

**Requirements Specifications Document**  
**Drywall Estimation System**  
**Gulf Islands Consulting**

**Requirements Engineering Ltd**  
**Group 8**

Designed by: Andreas Anglin, Ben Mazerolle, Derek Lowlind,  
Dryden Linden-Bremner, Jordan Zhen, Ken Dajani, Quynh Hoang, Waltvin Lee  
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# Revision History

Table 1: Revision History

Name	Date	Reason for Changes	Version
Requirements Engineering Ltd. Team	Feb. 5	Created initial document	RD 1.0
Requirements Engineering Ltd. Team	Feb. 6	Edited initial document given client feedback	RD 1.1
Requirements Engineering Ltd. Team	Mar. 12	Added analysis models, use cases, use case model, sequence diagrams, ER diagrams, DFD and UI mockups to create initial RSD	RSD 0.9
Requirements Engineering Ltd. Team	Mar. 19	Edited initial RSD given client feedback. Improved readability of document and updated storyboards	RSD 1.0
Requirements Engineering Ltd. Team	March 27	Added backwards and forwards traceability matrix. Corrected document based on client and TA feedback	RSD 2.0

# 1 Introduction

## 1.1 Purpose

This document covers the requirements for GIC's *Drywall Estimation System*. The estimation system is designed to reduce the time required to produce project cost estimations and will cover the drywall estimation process, from the initial measurements input to the final invoice creation.

## 1.2 Project Scope

The Drywall Estimation System is designed to provide support to the GIC staff by providing a faster project estimation process.

The Drywall Estimation System will improve drywall project estimation times and maintain the accuracy of current estimates. Estimates include cost calculation and invoice creation. The project has a primary goal of reducing the time required to complete a drywall estimate and a secondary goal of maintaining the current estimate accuracy.

To accomplish these goals, the project will analyze the entirety of the estimation process to determine sub-processes that can be improved or eliminated. Given the non-technical background of GIC's staff, the project will pursue solutions that integrate into and improve the current process, rather than creating an entirely new process.

## 1.3 Glossary of Terms

Table 2: Glossary of Terms

Drywall	A type of board used in the construction of internal walls and ceilings.
Building Materials	Materials used in the drywall installation process including but not limited to: drywall and insulation.
Sage	Business assistance software used for generating and tracking invoices.
Slegg Building Materials	Building supply retailer located on Vancouver Island.
Web Scrape	Extracting data from websites.
GIC	Gulf Islands Consulting.

Invoice	A finalized estimate in an emailable file type.
GUI	Graphical User Interface
Material Attributes	Name, Price, Supplier, URL and Notes of the material.

## 1.4 References

- [1] Gulf Islands Consulting (22 Jan. 2019). Drywall Estimation System Request for Proposal [Online]. Available: <https://andysmit.github.io/SENG321/RFP-SENG321-Group4.pdf>. [Accessed 30 Jan. 2019].
- [2] Sage South Africa Pty Ltd. (2018). Sage One Invoicing [Online]. Available: <https://www.sage.com/za/products/accounting-software/sage-one-accounting/invoicing> [Accessed 5 Feb. 2019].
- [3] Government of BC (2019). *The Codes - Province of British Columbia* [Online]. Available: <https://www2.gov.bc.ca/gov/content/industry/construction-industry/building-codes-standards/the-codes> [Accessed 5 Feb. 2019].
- [4] Islands Trust BC (24 Jan. 2019). *Gabriola Island Planning Bylaws* [Online]. Available: <http://www.islandstrust.bc.ca/islands/local-trust-areas/gabriola/bylaws/>. [Accessed 5 Feb. 2019].
- [5] City of Nanaimo (2018). *Bylaws Affecting Building Projects* [Online]. Available: <https://www.nanaimo.ca/property-development/building-permits/bylaws-for-building>. [Accessed 5 Feb. 2019].

## 1.5 Overview

There are 8 sections and three appendices in this document. The following section, section 2, describes GIC's need for a new system to reduce the time to produce cost estimates of their potential projects and describes their current estimation process. System features that must be implemented with any proposed solution are highlighted in section 3. Section 4 covers the system's external interface requirements which is split into 4 parts: the user interface, the software interface, the hardware interface, and the communications interface. Section 5 breaks down the system's non-functional requirements into performance, safety, security, and quality requirements. Section 6 covers additional requirements not covered in the previous sections. Section 7 contains the analysis models for the system, including an entity relationship diagram, data flow diagrams 0, 1, and 2, and the use case model. Section 8 contains a traceability matrix for forwards and backwards traceability as well as a list of test cases for each requirement. The first appendix contains outstanding questions regarding the current Gulf Islands Consulting Drywall Cost Estimation system. The second appendix describes the formula that is currently used by GIC. The third appendix contains justifications for any changes suggested by the client, GIC, that were not made to the document.

## **2 Overall Description**

### **2.1 Product Perspective**

Currently, GIC measures and calculates the cost estimations of drywall installation using a measuring tape, pen-and-paper calculations and personal experience to determine a final estimate. GIC must also determine material price and stock data manually through internet searches or phone calls. These written calculations are then transferred into the Sage Invoice software to produce a final document for the customer [2].

The product being developed will streamline the cost estimation process by automating many of the manual cases including: price estimation, searching material costs, and the delivery of a price invoice to the GIC customer.

### **2.2 Product Features**

The system shall produce cost estimates for potential drywall work based on data entered by a user. Users will be able to input the pricing of the materials for calculation either manually or by letting the system web scrape hardware retailer websites to find the most current pricing on materials. The system will allow GIC to create and delete user profiles of the staff to allow for quick labour calculations. Finally, the system will produce a downloadable file of the created invoice to send to the customers of GIC.

### **2.3 User Classes and Characteristics**

Only staff members will have access to a potential software solution. GIC's two current staff members are drywallers with varying levels of experience. These staff members will share the 'Experienced Drywaller' user class.

#### **2.3.1 The 'Experienced Drywaller' User Class**

The 'Experienced Drywaller' user class is the only user class for the Drywall Estimation System and members of the class will be granted full access to all system features. Experienced Drywallers are GIC employees with over two years of drywalling experience who have been granted the permission to create project estimates by the company owner.

### **2.4 Operating Environment**

A potential system must operate on PC and Android. Support should be given to all operating systems for these devices released in the last three years or the last release currently supported if a release has not occurred in the last 3 years. These operating systems include:

- Windows 10
- Android Version 9, 8, 7

## **2.5 Design and Implementation Constraints**

A potential software solution must account for laws and regulations regarding drywall installation. These requirements are outlined in Safety Requirements - Section 5.2. Given the small maintenance budget, a potential solution must be maintainable by a system user with no programming experience and a general unfamiliarity with computers.

## **2.6 Assumptions and Dependencies**

**A-1:** The Experienced Drywaller has basic computer knowledge.

**A-2:** Inputs for cost estimations are correct regarding measurement and unit.

**D-1:** Retail websites specified for automated material price data scraping are accessible.

# **3 System Features**

## **3.1 System Security and Access**

### **3.1.1 Description and Priority**

Allow a user with authentication credentials to access the system and deny system access to all unauthenticated users.

**Priority: Very High**

### **3.1.2 Functional Requirements**

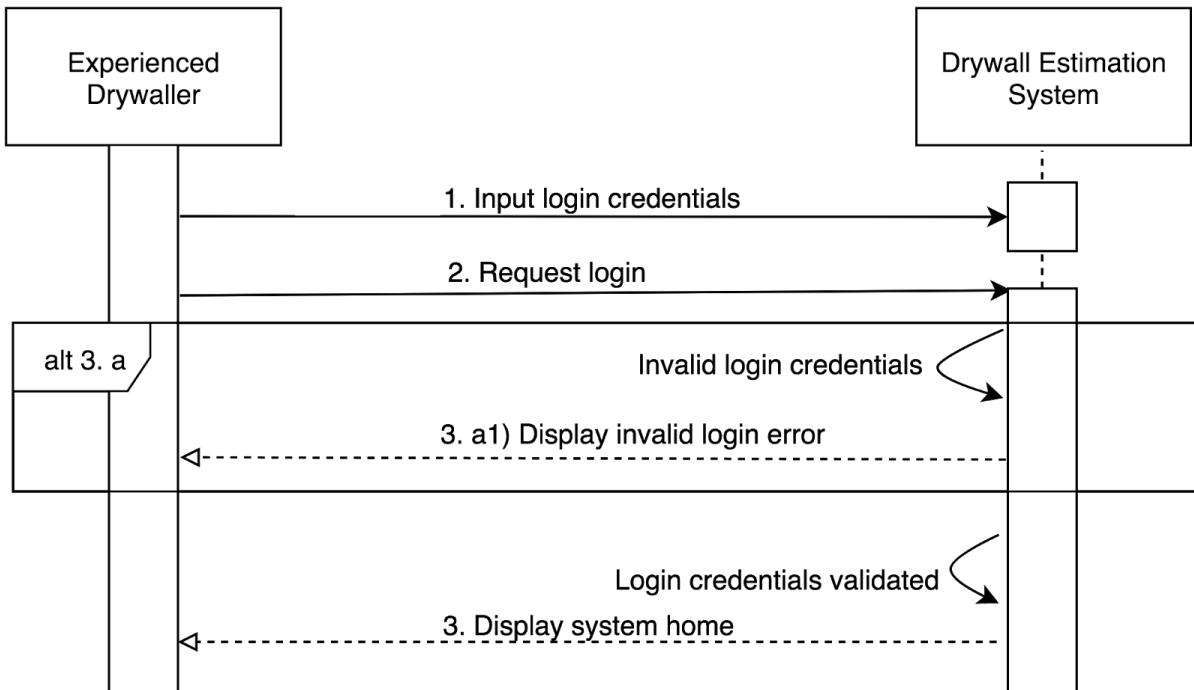
**R-F-01:** Only an authenticated user can access the system functionality.

**Rationale:** Only owner-approved GIC staff should be able to make estimates on behalf of the company.

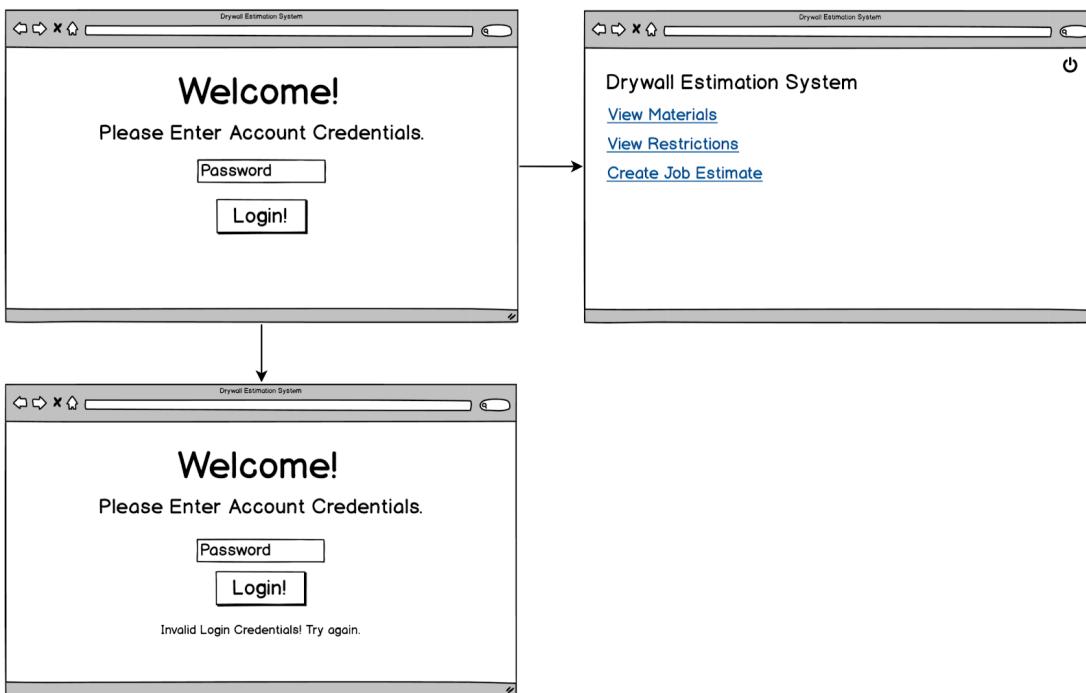
### **3.1.3 Use Case(s) Associated with Feature or Functional Requirements**

