displays a list of subscribe-able system events and indicates which events the user is currently subscribed to.
A.4. User selects one or more system events to subscribe to or deselects system events previously subscribed to.
A.5. Use case continues at step 7.

Post Conditions: One or more new event subscriptions or subscription changes have been recorded.

Special Requirements: None

Scenarios:

- User subscribes to one or more new events.
- User unsubscribes from one or more events.
- A combination of the above.
- User abandons process before making any subscription changes.

Issues:

- Need to define subscribe-able events for Consumer. Candidate events: asset information changed, asset artifact added, asset artifact removed, asset feedback added.
- Need to define subscribe-able events for Provider. Candidate events: asset artifact downloaded.
- Need to define how much information about a Consumer we want to give the Provider.
- Need to define subscribe-able system events. Candidate events: new user added for user organization.

Decisions: None

Use Case 006 – Discover Assets

Roles: Consumer

Brief Description: This Use Case allows the user to find reuse assets offered through the Reuse Enablement System (RES), information about those assets, as well as information about the providers. Discovery returns information about the RES holdings and sets the context for further browsing, results analysis, acquisition, and use.

Unique Features: This use case gives users an opportunity to see what assets the RES has to offer. In addition to a name and a short description as typically found in a catalog, Discovery will provide links to other useful supporting documents that exist in the RES (e.g., feedback) or outside of the RES (e.g., web sites), and other sets of more extensive metadata to give the user specific information about the product, how it is related to other assets, how it was created, verified, etc.

Goal: User discovers one or more assets that could be reused on his/her project.

Precondition: The RES has information describing reuse assets and providers, and a capability to display the information on line for users to review.

Assumptions: User has access via the web with industry standard browser.

Flow of Events:

1. User finds RES Discovery page by doing a Google-like search (available through a public search engine).
    a. Alternative 1: DMOZ search / Yahoo Directory search
    b. Alternative 2: Recommendation from colleague, conference, etc.
    c. Alternative 3: You already knew it.
2. User goes to the RES Discovery page for information about assets. The RES displays discovery options (keywords such as asset type, date of creation, provider name, standard, protocol, language).
    a. Alternative 1: User navigates links and discovers information/assets (classification hierarchies) as opposed to performing a keyword search.
    b. Alternative 2: User enters text in text box for string-search.
3. User specifies discovery criteria (as listed in step 2) to find data assets of interest.
    a. Option: User selects asset and chooses to view more descriptive information. System responds with description information.
    b. Alternative 1: Invalid discovery. No information is returned due to invalid or missing criteria. System responds with appropriate error message.
    c. Alternative 2: User aborts discovery.
4. User chooses to view asset metadata. System responds with asset metadata.
    a. Alternative 1: Invalid discovery. No information is returned due to invalid or missing criteria. System responds with appropriate error message.
    b. Alternative 2: User aborts discovery.
5. User chooses to view information about the provider(s) of assets. System responds with provider information page containing link to provider site or repository. (RES could be the repository of the asset.)
    a. Alternative 1: Invalid discovery. No information is returned due to invalid or missing criteria. System responds with appropriate error message.
    b. Alternative 2: User aborts discovery.
6. The RES allows the user to send the information as an e-mail or bookmark for future access.

Post Conditions: Context has been set for the user to select the assets that he/she wants.

Special Requirements:

1. Any browser requirements (e.g., Java enabled)?
2. Provider must be a registered user in order to use this system.
3. Metrics collection.

Scenarios:

- User discovers one or more assets (and optionally, other descriptive info available through links).
- User discovers provider information.
- User does not find any assets which meet his/her requirements

Note: These scenarios are not necessarily serial as indicated in the flow of events.

Issues: None

Decisions: User does not have to be registered and logged into the RES system in order to search for assets.

Use Case 009 – Register Asset Usage

Roles: Consumer

Brief Description: This Use Case allows a consumer to register the usage of an asset by his/her project. NASA can later use this information to generate various metrics associated with reuse of the asset and to keep users informed of asset enhancements, bug fixes, or other similar events.

Unique Features: None

Goal: A record of usage of an asset has been reported to NASA.

Precondition:

1. Consumer is a registered user of the system.
2. Consumer has successfully logged in to the system.
3. Asset has previously been contributed to the system.

Assumptions: Consumer has previously acquired an asset that is known to the system and has used that asset in some way.

Flow of Events:

1. Use case begins when Consumer is ready to submit asset usage information.
2. Consumer specifies the asset s/he is entering usage information for.
3. The system displays summary the asset information for confirmation.
4. Consumer records asset usage information.
5. Use case ends when the system indicates to the Consumer that the usage has been recorded.

Alternate Course A: Unauthorized Usage

Condition: Consumer has entered an asset usage that is not permitted for that user (for example, usage of NASA restricted software by a non-NASA Consumer).