**Table 3: Use Case 1: Login**

Actors	User (Experienced Drywaller)
Preconditions	<ul style="list-style-type: none"><li>User is on the system login</li></ul>
Steps	<ol style="list-style-type: none"><li>User inputs login credentials</li><li>User requests to login</li><li>User is shown the system home</li></ol>
Success Conditions	<ul style="list-style-type: none"><li>System home is displayed</li></ul>
Alternate Paths	3. a1) User is shown an invalid login error



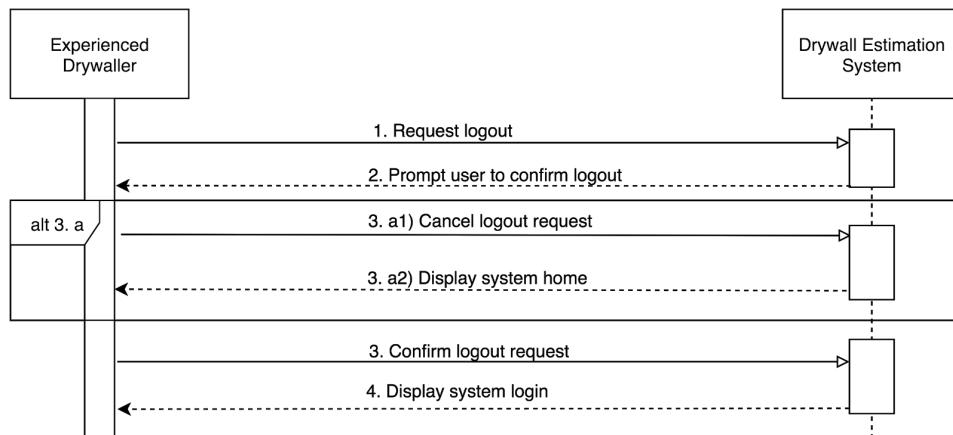
**Figure 1: Sequence Diagram for Use Case 1 (Login)**



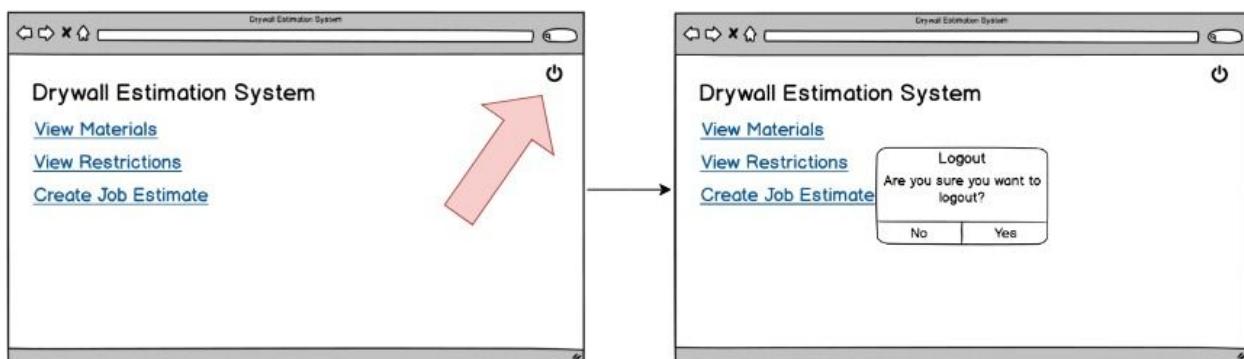
**Figure 2: Storyboard for Use Case 1 (Login)**  
*The user enters login credentials and requests access.*

**Table 4: Use Case 2: Logout**

Actors	User (Experienced Drywaller)
Preconditions	<ul style="list-style-type: none"> <li>User is logged in</li> <li>User is on the system home</li> </ul>
Steps	<ol style="list-style-type: none"> <li>User requests to logout</li> <li>User is shown a prompt to confirm logout request</li> <li>User confirms to logout</li> <li>User is shown the system login</li> </ol>
Success Conditions	<ul style="list-style-type: none"> <li>User is logged out</li> <li>The system login is displayed</li> </ul>
Alternate Paths	<ol style="list-style-type: none"> <li>User requests to cancel logout</li> <li>User is shown the system home</li> </ol>



**Figure 3: Sequence Diagram for Use Case 2 (Logout)**



**Figure 4: Storyboard for Use Case 2 (Logout)**  
The user requests to logout from the system home.

## **3.2 Generating Drywall Project Estimate for Client**

### **3.2.1 Description and Priority**

Allow a user to input measurements of the job site, required materials, and estimated work hours needed. Each estimate is generated based off of the formula in Appendix B that considers the above factors as well as the cost of materials and the amount of materials. A user can format the completed price estimate into an invoice. The newly created invoice can be downloaded, and a user can email the downloaded invoice to the client. Downloadable invoices will reduce a user's reliance on a separate invoice formatting software such as Sage.

**Priority:** High

### **3.2.2 Functional Requirements**

**R-F-02:** A user must be able to generate a new drywall estimate.

**Rationale:** The purpose of the system is to provide an estimation system for GIC.

**R-F-03:** A user must be able to define the region in which a drywall project takes place.

**Rationale:** GIC operates in multiple municipalities and will need to abide by different legislation depending on where the current project takes place.

**R-F-04:** A user must see the list of legislative restrictions prior to the start of an estimation.

**Rationale:** All GIC projects must abide by the applicable legislation that pertains to where the current project takes place.

**R-F-05:** A user must be able to input the materials used and the square footage of those materials for an estimate.

**Rationale:** In order to calculate material cost for an estimation, the total square footage of the material is needed.

**R-F-06:** A user must be able to enter estimated employee working hours for the current estimate.

**Rationale:** In order to calculate labor cost for an estimation, the total estimated employee working hours are needed.

**R-F-07:** A user must be able to download generated invoices.

**Rationale:** GIC staff email their invoices to the company owner for approval before emailing the client with the invoice.

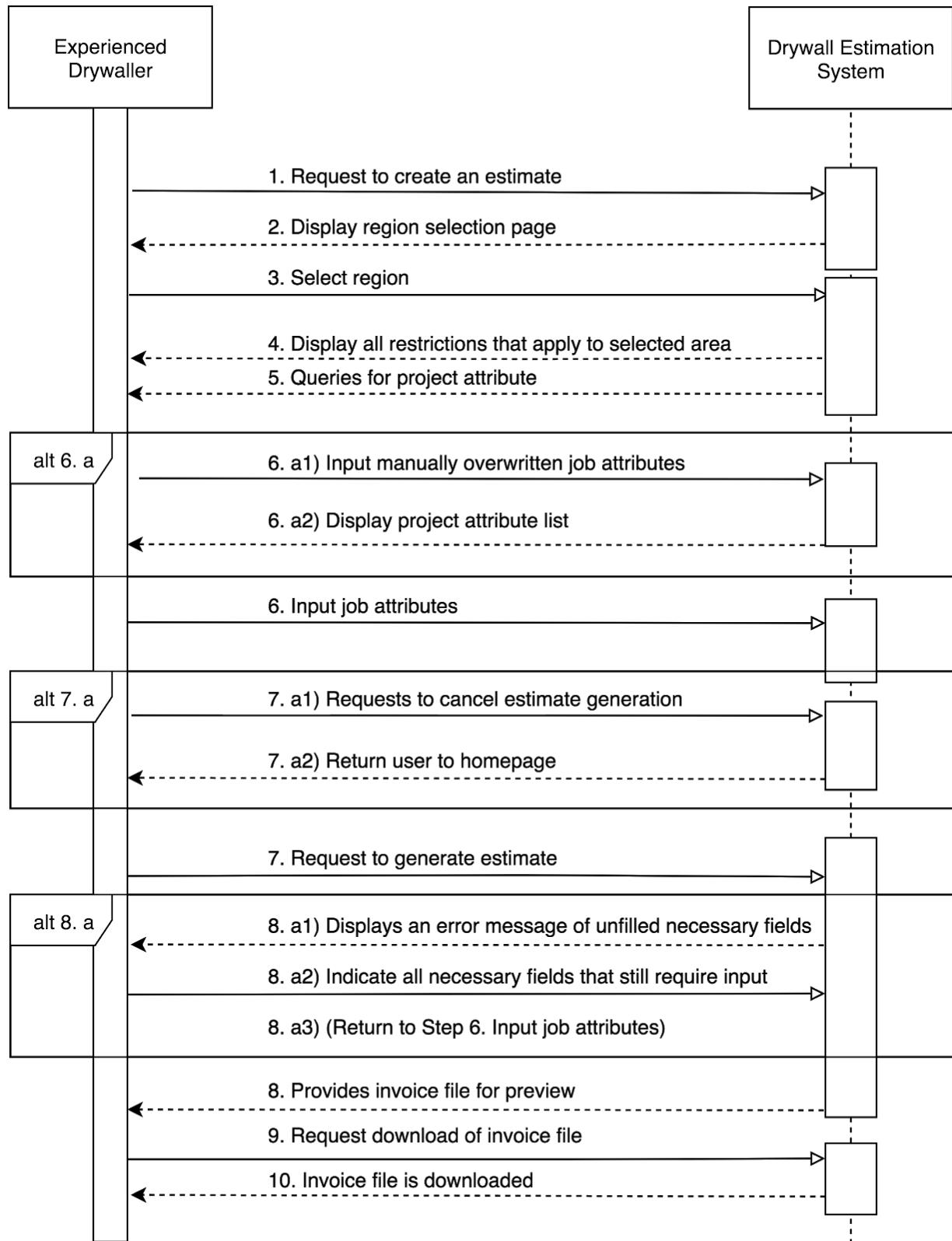
**R-F-08:** A user shall be able to change measurements, materials, and working hours for a project prior to generation of the downloadable project invoice.

**Rationale:** GIC staff may input values in error and will need to edit their entries to correct them.

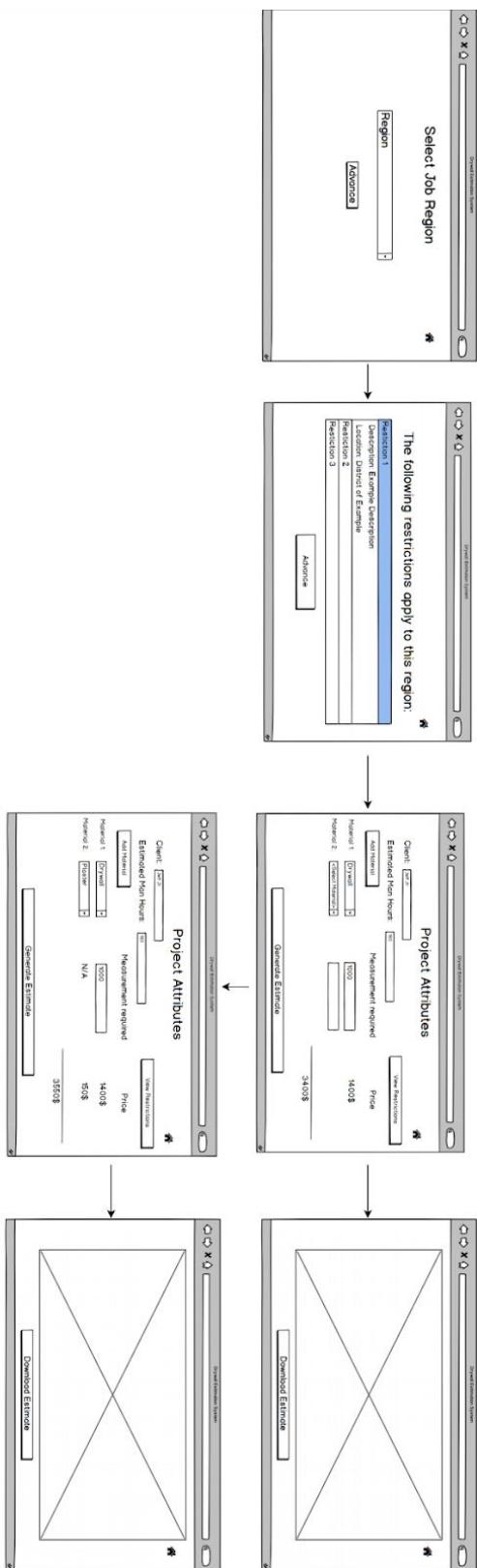
### 3.2.3 Use Case(s) Associated with Feature or Functional Requirements

**Table 5: Use Case 3: Generate Estimate and Download Invoice**

Actors	User (Experienced Drywaller)
Preconditions	<ul style="list-style-type: none"><li>• User is logged in</li><li>• User is on the system home</li></ul>
Steps	<ol style="list-style-type: none"><li>1. User requests to create an estimate</li><li>2. User is shown the region selection interface</li><li>3. User selects region where the project is taking place</li><li>4. User is shown any restrictions that apply to the selected area</li><li>5. User is queried for project attributes</li><li>6. User inputs project attributes. (Dimensions, material)</li><li>7. User requests to generate a emailable estimate file</li><li>8. A file preview of the completed estimate is displayed</li><li>9. User requests download of the invoice file displayed</li><li>10. The invoice file is downloaded</li></ol>
Success Conditions	<ul style="list-style-type: none"><li>• Invoice file is successfully generated and downloaded</li></ul>
Alternate Paths	<p>6. a1) User requests to input a material which has fields that have been manually overwritten by the user previously 6. a2) User is shown project attribute list with requested non-editable manually overwritten job attributes</p> <p>7. a1) User requests to cancel 7. a2) User is returned to the system home</p> <p>8. a1) User is shown an error message indicating either not all necessary fields are filled in. 8. a2) User is shown an indication that all necessary fields that still require input 8. a3) The user is returned to Step 5</p>



**Figure 5: Sequence Diagram for Use Case 3 (Generate and Download Invoice)**



**Figure 6: Storyboard for Use Case 3 (Generate and Download Invoice)**  
The user requests to generate estimate and download the invoice after entering project information.

### **3.3 Maintain an Inventory of Materials**

#### **3.3.1 Description and Priority**

Materials and their corresponding pricing data is critical to produce the drywall cost estimate given the formula used, which is outlined in Appendix 1. These prices will come from user-defined building material website URLs, but will also allow for the override of these prices by manually inputting a price for the material. The inventory of materials include material's name, price, supplier, URL, and notes as it's attributes.

**Priority:** High

#### **3.3.2 Functional Requirements**

**R-F-09:** A user shall be able to view an inventory of materials.

**Rationale:** GIC staff should be able to see all available materials for use in estimates.

**R-F-10:** A user shall be able to view each material's attributes.

**Rationale:** GIC should be able to see each material's price, name, supplier, URL, and notes for reference or to determine if an edit is necessary.

**R-F-11:** A user shall be able to edit the attributes of materials in the inventory.

**Rationale:** If a material attribute has changed or an attribute has been entered erroneously, GIC staff will need to change it.

**R-F-12:** A user shall be able to add a new material and the material's attributes to the inventory.

**Rationale:** As new materials are used by GIC in estimates, the material will need to be added to the material list for use in the estimation process.

**R-F-13:** A user shall be able to add an URL to each material from which the price can be automatically retrieved.

**Rationale:** Some materials used in GIC estimates have pricing data available online, allowing for a more accurate price for a material than a manually-entered one.

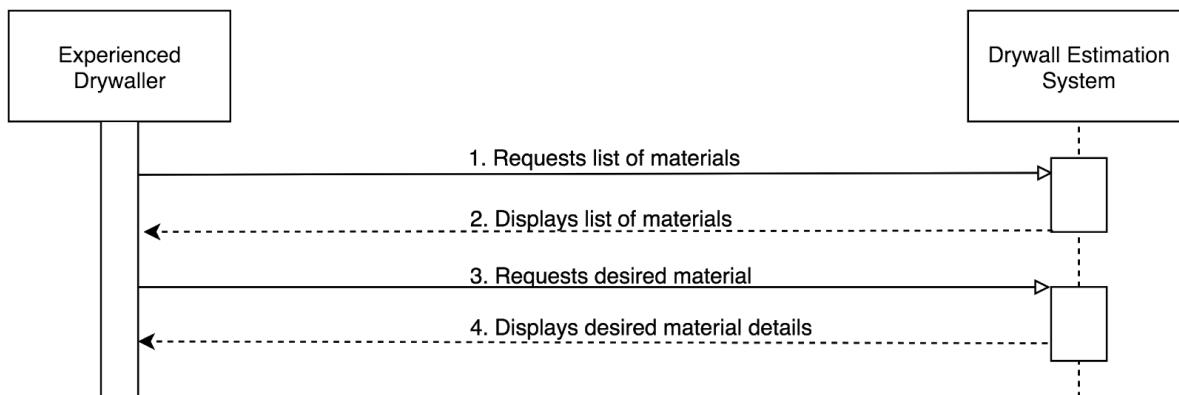
**R-F-14:** A user shall be able to delete a material from the inventory.

**Rationale:** If a material is discontinued or not used by GIC in estimates, the material should be removed from the materials list.

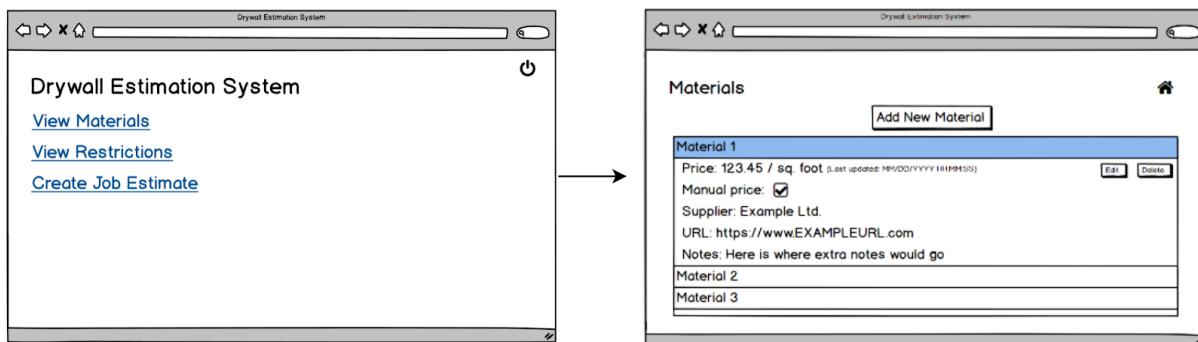
#### **3.3.3 Use Case(s) Associated with Feature or Functional Requirements**

**Table 6: Use Case 4: View Material**

Actors	User (Experienced Drywaller)
Preconditions	<ul style="list-style-type: none"> <li>User is logged in</li> <li>User is on the System home</li> </ul>
Steps	<ol style="list-style-type: none"> <li>User requests list of materials</li> <li>User is shown list of materials</li> <li>User selects the desired material</li> <li>User is shown details of desired material</li> </ol>
Success Conditions	<ul style="list-style-type: none"> <li>Details of desired material is displayed</li> </ul>
Alternate Paths	N/A



**Figure 7: Sequence Diagram for Use Case 4**

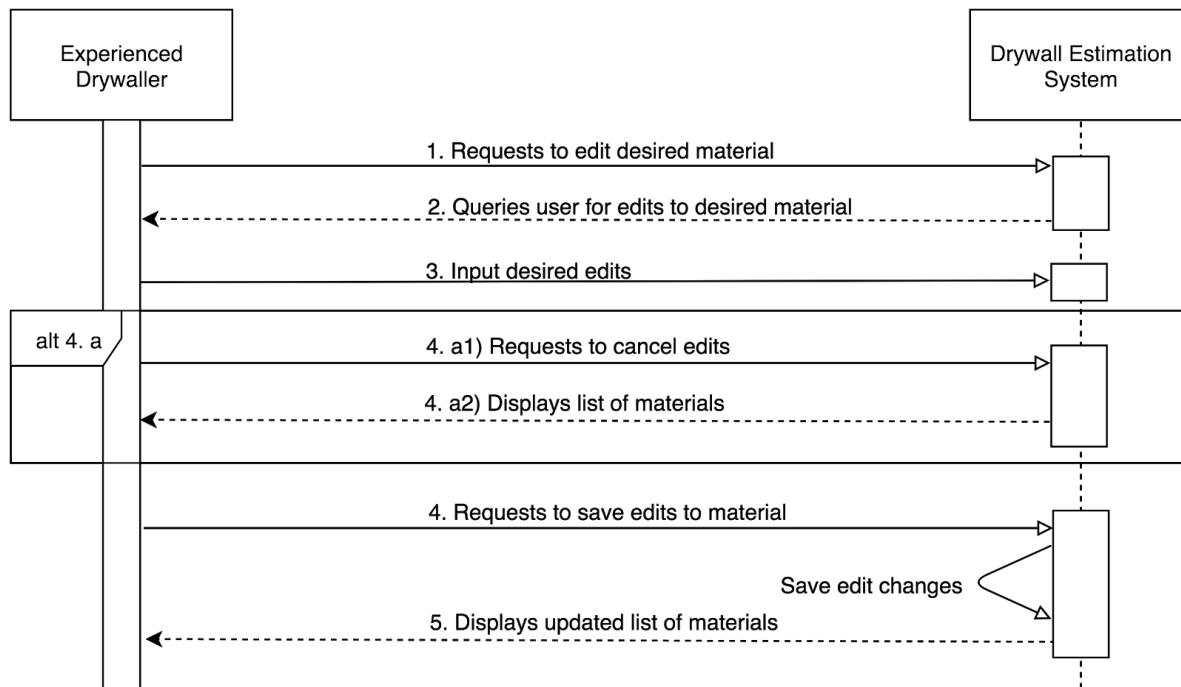


**Figure 8: Storyboard for Use Case 4 (View Material)**

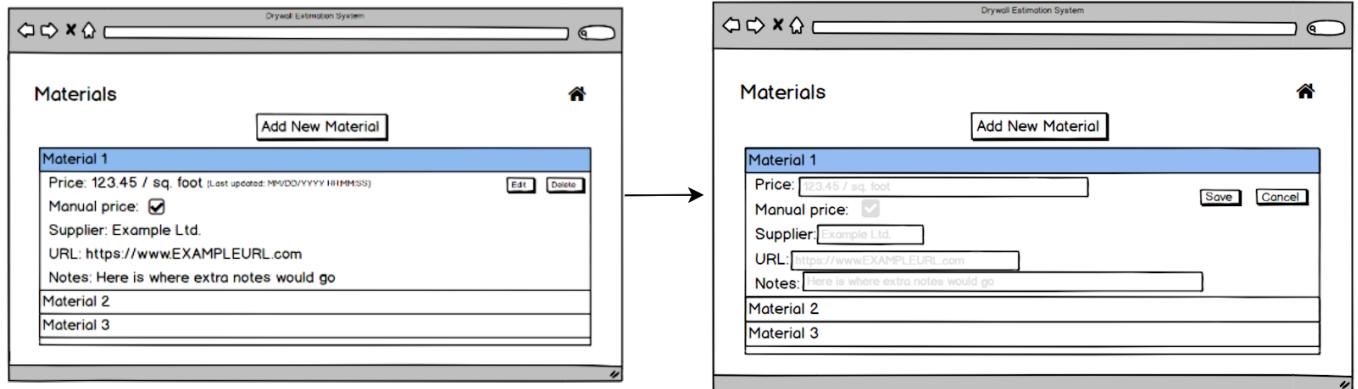
The user begins at the system home, views the list of materials, and then views and individual material's attributes.