A.5. Alternate course begins when the system determines that the consumer is not authorized to use the asset that s/he has registered.
A.6. The system flags the usage information to indicate that an issue exists.
A.7. Use case continues at step 5.

Post Conditions: A record of the asset usage has been recorded by the system.

Special Requirements: None

Scenarios:

- User successfully registers an asset.
- User abandons registration prior to completion.
- User registers an illegal use of an asset.

Issues:

1. Do we allow the registration to proceed if the system detects that the usage is not be permitted for some reason?
2. What usage information do we need to capture? And how much of this needs to be mandatory?

Decisions: None

Use Case 010 – Provide Asset Feedback

Roles: Consumer

Brief Description: This Use Case allows a user of the system to provide feedback on his/her experience of using an asset from the system.

Unique Features: Reviews may include such things as installation and usage experiences (good and bad), bug reports, performance problems, and suggestions for enhancements. This provides the provider of the asset with information on its usability and performance, which will be useful in planning future asset development. The review facility could also be used by Providers to respond to review comments (e.g., giving additional advice to consumers in response to issues raised in a review).

Goal: User opinions on system functionality and/or content are communicated to the Administrators or Content Managers.

Precondition: None

Assumptions: User does not have to be a registered user of the system or a registered user of an asset to provide feedback on an asset.

Flow of Events:

1. Use case begins when user is ready to submit review information.
2. User selects an asset using one of the standard methods that the system supports.
3. User selects a link that takes him/her to the review page for the asset.
4. User reads existing reviews for the asset.
5. User enters his/her review text for the asset.
6. User enters a review rating (scale 1 to 5) for the asset.
7. The system creates a new review item and recalculates and stores the average review rating for the asset.
8. The system confirms to the user that the review has been recorded.
9. The system sends an e-mail notification to each user that has subscribed to review events for the asset.
10. Use case ends when user determines that s/he has finished entering reviews.

Post Conditions: Review text and/or review rating have been recorded.

Special Requirements: None

Scenarios:

- User enters review text and rating.
- User enters review text only.
- User enters rating only.
- User abandons process before entering review.

Issues: Do we want to allow unregistered users to enter reviews or should this feature be restricted to registered users only?

Decisions: None

Use Case 012 – Acquire Asset

Roles: Consumer

Brief Description: This Use Case allows a consumer to acquire an asset for evaluation purposes or for use by his/her project. If the asset is stored by the system, the consumer will download the artifacts associated with the asset. Otherwise, the user will be redirected to the relevant repository where the assets are stored.

Unique Features: None

Goal: An asset has been transferred from the system to a Consumer.

Precondition:

1. Consumer is a registered user of the system.
2. Consumer has successfully logged in to the system.

Assumptions:

1. Consumer has previously identified the asset that they wish to acquire.
2. The asset that the Consumer wishes to acquire is stored by the system.

Flow of Events:

1. Use case begins when Consumer is ready to acquire the asset.
2. Consumer specifies the asset s/he wishes to acquire.
3. The system displays a summary of the asset information for confirmation.
4. The system verifies that the Consumer is permitted to acquire the desired asset.
    a. User and user organization must meet export control requirements for the asset.
    b. Other?
5. Consumer confirms acceptance of licensing terms.
6. Consumer records information about the reason for acquisition.
7. Consumer selects the individual artifacts to acquire (for example, the user may just want the executable and not the source code or user guide).
8. Consumer downloads the selected artifacts from the system to his/her computer.
9. Use case ends when the download is complete.

Alternate Course A: Unauthorized Usage

Condition: Consumer has requested an asset that is not permitted for that user/user organization (for example, does not comply with export control restrictions).

A.5. Alternate course begins when the system determines that the Consumer is not permitted to acquire the asset that s/he has requested.
A.6. The system informs the user that requested asset cannot be acquired.
A.7. Use case ends when the error message is delivered.

Alternate Course B: License Not Accepted

Condition: Consumer declines to accept the licensing terms.

B.5. Alternate course begins when the Consumer declines to accept the licensing terms for the asset that s/he has requested.
B.6. The system informs the user that requested asset cannot be acquired.
B.7. Use case ends when the error message is delivered.

Alternate Course C: Asset Not In This Repository

Condition: Consumer has requested an asset which is not stored by this system.

C.4. Alternate course begins when the system determines that the requested asset is stored in some other repository.
C.5. The system informs the user that requested asset is not stored by the system and displays information about the location of the asset (e.g., web site URL).
C.6. Use case ends when the error message is delivered.

Post Conditions: A record of the asset download (or attempted download) has been recorded by the system.

Special Requirements: None

Scenarios:

- User successfully downloads an asset.

- User is redirected to another repository.
- User attempts to acquire an asset that is not permitted for this user.
- User declines to accept licensing terms.
- User abandons acquisition prior to completion.