**Table 7: Use Case 5: Edit Material**

Actors	User (Experienced Drywaller)
Preconditions	<ul style="list-style-type: none"> <li>User is logged in</li> <li>User has navigated to view materials interface</li> </ul>
Steps	<ol style="list-style-type: none"> <li>User requests to edit desired material</li> <li>User is shown prompt to make edits to desired material</li> <li>User inputs desired edits</li> <li>User requests to save changes</li> <li>User is returned to an updated list of materials</li> </ol>
Success Conditions	<ul style="list-style-type: none"> <li>Details of desired material are updated</li> <li>System displays the updated list of materials</li> </ul>
Alternate Paths	4. a1) User requests to cancel edits 4. a2) User is returned to a list of materials



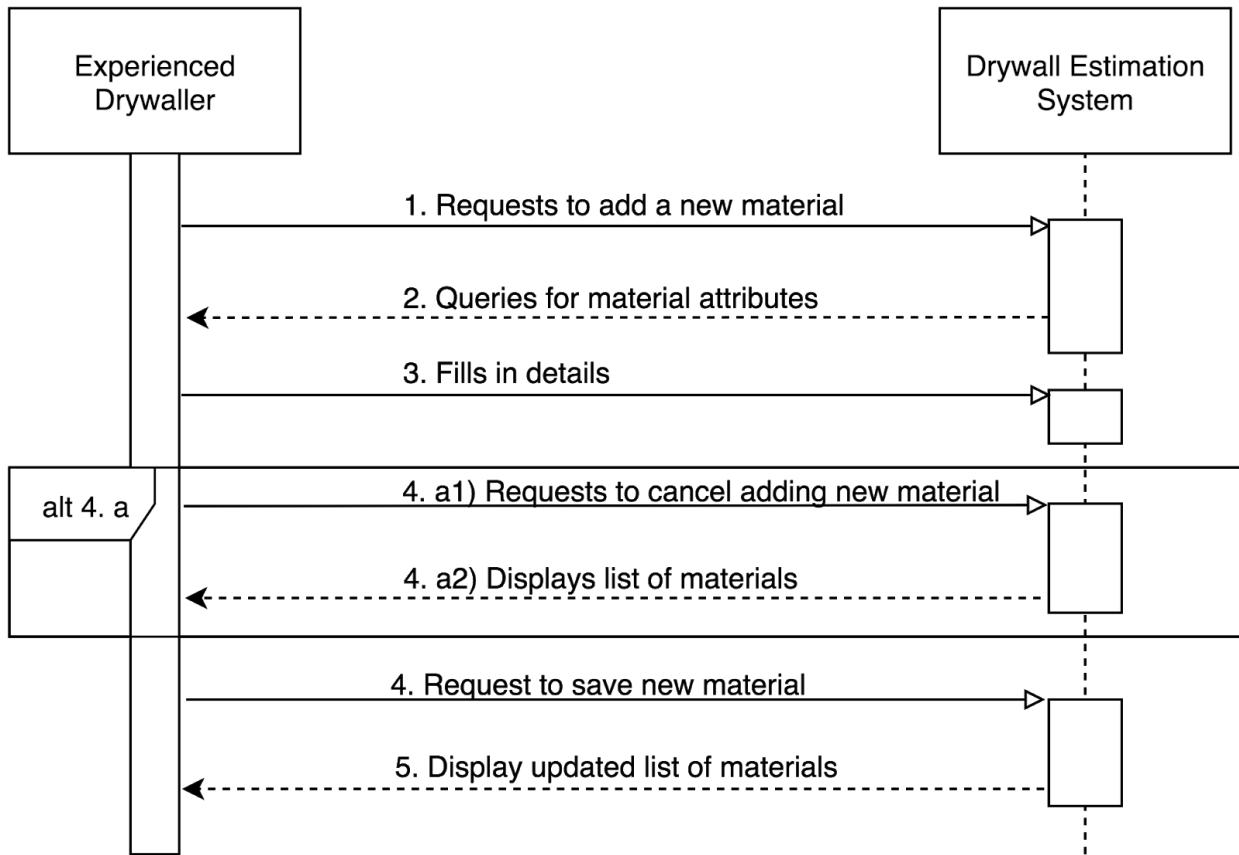
**Figure 9: Sequence Diagram for Use Case 5 (Edit Material)**



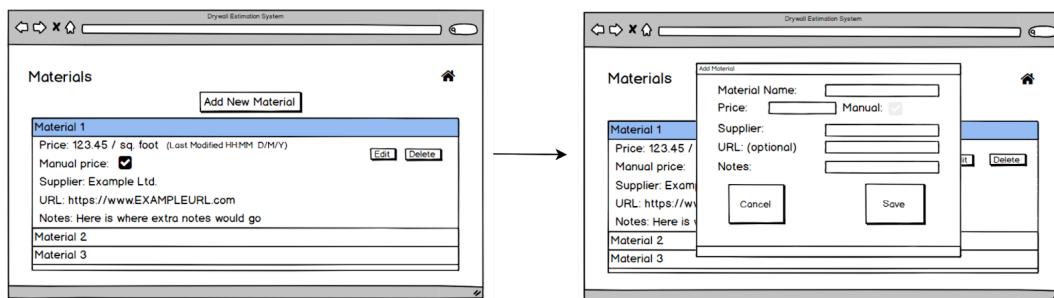
**Figure 10: Sequence Diagram for Use Case 5 (Edit Material)**  
*The user views an individual material's attributes, selects the edit button, then is prompted to fill in new values.*

**Table 8: Use Case 6: Add Material**

Actors	User (Experienced Drywaller)
Preconditions	<ul style="list-style-type: none"> <li>User is logged in</li> <li>User has navigated to view materials interface</li> </ul>
Steps	<ol style="list-style-type: none"> <li>User requests to add a new material</li> <li>User is queried for material attributes</li> <li>User fills in material attributes</li> <li>User requests to save the new material</li> <li>User is returned to an updated list of materials</li> </ol>
Success Conditions	<ul style="list-style-type: none"> <li>The new material is added to the system</li> </ul>
Alternate Paths	4. a1) User requests to cancel 4. a2) User is returned to the list of materials



**Figure 11: Sequence Diagram for Use Case 6 (Add Material)**

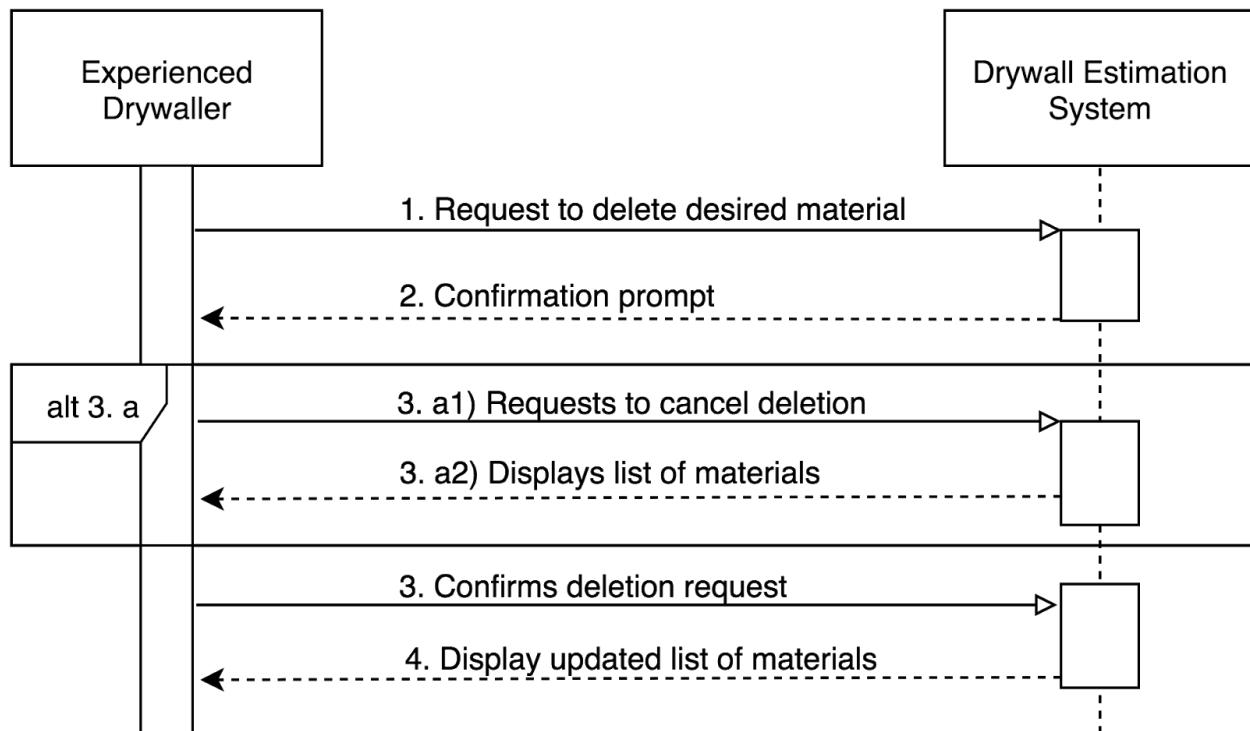


**Figure 12: Storyboard for Use Case 6 (Add Material)**

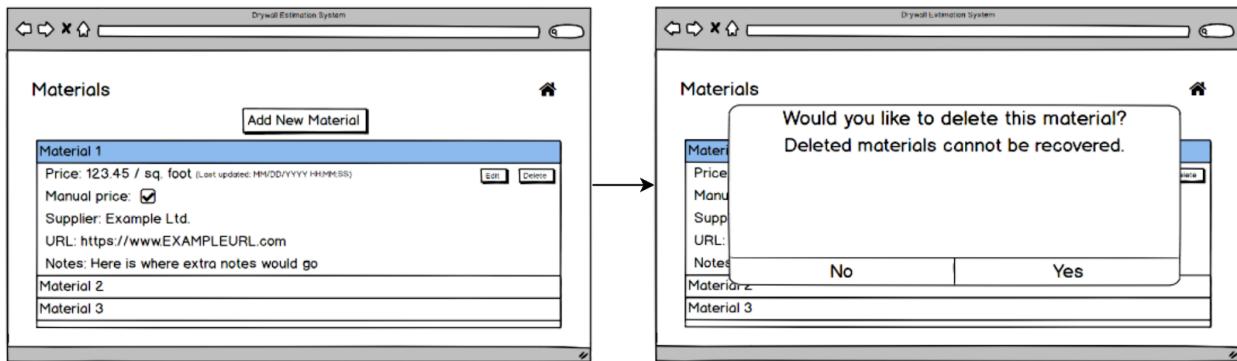
The user views the materials list, selects the add new material button, and then is prompted to define a new material and add it.

**Table 9: Use Case 7: Delete Material**

Actors	User (Experienced Drywaller)
Preconditions	<ul style="list-style-type: none"> <li>User is logged in</li> <li>User has navigated to the view materials interface</li> <li>User has selected the desired material</li> </ul>
Steps	<ol style="list-style-type: none"> <li>User requests to delete the material</li> <li>User is prompted to confirm the deletion of material</li> <li>User confirms to delete material</li> <li>User is returned to an updated list of materials</li> </ol>
Success Conditions	<ul style="list-style-type: none"> <li>Material is successfully deleted</li> </ul>
Alternate Paths	<ol style="list-style-type: none"> <li>User requests to cancel deletion</li> <li>User is returned to list of materials</li> </ol>



**Figure 13: Sequence Diagram for Use Case 7 (Delete Material)**



**Figure 14: Storyboard for Use Case 7 (Delete Material)**

*The user views an individual material, selects the delete button, and then is prompted to confirm their deletion.*

## 3.4 Maintain an Inventory of Applicable Legislative Restrictions

### 3.4.1 Description and Priority

The system shall store an editable list of legislative restrictions in a database. The system will then have the option to allow user to view the restriction list. At the beginning of each estimation, a user will see a list of all applicable legislative restrictions for the current estimation geographic region. Users will only be informed of these restrictions and will not have their inputs restricted by the system, leaving the onus on a user themself to follow each restriction.

**Priority:** Medium

### 3.4.2 Functional Requirements

**R-F-15:** Then user shall be able to view a list of legislative restrictions.

**Rationale:** GIC staff should be able to see all possible legislations that can affect estimates.

**R-F-16:** A user shall be able to view the name and description of each legislative restriction.

**Rationale:** GIC staff should be able to see each legislation's name and description for reference or to determine if an edit is necessary.

**R-F-17:** A user shall be able to edit the name and description of each legislative restriction.

**Rationale:** If a legislation name or description has changed or has been entered erroneously, GIC staff will need to change it.

**R-F-18:** A user shall be able to add a new legislative restriction and the restriction name and description to the list.

**Rationale:** As new legislation is created that applies to GIC estimates, the legislation will need to be added to the restriction list to be shown prior to the estimation process.

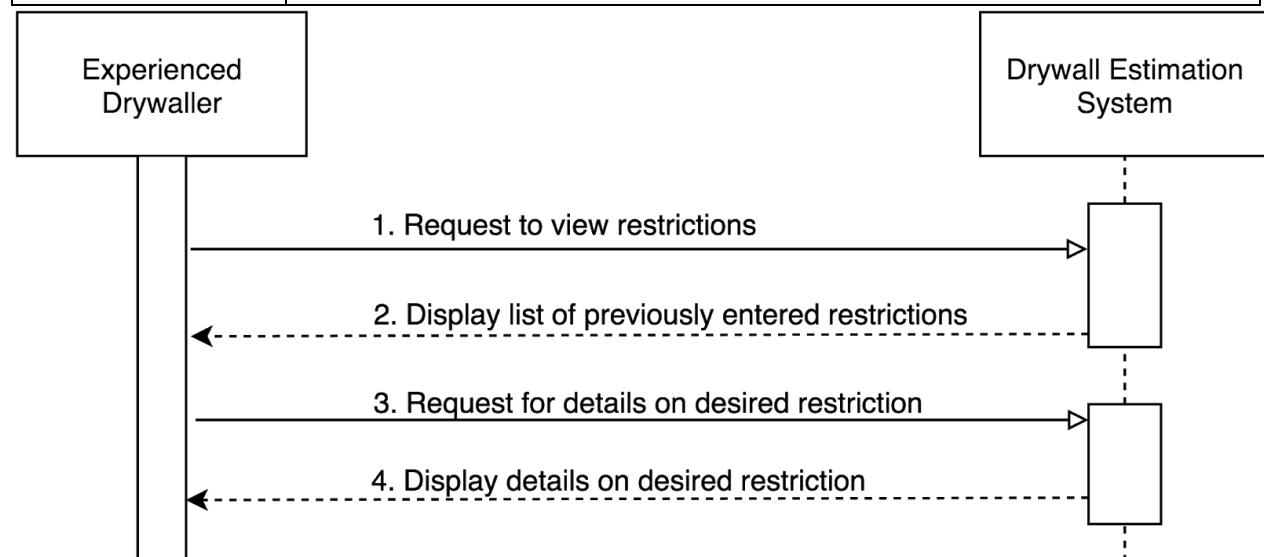
**R-F-19:** A user shall be able to delete a legislative restriction from the list.

**Rationale:** If a legislation is removed from law or is no longer applicable to GIC estimates, the legislation should be removed from the legislation list.

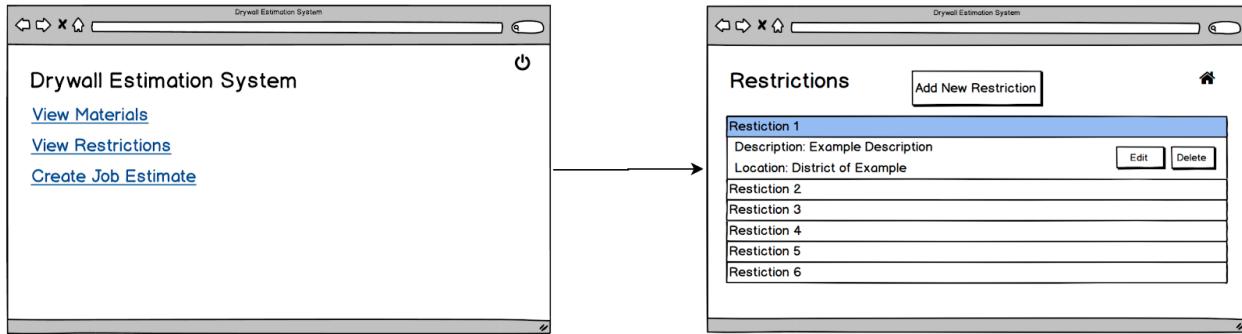
### 3.4.3 Use Case(s) Associated with Feature or Functional Requirements

**Table 10: Use Case 8: View Legislative Restrictions**

Actors	User (Experienced Drywaller)
Preconditions	<ul style="list-style-type: none"> <li>User is logged in</li> <li>User is in the system home</li> </ul>
Steps	<ol style="list-style-type: none"> <li>User requests to view the list of restrictions</li> <li>User is shown a list of previously entered restrictions</li> <li>User requests for details on the desired restriction</li> <li>User is shown details of desired restriction</li> </ol>
Success Conditions	<ul style="list-style-type: none"> <li>Details of desired restriction is displayed</li> </ul>
Alternate Paths	N/A



**Figure 15: Sequence Diagram for Use Case 8 (View Legislative Restrictions)**

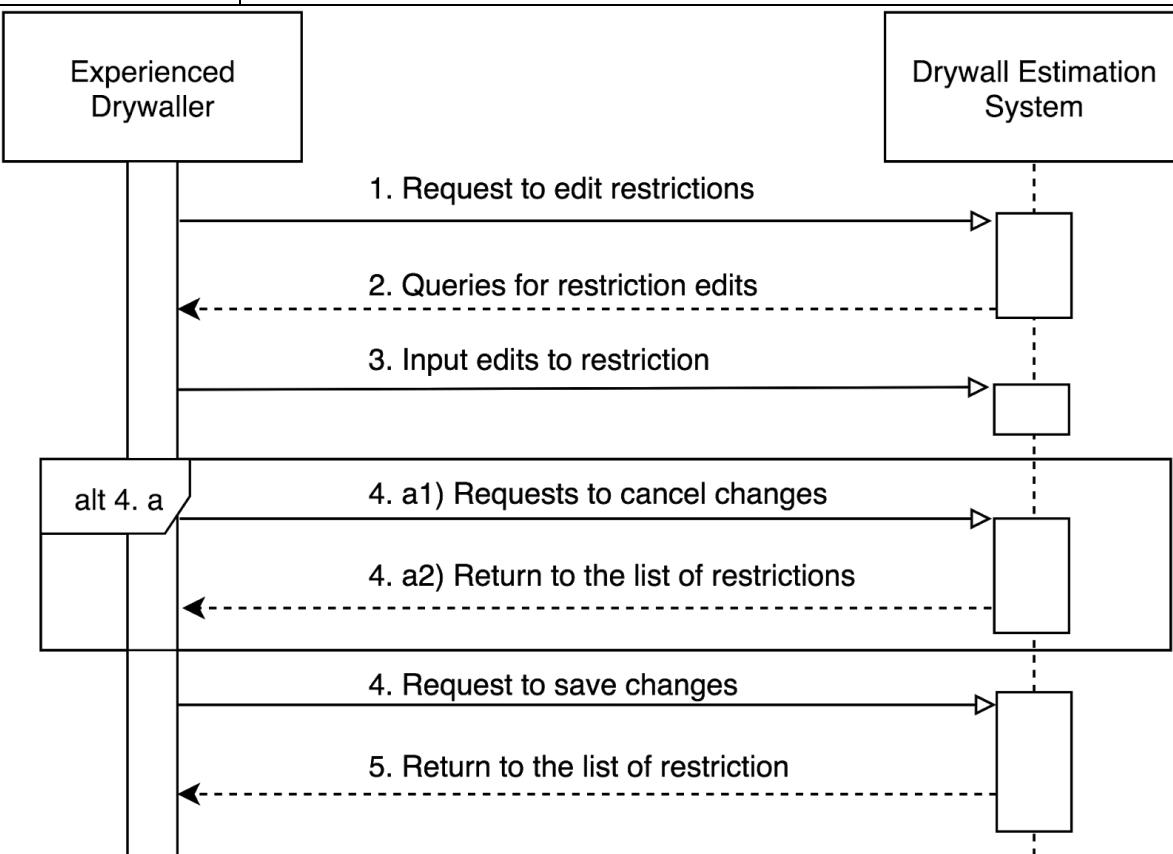


**Figure 16: Storyboard for Use Case 8 (View Legislative Restrictions)**

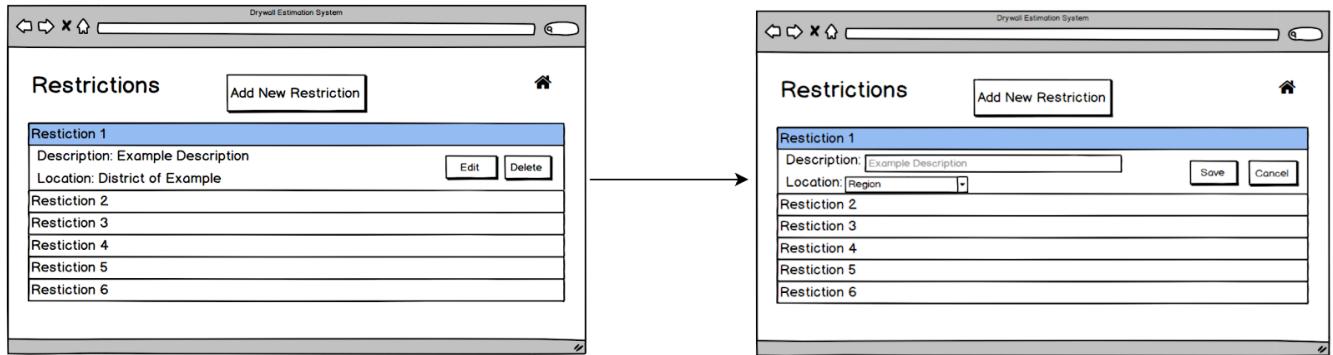
*The user begins at the system home, views the list of restrictions, then views and individual restrictions' attributes.*

**Table 11: Use Case 9: Edit Legislative Restriction**

Actors	User (Experienced Drywaller)
Preconditions	<ul style="list-style-type: none"> <li>User is logged in</li> <li>User has navigated to the view restrictions interface</li> <li>User has selected a desired restriction</li> </ul>
Steps	<ol style="list-style-type: none"> <li>User requests to edit restriction</li> <li>User is prompted to input edits for selected restriction</li> <li>User inputs edits to restriction</li> <li>User requests to save the changes</li> <li>User is returned to the updated list of restrictions</li> </ol>
Success Conditions	<ul style="list-style-type: none"> <li>List of restrictions is updated to reflect the changes made</li> </ul>
Alternate Paths	<ol style="list-style-type: none"> <li>User requests to cancel changes</li> <li>User is returned to the list of restrictions</li> </ol>



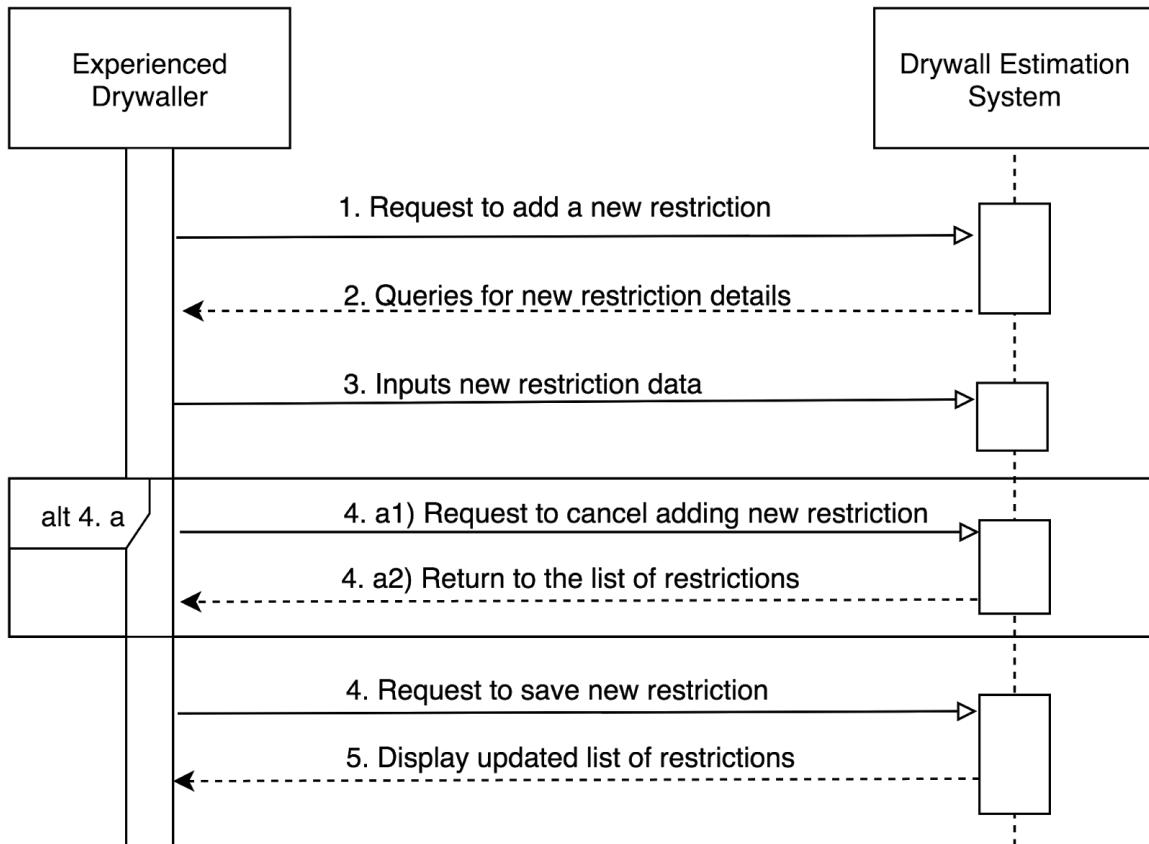
**Figure 17: Sequence Diagram for Use Case 9 (Edit Restriction)**