Issues: What information do we need to capture about the reason for acquisition? And how much of this needs to be mandatory?

Decisions: None

Request Unavailable Asset

Consumer requests an asset that does not exist in the RES registry, catalog, or repository. This is an exception condition to this use case.

Use Case 013 – Update User Profile

Roles: Consumer, Provider, Administrator

Brief Description: This Use Case allows a Consumer or Provider to update their profile information.

Unique Features: None

Goal: User profile is updated with the most current information.

Precondition:

1. User is a registered user of the system.
2. User has successfully logged in to the system.

Assumptions: A change of user organization or change to the type of system access requested will require the Administrator to review the user's access to the system.

Flow of Events:

1. Use case begins when user is ready to update user information.
2. User enters user name and password.
3. User enters changed user information.
4. The system records the new user information.
5. The system confirms to the user that the changes have been recorded.
6. Use case ends when the user has finished making changes.

Alternate Course A: Changed Key Information

Condition: User has moved to a new organization or has requested a different type of access to the system.

A.5. Alternate course begins when the user changes the type of access requested (Consumer or Provider) or his/her organization.
A.6. The system records the new user information. The system sets the user status to *changed user*.
A.7. The system sends an e-mail to the system Administrator notifying him/her of the changes.

A.8. The system confirms to the user that the changes have been recorded.
A.9. The Administrator logs onto the system and reviews the list of changed user registration requests.
A.10. The Administrator reviews the user information for each changed user.
A.11. The Administrator accepts or rejects each changed user registration request. The system updates the user status to *accepted* or *rejected,* as appropriate.
A.12. The system sends an e-mail to the user notifying him/her of the request status.
A.13. Use case ends when the Administrator determines that s/he has finished reviewing user registration requests.

Post Conditions: A record of user profile changes has been recorded by the system.

Special Requirements:

Scenarios:

- User makes minor profile changes that do not require Administrator approval.
- User makes key profile changes and changes are accepted by Administrator.
- User makes key profile changes and changes are rejected by Administrator.
- User makes key profile changes, but Administrator neither approves nor rejects the changes.
- User abandons profile changes prior to completion.

Issues: Need to decide what information can be changed without requiring Administrator review.

Decisions: None

Use Case 015 – Manage User Account

Roles: Administrator

Brief Description: This Use Case allows review and modification of user account information.

Unique Features: None

Goal: The system is updated with the most up-to-date and accurate information about a user.

Precondition:

1. Administrator is a registered user of the system with administrator authority.
2. Administrator has successfully logged in to the system.
3. User account has previously been set up on the system.

Assumptions: None

Flow of Events:

1. Use case begins when Administrator is ready to change user information.
2. The system displays a list of current registered users and summary account information (name, organization, account status).
3. Administrator selects from the list the user that s/he wishes to change account information for.
4. The system displays the current profile and account information for the selected user.

5. Administrator optionally changes user profile information: user name, personal identification details, contact details, user organization, project and project role.
6. Administrator optionally changes type of access permitted (Consumer, Provider, Content Manager, Administrator, or None).
7. Administrator optionally changes user password.
8. The system records the new user information and sets the user status to either *approved* (if permitted access is Consumer, Provider, Content Manager, or Administrator) or *inactive* (if permitted access is None).
9. The system confirms to the Administrator that the changes have been applied.
10. The system sends an e-mail to the user notifying him/her of the changes to his/her account.
11. Use case ends when the Administrator determines that s/he has finished amending user accounts.

Post Conditions: User account changes have been recorded by the system.

Special Requirements: None

Scenarios:

- Administrator changes user profile information.
- Administrator changes user access permissions.
- Administrator changes user password.
- Some combination of the above.
- Administrator abandons process prior to making any changes.

Issues: None

Decisions: None

Use Case 016 – Monitor System Feedback

Roles: Administrator

Brief Description: This Use Case allows the administrator of the system to review feedback from users on their experience of using the system.

Unique Features: Feedback may include such things as bug reports, performance problems and suggestions for enhancements. This provides the custodians of the system with information on its usability and performance, which will be useful in maintaining the system, improving system content, and planning future system development.

Goal: Administrator receives feedback from users of the system.

Precondition:

1. Administrator is a registered user of the system with administrator authority.
2. Administrator has successfully logged in to the system.

Assumptions: Administrator is sufficiently familiar with the operational principles of the reuse enablement system and general software design principles to be able to meaningfully interpret user feedback.

Flow of Events:

1. Use case begins when Administrator is ready to review feedback information.
2. Administrator selects a link that takes him/her to the feedback review area of the system.
3. Administrator selects the feedback items to review using the following criteria:
   a. Feedback type (from a predefined list) or all types
   b. Feedback status
   c. Feedback start and end dates
4. The system displays a list of feedback items which match the selection criteria.
5. Administrator selects a feedback item from the list.
6. The system displays the full feedback details for the selected item.
7. The system updates the feedback item status to *reviewed*.
8. Use case ends when Administrator determines that s/he has finished reviewing feedback.