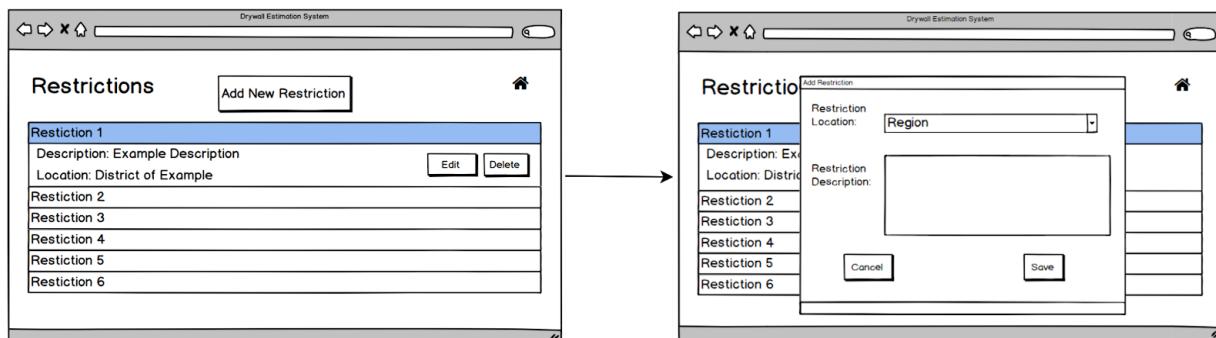
**Figure 18: Storyboard for Use Case 9 (Edit Legislative Restriction)**  
*The user views an individual restriction's attributes, selects the edit button, and then is prompted to fill in new values.*

**Table 13: Use Case 10: Add Legislative Restriction**

Actors	User (Experienced Drywaller)
Preconditions	<ul style="list-style-type: none"> <li>• User is logged in</li> <li>• User has navigated to the view restrictions interface</li> </ul>
Steps	<ol style="list-style-type: none"> <li>1. User requests to add a new restriction</li> <li>2. User is prompted for new restriction details</li> <li>3. User inputs new restriction data</li> <li>4. User requests to save the new restriction</li> <li>5. User is shown the updated list of restrictions</li> </ol>
Success Conditions	<ul style="list-style-type: none"> <li>• The new restriction is added to the list of restrictions</li> </ul>
Alternate Paths	4. a1) User requests to cancel adding new restriction 4. a2) User is returned to the list of restrictions



**Figure 19: Sequence Diagram for Use Case 10 (Add Legislative Restriction)**

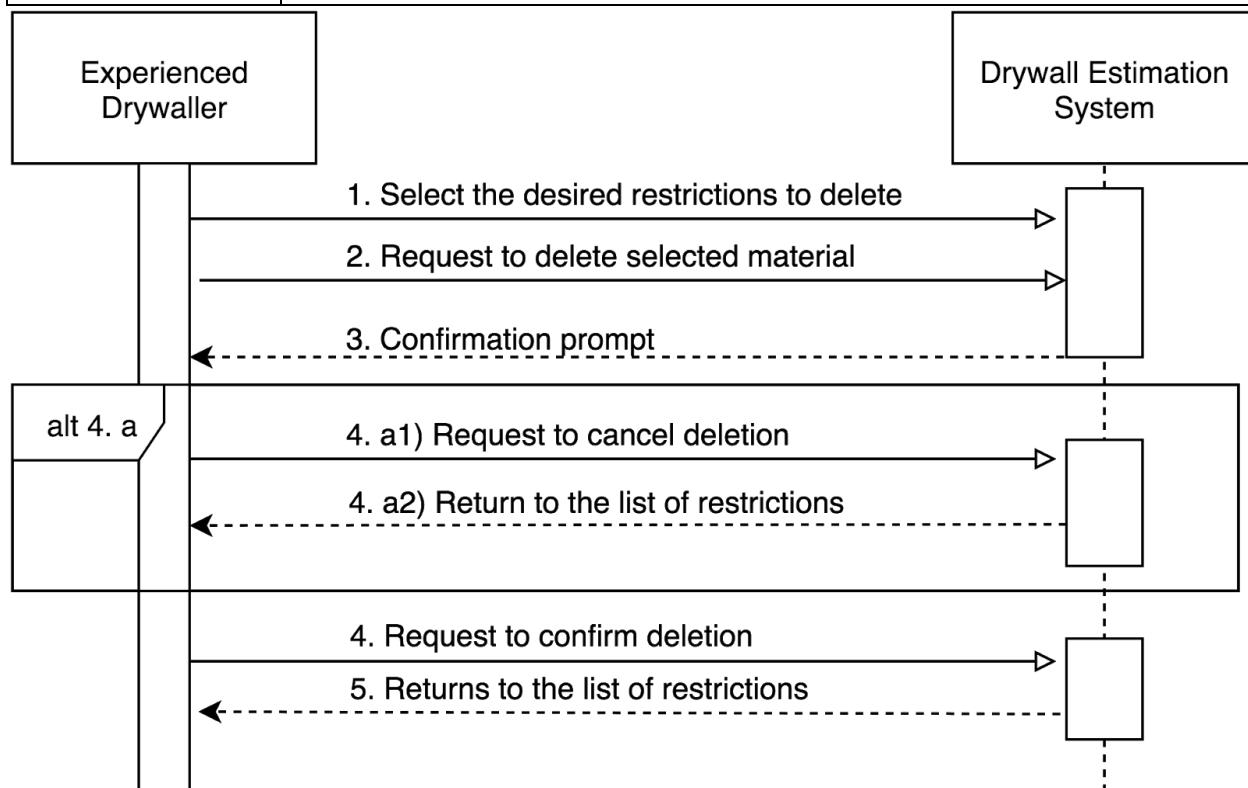


**Figure 20: Storyboard for Use Case 10 (Add Legislative Restriction)**

The user requests to add a restriction.

**Table 12: Use Case 11: Delete Legislative Restriction**

Actors	User (Experienced Drywaller)
Preconditions	<ul style="list-style-type: none"> <li>User is logged in</li> <li>User has navigated to the view restrictions interface</li> <li>User has selected desired restriction</li> </ul>
Steps	<ol style="list-style-type: none"> <li>User selects the desired restriction to delete</li> <li>User requests to delete selected material</li> <li>User is prompted for confirmation</li> <li>User requests to confirm the deletion</li> <li>User is shown the updated list of restrictions</li> </ol>
Success Conditions	<ul style="list-style-type: none"> <li>The requested restriction is deleted from the list</li> </ul>
Alternate Paths	<ol style="list-style-type: none"> <li>User requests to cancel the deletion</li> <li>User is returned to the list of restrictions</li> </ol>



**Figure 21: Sequence Diagram for Use Case 11 (Delete Legislative Restriction)**



**Figure 22: Storyboard for Use Case 11 (Delete Legislative Restriction)**  
The user selects a desired restriction to delete, and the system prompts for a confirmation.

## 4 External Interface Requirements

### 4.1 User Interfaces

#### 4.1.1 Description and Priority

The user interface must be designed to maximize the learnability and productivity of the system. This will reduce time spent on learning the system and provide a satisfactory user experience.

**Priority:** Medium

#### 4.1.2 External Interface Requirements

**R-EI-01:** If a user provides an invalid input, they are immediately notified.

**Rationale:** GIC staff may enter an impossible measurement or working hour number, such as a negative number, and must be informed to prevent an incorrect estimate.

**R-EI-02:** A user shall be provided an interface to manually input data.

**Rationale:** Inputted measurements, prices, and working hours are used to calculate all estimates.

**R-EI-03:** A user shall be able to amend and update any manually inputted data.

**Rationale:** GIC staff may incorrectly input measurements or working hours and will need to edit them to be correct.

## **4.2 Hardware Interfaces**

### **4.2.1 Description and Priority**

The system must be built such that it is compatible with computers and mobile phones as defined in Section 2.4.

**Priority: Low**

### **4.2.2 External Interface Requirements**

**R-EI-04:** The system layout shall be functional with all aspect ratios of the following monitor displays: 5:4, 4:3, 16:10, 16:9.

**Rationale:** GIC staff use both android smartphones and PC computers to complete estimates.

**R-EI-05:** The system shall support touch-screen input.

**Rationale:** GIC staff use mobile phones to complete estimates.

**R-EI-06:** The system shall support keyboard and mouse inputs.

**Rationale:** GIC staff use laptops to complete estimates.

## **4.3 Software Interfaces**

### **4.3.1 Description and Priority**

The system is required to be compatible with any software that is currently used by GIC. The system must be compatible with all devices running the operating environment defined in section 2.4.

**Priority: Medium**

### **4.3.2 External Interface Requirements**

**R-EI-07:** The system shall be able to extract building materials' price information from retail websites specified by a user.

**Rationale:** Automatic price updates for materials are needed to keep GIC estimates accurate.

**R-EI-08:** The system shall export a detailed price invoice as an emailable file.

**Rationale:** GIC staff use email to send completed invoices to the GIC owner for approval, and then email the approved report to the client.

**R-EI-09:** The system shall be compatible with any operating system versions released within the past 3 years (Android 7.0+, Windows 10).

**Rationale:** Some GIC employees have out-of-date phones and laptops and will need to access the system with them.

**R-EI-10:** The drywall estimation process shall be accessible through an internet connection.

**Rationale:** GIC needs the system to be as hardware-agnostic as possible as some staff have outdated cell phones and laptops.

#### **4.4 Communications Interfaces**

There are none at this time.

# 5 Other Non-Functional Requirements

## 5.1 Performance Requirements

### 5.1.1 Description and Priority

The current estimation process for GIC takes approximately 4 hours according to GIC. This process includes measurement, calculation, and invoice completion. The system should reduce the average time taken by the complete process to half of what it currently is.

**Priority:** Medium

### 5.1.2 Non-Functional Requirements

**R-NF-01:** The time between R-F-02 and R-F-07 shall be no longer than 2 hours.

**Rationale:** Under normal circumstances, the contractor should take no longer than 2 hours to create a new estimation in the Drywall Estimation System.

## 5.2 Safety Requirements

### 5.2.1 Description and Priority

Drywall projects undergone by GIC take place in BC, primarily in Gabriola Island and Nanaimo, must comply to all applicable laws. This always includes the BC Building, Fire, and Plumbing codes [3], and often will include local municipal bylaws, dependent on location.

**Priority:** Medium

### 5.2.2 Non-Functional Requirements

**R-NF-02:** All estimations shall be compliant to the BC Building, Fire, and Plumbing Codes [3].

**Rationale:** As GIC resides in BC, the drywalling company must comply with BC's building, Fire and Plumbing Codes.

**R-NF-03:** All estimations shall be compliant to all municipal bylaws that govern drywall installation [4,5].

**Rationale:** All estimations are required to comply by municipal bylaw which govern drywall installation to ensure safety guidelines are followed during drywall operations.

**R-NF-04:** All regulations that affect user input values shall be made apparent to a user of the system.

**Rationale:** The GIC staff should be aware of all user inputs which violate any of the regulations.

## **5.3 Security Requirements**

### **5.3.1 Description and Priority**

Currently, only the owner of GIC calculates drywall project estimates. However, it would be of benefit for some GIC staff to be able to complete estimates, thus a verification process should be in place to ensure only qualified staff may access and utilize the system.

**Priority:** Medium

### **5.3.2 Non-Functional Requirements**

**R-NF-05:** No individual, other than approved GIC staff with correct authentication credentials, shall be able to access the system.

**Rationale:** For the purpose of security, only the GIC staff members have the authentication credentials to access the system.

## **5.4 Software Quality Attributes**

### **5.4.1 Description and Priority**

The numbers used in drywall project estimation, including material cost and labor cost are subject to change at any time. Similarly, the provincial regulations that apply to drywall installation are typically updated yearly, while municipal bylaws can be updated multiple times per year. Therefore, it is important to allow these values within the system to be fluid. As well, errors in both regulation compliance and estimation results are possible, therefore the logging and correction of both is necessary.

**Priority:** Medium

### **5.4.2 Non-functional Requirements**

**R-NF-06:** All automatically determined prices for materials shall be updated every 24 hours.

**Rationale:** The prices of material should be updated frequently enough to provide accurate estimates and 24 hours is realistic to achieve.

**R-NF-07:** A user shall be able to use the system within 1 hour of use and without formal training.

**Rationale:** The system should be user friendly and allow new users to quickly learn the functionalities of the system.

**R-NF-08:** All system errors including regulation errors, must be logged, stored, and accessible by a user.

**Rationale:** The GIC staff should have access to all system errors to evaluate if an error is a result of municipal bylaws update, changes to BC's drywall Code or a user overwrite.

**R-NF-09:** Cost estimates shall be within a +/-10% range of the actual cost.

**Rationale:** The estimation system must be accurate enough within a range of the actual cost.

**R-NF-10:** A user shall be able to navigate the GUI without formal training.

**Rationale:** The system should improve the speed and accessibility of estimate creation, so no training should be required.

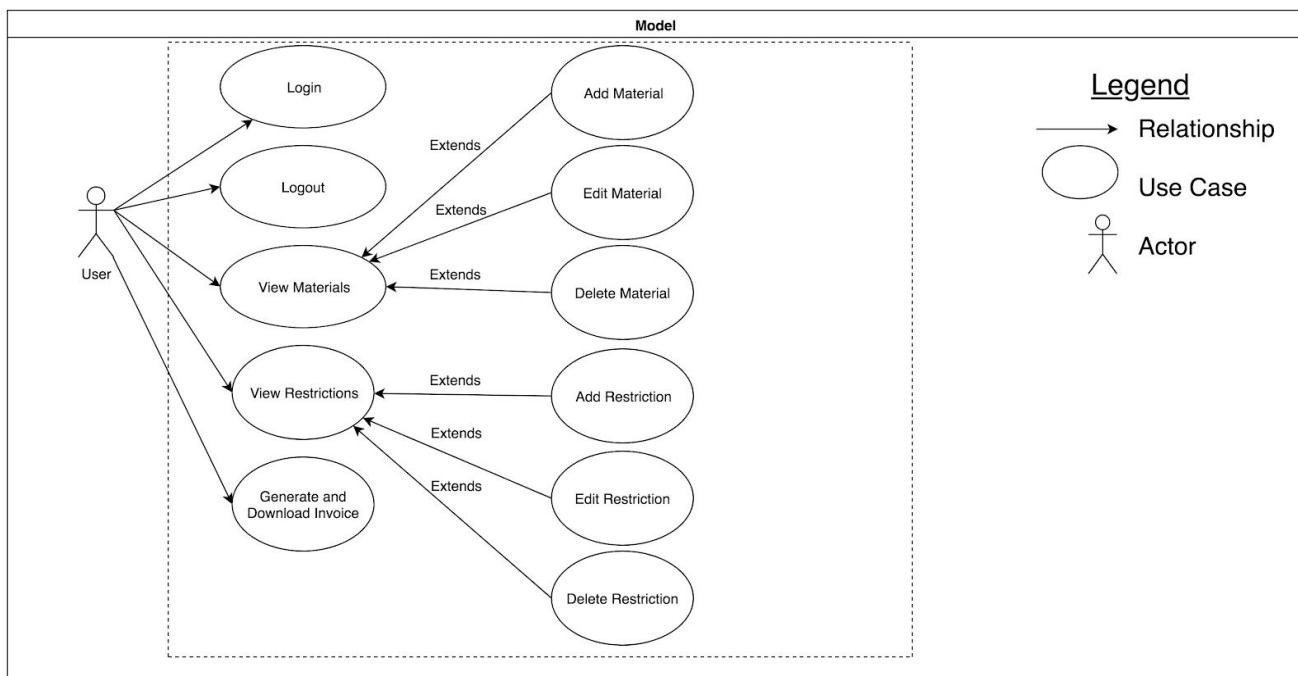
## 6 Other Requirements

There are no other requirements that apply to the system at this time.

# 7 Analysis Models

## 7.1 Use Case Model

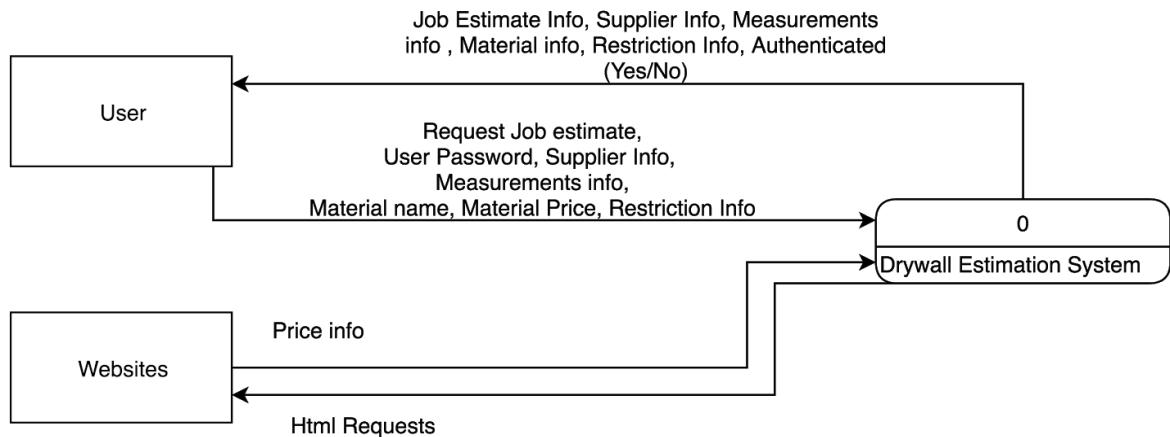
This diagram shows the user, use cases, and relationships between them. Since there is only one actor (the user), the user is related to all use cases. The user is directly related to the first column (from the left) of use cases which, using includes and extends relationships, relates the user to all other use cases in the second and third columns. In Section 3 “System Features”, the requirements and a detailed sequence diagram are available for each use case listed in the Use Case Model.



**Figure 23: Use Case Model**

## 7.2 Data Flow Diagram 0 (Context Diagram)

This diagram shows a high-level representation of the Drywall Estimation System. The Drywall Estimation System is shown as the Drywall Estimation System. The external entities, the user, and the website, are shown with respective data inputs and outputs.



### Legend

→ Direction of Data Flow

Object

External Actor

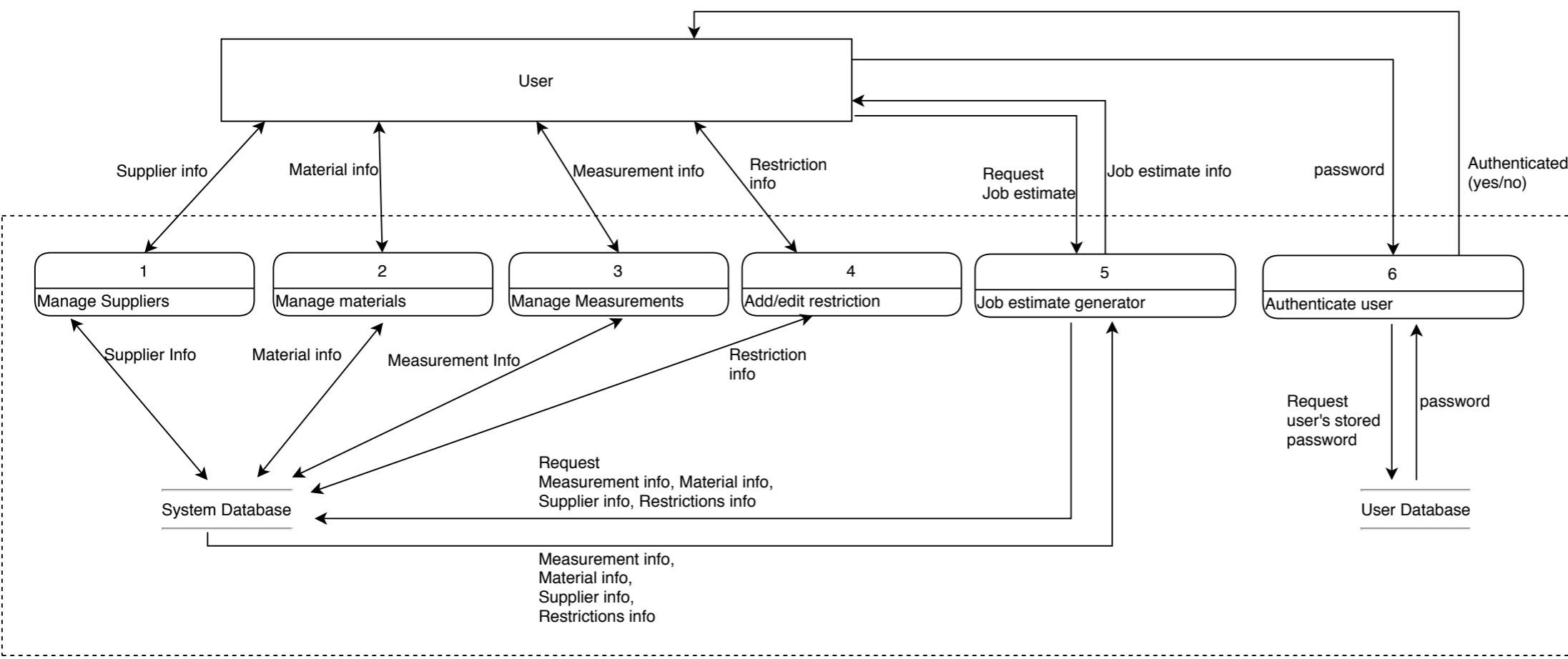
#

Internal Process

*Figure 24: Context Diagram*

### **7.3 Data Flow Diagram 1.0**

This diagram shows a more detailed breakdown of the main processes that make up the Drywall Estimation System. The data is stored in the main database as well as in the user database. The processes represent the actions taken by the system and data flow direction is represented by the arrows.



## Legend

→ Direction of Data Flow

Object  
External Actor

#  
Process Name  
Internal Process

Datastore  
Datastore

Figure 25: Data Flow Diagram 1.0

## **7.4 Data Flow Diagram 2.0**

This diagram shows a more detailed breakdown of the processes in DFD 1.0 that has sub components broken down. The user authentication is not shown as there are no more steps to break down. The steps are broken down from manage [table name] to several functions that the manage function has.