Post Conditions: Zero or more feedback items have had their status updated.

Special Requirements: None

Scenarios:

- Administrator reviews one or more feedback items.
- Administrator abandons process without reviewing any feedback items.

Issues: None

Decisions: None

Use Case 018 – Monitor Asset Feedback

Roles: Consumer, Provider

Brief Description: This Use Case allows a user of the system to review feedback on other users' experiences of using an asset from the system.

Unique Features: Reviews may include such things as installation and usage experiences (good and bad), bug reports, performance problems, and suggestions for enhancements. This provides the Provider of the asset with information on its usability and performance, which will be useful in planning future asset development. The facility can also be used by prospective consumers of an asset to get guidance from other consumers (like reading a book review before buying a book).

Goal: Consumer experiences with an asset are communicated to the provider or other prospective Consumers.

Precondition:

1. None (for normal flow of events or alternate course A).
2. User is a registered user of the system with Content Manager authority and has successfully logged in to the system (for alternate course B).

Assumptions: User does not have to be a registered user of the system to see asset feedback.

Flow of Events:

1. Use case begins when user is ready to review feedback information.
2. User selects an asset using one of the standard methods that the system supports.
3. User selects a link that takes him/her to the review page for the asset.
4. The system displays existing reviews and ratings for the asset.
5. Use case ends when user determines that s/he has finished viewing reviews.

Alternate Course A: Challenge Feedback

Condition: User considers a feedback item to be invalid, inappropriate or in some way contrary to the intended use of the feedback mechanism.

A.1. Alternate course begins when the user sees a feedback item that s/he wishes to challenge.
A.2. User selects the item that they wish to challenge.
A.3. User enters a brief explanation of the reason for the challenge.
A.4. The system records the challenge information.
A.5. The system changes the status of the feedback item to *challenged*.
A.6. The system sends an e-mail notification to the Content Manager indicating which feedback item has been challenged.
A.7. Use Case ends when user has finished entering challenges.

Alternate Course B: Challenge Feedback Review

Condition: Content Manager wants to inspect a challenged feedback item.

B.1. Alternate course begins when the Content Manger sees a feedback item that has been challenged.
B.2. Content Manager selects the challenged feedback item that s/he wishes to review.
B.3. The system displays the explanation of the reason for the challenge.
B.4. Content Manager accepts, rejects, or ignores the challenge.
B.5. The system changes the status of the feedback item to *removed* (challenge accepted), *normal* (challenge rejected), or leaves it as *challenged*.
B.6. Use Case ends when Content Manager has finished reviewing challenges.

Post Conditions:

1. Feedback item status is updated.
2. If a new feedback challenge has been made, then a challenge reason is recorded.

Special Requirements: None

Scenarios:

- User challenges one or more feedback items.
- Content Manager accepts one or more feedback challenges.
- Content Manager rejects one or more feedback challenges.
- Feedback items are reviewed, but no changes are made.

Issues: None

Decisions: None

Use Case 019 – Approve Asset Submission

Roles: Content Manager

Brief Description: This function allows the Content Manager to approve submitted asset profile information and/or the actual asset.

Unique Features: This use case gives the Content Manager an opportunity to review information regarding an asset profile such as a name and a short description, as typically found in a catalog, links to other useful supporting documents that exist in the RES (e.g., feedback) or outside of the RES (e.g., websites), and other sets of more extensive metadata to give the user specific information about the product, how it is related to other assets, how it was created, verified, etc. In addition, the Content Manager can approve/disapprove assets to be included as part of the RES.

Goal: A previously submitted asset is approved by the Content Manager for release to the community.

Precondition:

1. The asset has previously been submitted to the system.
2. Provider is registered in the RES.

Assumptions:

1. Content Manager has sufficient Earth science expertise to be able to recognize assets which will be of value to the community.
2. Content Manager has sufficient software development and reuse expertise to be able to recognize assets which are sufficiently well described and documented for a Consumer to be able to find them using the system.

Flow of Events:

1. Content Manger receives an e-mail regarding a submission.
    a. Alternative: Content Manager can check in the RES system for all new submissions.
2. Content Manager selects Content Manager Login Page.
    a. Alternative: Content Manager has different access to the system not available publicly.
3. Content Manager logs in to the RES Content Manager page.
    a. Option: Content Manager chooses to view more descriptive information. System responds with description information.
4. The RES displays information/direction/form on submitted asset profile information (keywords such as asset type, date of creation, provider name, standard, protocol, language, etc.) and Content Manager can review all the required information.
5. Content Manager Approves/“activates” data assets of interest.
    a. Alternative 1: Content Manager does not approve and enters explanation on why.
    b. Alternative 2: Content Manager deletes the asset and enters explanation on why.
6. System will “activate” the approved asset and add asset information to the RES for public access.
7. System will send a notification to Provider with the Content Manager’s action.

Post Conditions:

1. Approved software asset and asset profile are activated for public access.
2. A notification goes to users informing them of this addition.

Special Requirements:

1. Any browser requirements (e.g., Java enabled)?
2. Content Manager must be a registered user in order to use this system.
3. Metrics collection.

Scenarios:

1. Content Manager reviews and approves asset(s).
2. Content Manager reviews and rejects asset(s).
3. Content Manager reviews asset(s), but neither approves or rejects. Assets remain pending approval/rejection at a later time.

Issues:

1. What happens to assets that are rejected? Do they remain on the system?
2. Can an asset that has been rejected subsequently be accepted? How about the other way round?

Decisions: None

Use Case 020 – Cleanup Assets

Roles: Administrator

Brief Description: This Use Case allows the Administrator to review assets and deprecate those which are no longer of interest to the community. The ultimate decision on which assets to deprecate will be up to the Administrator, but the assets deprecated are likely to be those that have received poor reviews, had very few downloads, or have been outdated by newer alternatives.

Unique Features: None

Goal: To remove those assets that are no longer of interest to the community and thereby ensure that asset searches remain relevant to Consumers.

Precondition:

1. Administrator is a registered user of the system and has administrator authority.
2. Administrator has successfully logged in to the system.

Assumptions: Administrator has relevant domain knowledge that will allow him/her to make informed decisions about which assets to deprecate.

Flow of Events:

1. Use case begins when Administrator is ready to review the assets for cleanup.
2. Administrator requests a list of assets with a rating below a given level, which were last downloaded before a given date, and which have less than a given number of current registered users.
3. The system displays a list of assets and a summary of the asset information for each asset meeting the selection criteria.
4. Administrator reviews the asset summary information and, optionally, detailed asset, asset usage, and asset review information for individual assets.

5. Administrator selects none, one, or more than one assets to be deprecated.
6. The system updates the status of the selected assets to *deprecated*.
7. Use case ends when the Administrator decides that there are no more assets to be deprecated.

Post Conditions: Change in asset status for each deprecated asset has been recorded by the system.

Special Requirements: None

Scenarios:

- Administrator finds one or more assets which meet the selection criteria and deprecates one or more assets.
- Administrator finds one or more assets which meet the selection criteria, but elects not to deprecate any assets.
- No assets meet the selection criteria.

Issues: Do we need to capture information about the reason for deprecating each asset?

Decisions: Deprecated assets will not be removed from the system, but will not appear in future asset discovery searches. NASA may still be interested tracking metrics and past usage information associated with deprecated assets.

Use Case 022 – Capture Asset Needs

Roles: Administrator

Brief Description: This Use Case allows the Administrator to review system activity to identify asset needs that are not currently being met by existing assets.

Unique Features: None

Goal: Identify demand for additional assets that are needed by the community.

Precondition:

1. Administrator is a registered user of the system with administrator authority.
2. Administrator has successfully logged in to the system.

Assumptions:

1. Administrator has sufficient Earth Science expertise to be able to identify assets which will be of value to the community.
2. Administrator has sufficient software development and reuse expertise to be able to recognize patterns of system activity which indicate a demand for an asset.

Flow of Events:

1. Use case begins when Administrator is to review system activity.
2. Administrator enters selection criteria: start date, end date, asset type.

3. The system generates a list of asset discovery searches which resulted in no hits for the selected criteria.
4. Administrator downloads the generated list for later analysis.
5. Use case ends when Administrator has finished requesting activity lists.

Post Conditions: System is unchanged.

Special Requirements: None

Scenarios:

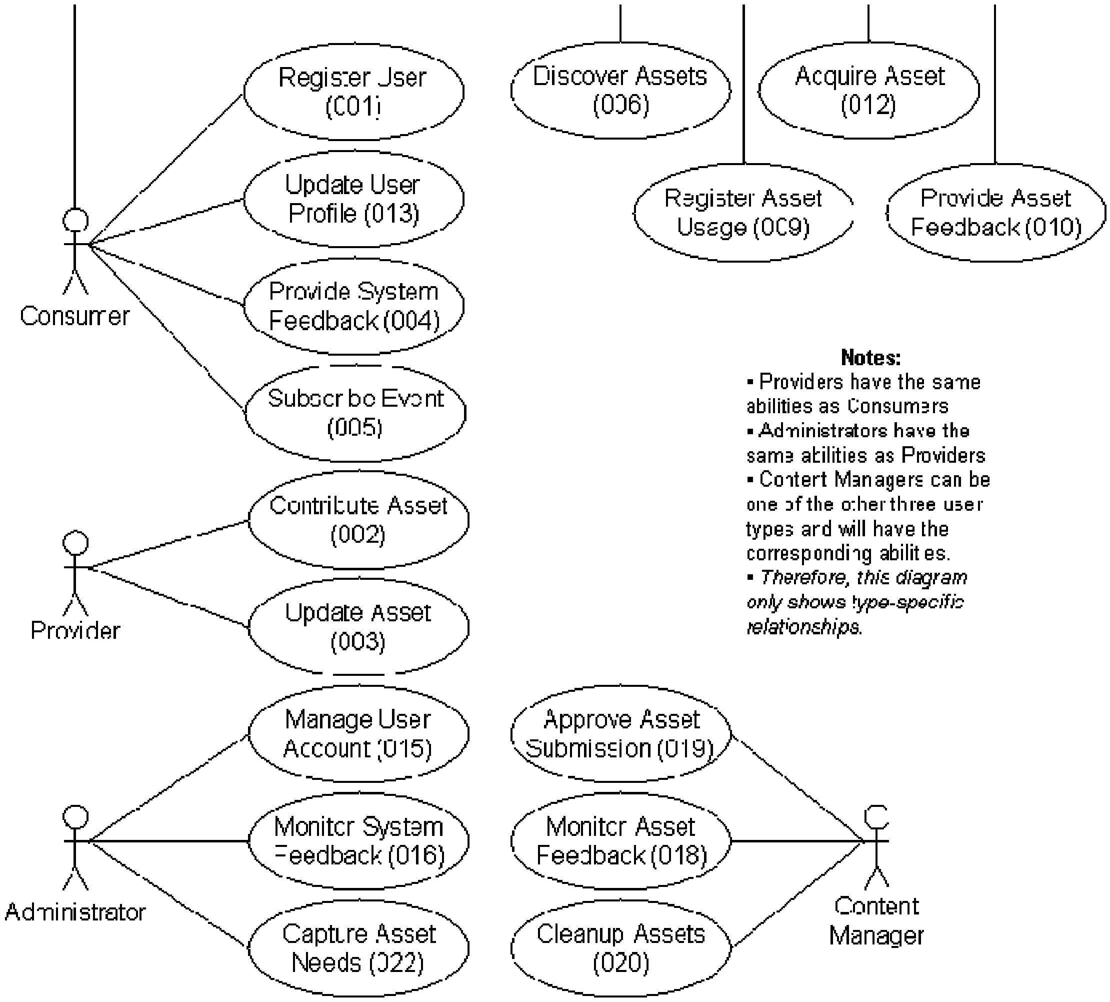
- Selected activity criteria match one or more “no hit” asset discovery search attempts.
- Selected activity criteria do not match any “no hit” asset discovery search attempts.

Issues: None

Decisions: None

Use Case Diagrams

Figure 1 is a UML diagram which displays the relationships between users of the system and the use cases of the system. This illustrates the basic flow of events. Figure 2 displays the functional areas in which the use cases can be grouped.


Register User (001)
Discover Assets (006)
Acquire Asset (012)
Update User Profile (013)
Register Asset Usage (009)
Provide Asset Feedback (010)
Consumer
Provide System Feedback (004)
Subscribe Event (005)
Contribute Asset (002)
Provider
Update Asset (003)
Manage User Account (015)
Approve Asset Submission (019)
Monitor System Feedback (016)
Monitor Asset Feedback (018)
Administrator
Content Manager
Capture Asset Needs (022)
Cleanup Assets (020)

Notes:

- Providers have the same abilities as Consumers
- Administrators have the same abilities as Providers
- Content Managers can be one of the other three user types and will have the corresponding abilities.
- *Therefore, this diagram only shows type-specific relationships.*