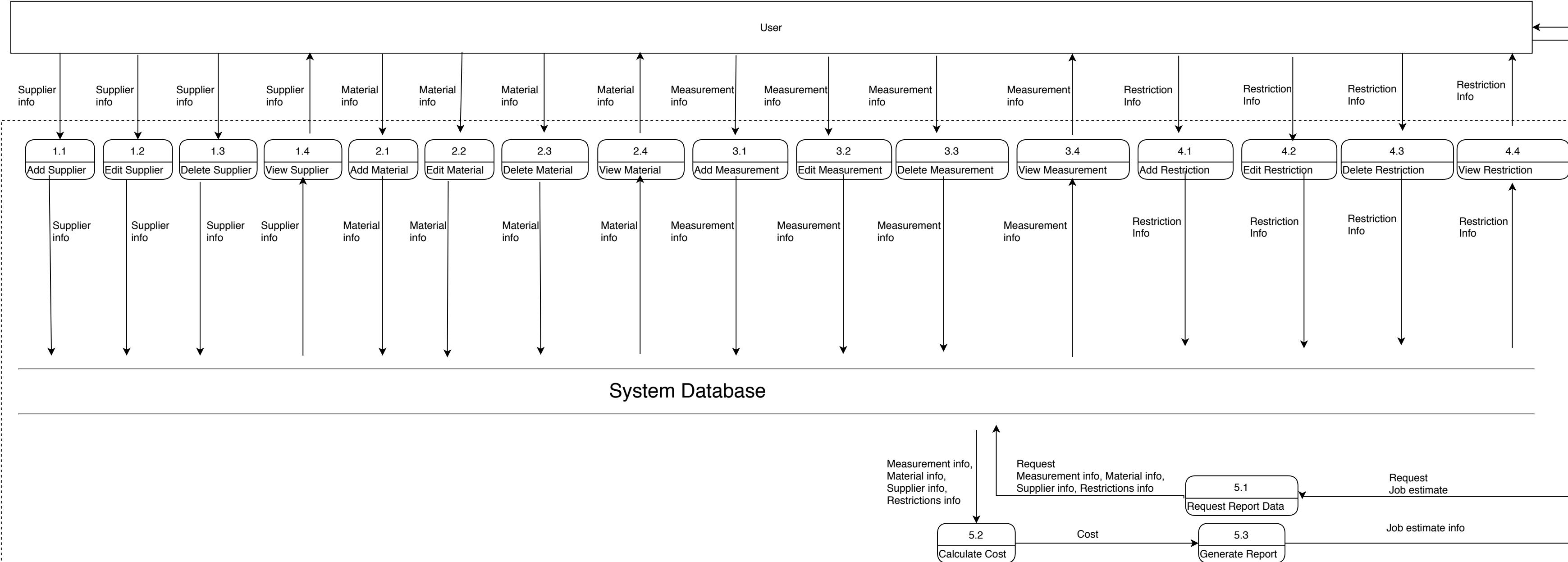
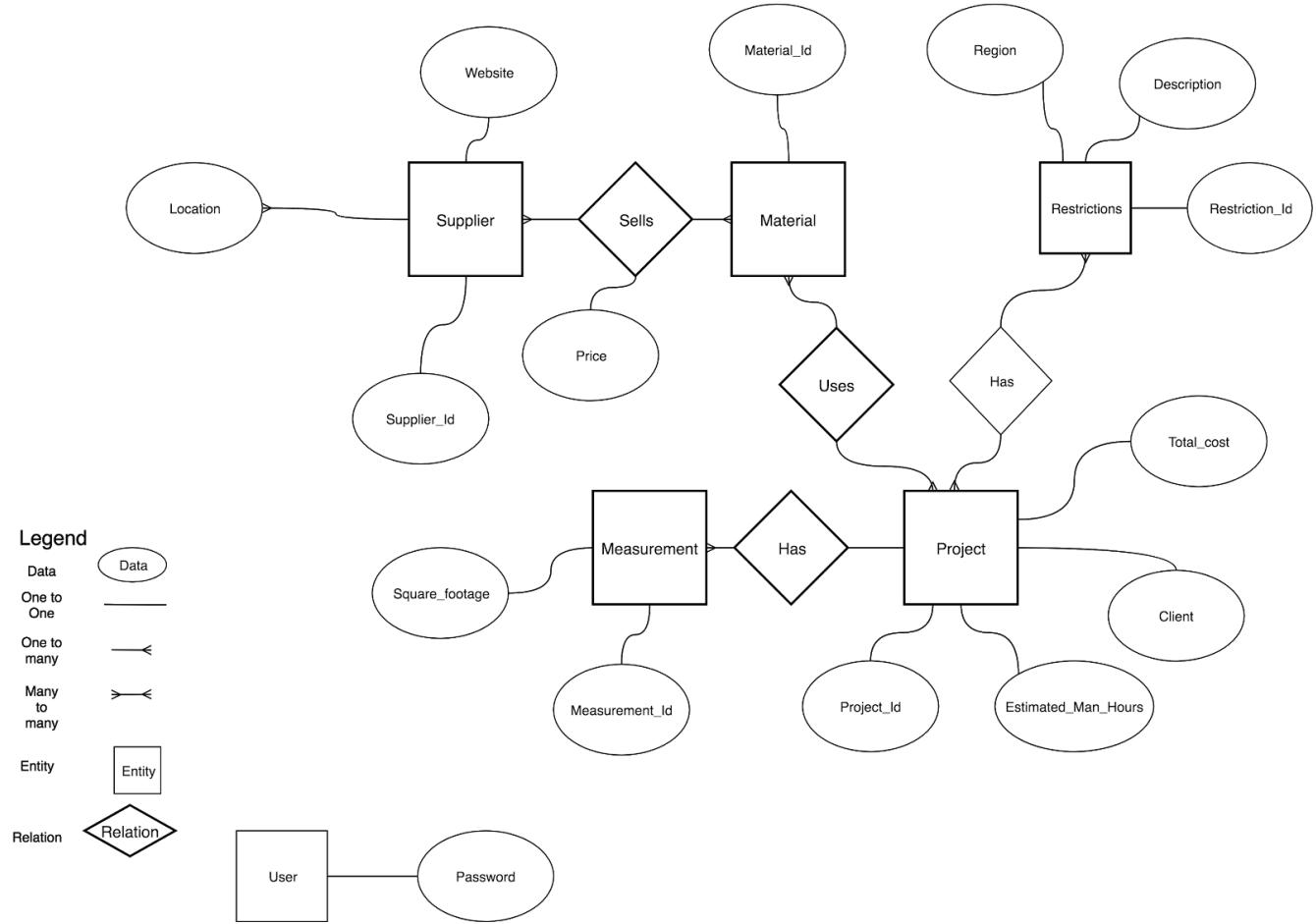


Figure 26: Data Flow Diagram 2.0

## 7.5 Entity Relationship Diagram

This Diagram shows the relation between the project the user inputted measurements and the materials used with the measurements.



**Figure 27: Entity Relationship Diagram**

## 7.6 Data Dictionary

Table 14: Data Dictionary

Table	Column	Data Type	Primary key	References	Not Null	Description
Supplier	Supplier_Id	String	Y		Y	Id of supplier
Supplier	Website	String	N		Y	Suppliers website
Supplier	Location	String	N		N	Location of supplier
Supplier	Material_id	String	N	Material.Material_Id	N	Materials sold
User	Password	String	N		Y	User's password
Restrictions	Description	String	N		Y	Description of regulation or other limitation
Restrictions	Restriction_Id	String	Y		Y	Id of restriction
Project	Project_Id	String	Y		Y	Project Id
Project	Client	String	N		Y	The name of a Customer for a given project
Project	Total_Cost	Double	N		Y	Projects total cost
Project	Estimated_Man_Hours	Int	N		Y	Number of man hours needed to complete project
Project	Measurement_Id	Int	N	Measurement.Measurement_id	Y	Id of a given measurement
Project	Material_Id	String	N	Material.Material_Id	Y	Id of a material
Project	Restriction_Id	String	N	Restriction.Restriction_Id	Y	Id of restriction
Measurement	Square_Footage	Double	N		Y	Total square footage of a job
Measurement	Measurement_Id	Int	Y		Y	Id of a given measurement
Material	Material_Id	String	Y		Y	Id of a material
Material	Price	Double	N		Y	Price of a material
Material	Supplier_Id	String	N	Supplier.Supplier_Id	Y	Id of supplier

# 8 Requirements Traceability

## 8.1 Test Case Table

Table 15: Test Case Table

Test Case ID	Requirement ID	Test Case Description
T-C-01	R-F-01	Verify that the “Experienced drywall” user can login and use the Drywall Estimation software’s features; and verify that a unauthorized user cannot access the system
T-C-02	R-F-02	Verify that a user can generate a drywall estimate
T-C-03	R-F-03	Verify that a user can define a region for a drywall project
T-C-04	R-F-04	Verify that a user can view all input restrictions prior to input
T-C-05	R-F-05	Verify that a user can input square footage and desired materials for an estimate
T-C-06	R-F-06	Verify that a user can input the number of man hours
T-C-07	R-F-07	Verify that the estimate invoice is downloadable
T-C-08	R-F-08	Verify that a user can make changes to inputs prior to estimate generation
T-C-09	R-F-09	Verify that the inventory of materials is viewable by a user
T-C-10	R-F-10	Verify that a user can view the attributes of materials
T-C-11	R-F-11	Verify that a user can edit a material in the database
T-C-12	R-F-12	Verify that a user can add a material to the database
T-C-13	R-F-12	Verify that a user can add a material’s attributes to the database
T-C-14	R-F-13	Verify that a user can add a material’s website (URL) to the database
T-C-15	R-F-14	Verify a user can delete a material in the database
T-C-16	R-F-15	Verify that a user can view a list of legislative restrictions
T-C-17	R-F-16	Verify that a user can view the name and description of each legislative restriction

T-C-18	R-F-17	Verify that a user can edit the name and description of each legislative restriction
T-C-19	R-F-18	Verify that a user can add a new legislative restriction
T-C-20	R-F-18	Verify that a user can add a legislative restriction name and description
T-C-21	R-F-19	Verify that a user can delete a legislative restriction from the list
T-C-22	R-EI-01	Verify that a user is notified if an invalid input is entered
T-C-23	R-EI-02	Verify that a user is able to manually input data.
T-C-24	R-EI-03	Verify that a user can update and amend manually inputted data that has been previously entered.
T-C-25	R-EI-04	Verify that the system is functional on all 5:4, 4:3, 16:10, 16:9 monitors
T-C-26	R-EI-05	Verify that a user using a touch screen device is able to make use of system of functionality
T-C-27	R-EI-06	Verify that a user can use a mouse and/or keyboard to navigate
T-C-28	R-EI-07	Verify that the building material prices are gathered correctly and updated daily
T-C-29	R-EI-08	Verify that a user can export a detailed price invoice as an emailable file.
T-C-30	R-EI-09	Verify that the system is compatible with Android 7+ and Windows 10+
T-C-31	R-EI-10	Verify that the system is accessible through an internet connection
T-C-32	R-NF-01	Verify that the time to complete an estimate from start to finish takes no longer than 2 hours
T-C-33	R-NF-02	Verify that all estimates generated comply with BC Building, Fire, and Plumbing Codes
T-C-34	R-NF-03	Verify that all estimates generated comply with municipal bylaws that govern drywall installation
T-C-35	R-NF-04	Verify that the system displays any input restrictions that

		apply to a input field
T-C-36	R-NF-05	Verify that a user without authentication credentials cannot access the system
T-C-37	R-NF-06	Verify that material prices are automatically updated every 24 hours
T-C-38	R-NF-07	Verify that a new user without formal training can use the system within 1 hour of use
T-C-39	R-NF-08	Verify that all errors are logged, stored, and accessible by a user
T-C-40	R-NF-09	Verify that generated cost estimates are within 10% of the actual cost.
T-C-41	R-NF-10	Verify that a user can navigate the GUI without formal training

## 8.2 Test Case Matrices

Table 16: Functional Requirements Test Case Matrix

Functional Requirements		Test case ID (T-C-#)																				
Req ID		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
R-F-01	X																					
R-F-02		X																				
R-F-03			X																			
R-F-04				X																		
R-F-05					X																	
R-F-06						X																
R-F-07							X															
R-F-08								X														
R-F-09									X													
R-F-10										X												
R-F-11											X											
R-F-12												X	X									
R-F-13													X									
R-F-14														X								
R-F-15															X							
R-F-16																X						
R-F-17																	X					
R-F-18																		X	X			
R-F-19																						X

**Table 17: External Interface Requirements Test Case Matrix**

External Interface Requirements										
Req ID	Test case ID (T-C#)									
	22	23	24	25	26	27	28	29	30	31
R-EI-01	X									
R-EI-02		X								
R-EI-03			X							
R-EI-04				X						
R-EI-05					X					
R-EI-06						X				
R-EI-07							X			
R-EI-08								X		
R-EI-09									X	
R-EI-10										X

**Table 18: Non-Functional Requirements Test Case Matrix**

Non-Functional Requirements										
Req ID	Test case ID (T-C-#)									
	32	33	34	35	36	37	38	39	40	41
R-NF-01	X									
R-NF-02		X								
R-NF-03			X							
R-NF-04				X						
R-NF-05					X					
R-NF-06						X				
R-NF-07							X			
R-NF-08								X		
R-NF-09									X	
R-NF-10										X

## **Appendix A: Issues List**

There are no issues at this time.

## **Appendix B: Estimation Formula**

The following formula is currently used by GIC to estimate project costs:

$$\Sigma(\text{all material})(\text{cost of respective material}) + (\text{estimated man-hours})(\text{hourly wage}) = \text{total project cost}$$

The system will calculate the material costs, but estimated man-hours are manually inputted.

## **Appendix C: Client Comment Rebuttals**

**R-NF-06:** All automatically determined prices for materials shall be updated every 24 hours.

GIC commented on R-NF-06 from Section 5.4.2, stating “it would be better if updated whenever creating an estimate.” However, in previous negotiations with GIC, they stated a frequency of 24 hours was acceptable.

With regards to the storyboards, GIC commented on the home button and that it had no associated use case. There is no requirement for a system home navigation. This home button is a solution specific possibility included only in the storyboards.