Figure 1 – UML Use Case Diagram

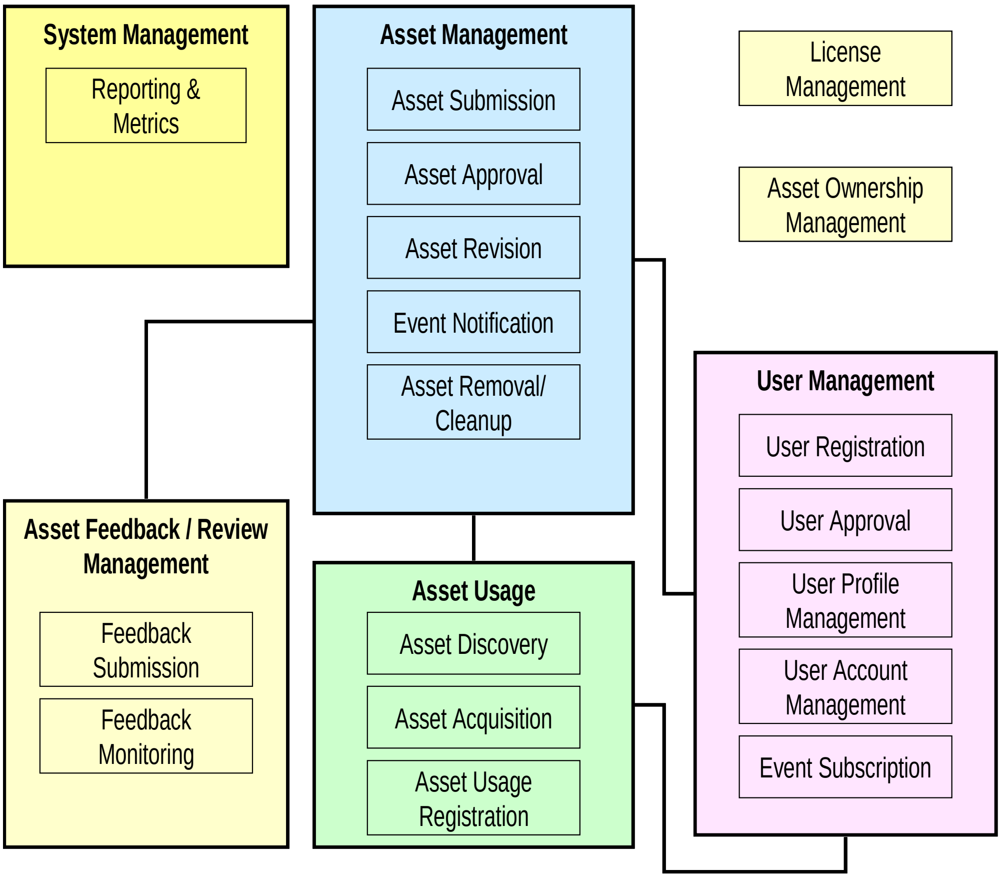


Figure 2 – RES Use Case Categories

Outdated Use Cases

During the process of creating the use cases for the system, some use cases were combined into others, deleted, or otherwise omitted from consideration. These use cases and the means by which they are covered are listed in Table 2 below.

Table 2 – Outdated Use Cases

Outdated Use Case	***Reason***
Use Case 007 – Register Consumer	Combined with Use Case 001 – Register User
Use Case 008 – Subscribe	Combined with Use Case 005 – Subscribe Event
Use Case 011 – Provide Feedback on RES System	See Use Case 004 – Provide System Feedback

Outdated Use Case	***Reason***
Use Case 014 – Monitor System	Deleted as too vague
Use Case 017 – Monitor Discussion Forum	Moved to portal web site functionality (http://softwarereuse.nasa.gov/)
Use Case 021 – Manage Users	See Use Case 015 – Manage User Account

Organizational Considerations

The use cases presented here deal with the functional requirements of the system, and therefore some areas such as performance (e.g., number of simultaneous users the system can support, system scalability) have been omitted. The Reuse Enablement System will be compliant with all standard NASA information technology policies, such as security policies and data preservation rules (e.g., creating backups of data on the system), the specifics of which can be found in appropriate NASA documents. These areas are either omitted here.

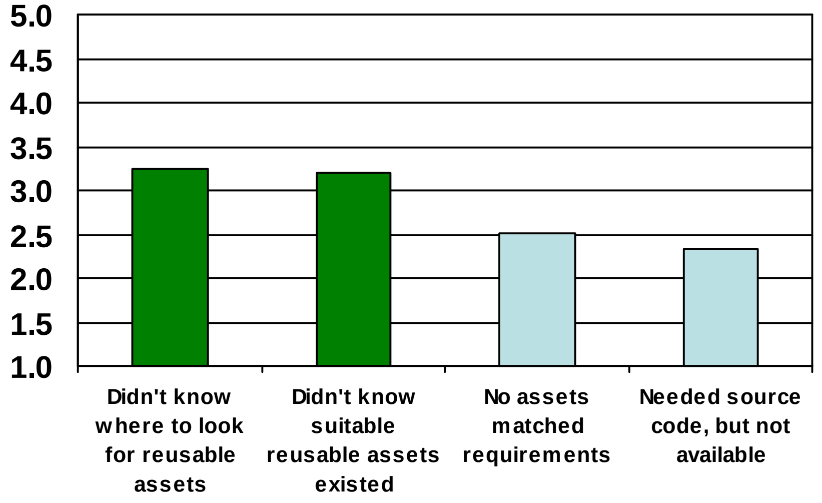
Conclusion

This document has presented the use cases developed by the Software Reuse Working Group for a Reuse Enablement System (RES), containing reusable software artifacts in the Earth science domain, designed to serve the community of Earth science software developers. These use cases, developed over several months of collaboration in 2004, were used to determine the requirements used in the 2005 trade study analysis of existing Earth science catalog and repository systems. The results of the trade study showed that none of the existing systems perform the role of providing software developers in the Earth science community with the types of reusable assets they find most useful. While each system may meet the needs of its target audience, none have been designed to meet the reuse needs of the Earth science software development community. None of the existing systems satisfactorily meet all of the functional and non-functional requirements identified by the Working Group as being necessary to host a reuse enablement system for the Earth science community. Therefore, the Working Group plans to undertake an architecture study to determine the best option for creating a Reuse Enablement System.

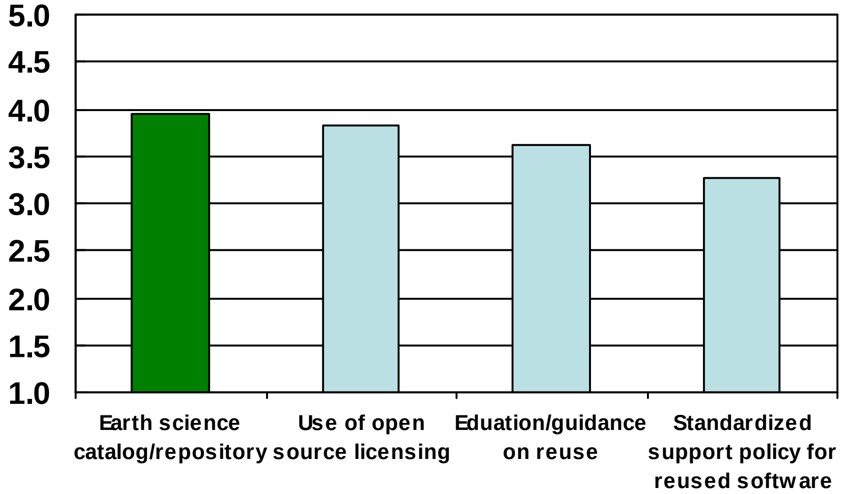
Appendix A – Software Reuse Questionnaire

The majority of the survey consisted of multiple choice questions where each listed option was ranked from 1 (not important at all) to 5 (very important). The following charts show the average results for the top few responses to two of the questions.

Question 7 – How important were the following factors in preventing you from reusing software development artifacts developed outside your group?



Question 47 – In your opinion, how important would the following factors be in helping increase the level of reuse within the Earth science community?



Appendix B – Enabling Systems Recommendation

The Software Reuse Working Group previously submitted a recommendation for a Reuse Enablement System to NASA HQ. This appendix contains the content of that recommendation and HQ's response to it.

- NASA should establish a system to facilitate the cataloging and distribution of reusable assets for the Earth science community
- NASA should establish an effective mechanism for dissemination of reusable assets within the Earth science community
- NASA should evaluate the technology options for the provision of a reuse enablement system including:
    - commercial reuse catalogs/repositories
    - open source reuse catalogs/repositories
    - use of existing publicly available catalogs/repositories
    - custom build of a community-specific catalog
- Based on the conclusions of the technology evaluation, NASA should implement a reuse enablement system
- NASA should develop guidelines and standards for the management and operation of a reuse enablement system

Impact for the Working Group

- The reuse working group will evaluate the technology options for the provision of a reuse enablement system
- The reuse working group will develop guidelines and standards for the management and operation of a reuse enablement system
- The reuse working group will develop a proposal for the implementation of a reuse enablement system based on the conclusions of the technology evaluation
- One additional FTE will be required for the balance of '05 fiscal year

Desired Decision

- HQ agreement to proceed with the evaluation of technology options and to provide funding for the evaluation
- HQ agreement in principle to the establishment of a reuse catalog subject to the findings of the evaluation

Headquarters' Response

- HQ thinks such a recommendation is premature and needs to await the results of a trade study concerning the establishment of a reuse catalog

Appendix C – Glossary of Terms

- Administrator – a user who controls, operates, and manages the system

- Asset – an item produced at some point in the software development life cycle that is recognized as having a particular value

- Catalog – a system that stores links to assets, but does not store/host the assets themselves

- Consumer – a user, either registered or unregistered, who is allowed to access or otherwise use assets in the system, subject to their license terms

- Content Manager – a user whose main role is to review content submitted to the system (e.g., a new asset) for appropriateness and relevance

- Provider – a registered user who has been granted permission to upload asset resources and metadata to the system

- Registered user – a user who has completed a registration process in order to obtain an account on the system

- Repository – a system that stores/hosts the actual assets themselves

- Submit – refers to the process by which information is provided to the system for inclusion in the system

- Unregistered user – a user who has not completed a registration process in order to obtain an account on the system

- User – any person who accesses the system