Requirements Document
Drywall Estimation System
Gulf Islands Consulting

Requirements Engineering Ltd
Group 8
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March 12, 2019

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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	1.0
Requirements Engineering Ltd. Team	Feb. 6	Edited initial document given client feedback	1.1
Requirements Engineering Ltd. Team	Mar. 12	Added analysis models, use cases and sequence diagrams, and UI mockups to create initial RSD	2.0

1 Introduction

1.1 Purpose

This requirements document 1.0 covers the requirements for Gulf Islands Consulting'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 Gulf Islands Consulting 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. These 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 Gulf Islands Consulting's workers, 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.
Framing	Fitting together components to create a defined shape and structure.
Building Materials	Materials used in the drywall installation process including but not limited to: drywall and insulation.
Quote	An approximation of the project cost calculated from the price and measurements of materials and labour costs.
Sage	Business assistance software used for generating and tracking invoices.
Slegg Building Materials	Building supply retailer located on Vancouver Island.
RONA	Retailer of home improvement and construction products and services.
Home Depot	Home improvement supplies retailing company.
Web Scrape	Extracting data from websites
GIC	Gulf Islands Consulting

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 6 sections and two appendices in this document. The following section, section 2, describes Gulf Islands Consulting'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. The fifth section breaks down the system's non-functional requirements into performance, safety, security, and quality requirements. Section 6 covers additional requirements requirements not covered in the previous sections. The first appendix contains outstanding questions regarding the current Gulf Islands Consulting Drywall Cost Estimation system are listed in this section. The second appendix, describes the formula that is currently used by Gulf Islands Consulting. 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.

2 Overall Description

2.1 Product Perspective

Currently, Gulf Islands Consulting 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. Gulf Islands Consulting 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 estimate to the customer.

2.2 Product Features

The system shall produce cost estimates for potential drywall work based on data entered by the user. The user 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 Gulf Islands Consulting to create and delete user profiles of the staff to allow for quick labour calculations. Finally, the system will produce a PDF version of the created invoice to send to the customers of Gulf Islands Consulting.

2.3 User Classes and Characteristics

Only staff members will have access to a potential software solution. Gulf Islands Consulting'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 used for the system. Employees in the 'Experienced Drywaller' class should have one year or more of drywalling experience, and are the only Gulf Islands Consulting staff member who make estimates and use the system.

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 from a system user with no programming experience and a general unfamiliarity with computers.

2.6 Assumptions and Dependencies

A-1: Experienced Drywallers have a basic knowledge of computer application use and the purpose of a potential solution system.

A-2: User inputs for cost estimations are correct regarding measurement and unit.

D-1: Retail websites specified in section 3.4.1 for automated material data scraping are accessible.

3 System Features

3.1 System Security and Access

3.1.1 Description and Priority

Allow an authenticated user to access the system functionalities.

Priority: Very High

3.1.2 Functional Requirements

R-F-01: Unauthenticated users cannot access the system functionalities.

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

Table 3: Use Case 1: *Login*

Actors	User (Experienced Drywaller)
Preconditions	● User is on the application login page
Steps	1. User inputs login credentials 2. User requests to login 3. System validates the entered user credentials 4. System displays application homepage
Success Conditions	● System homepage is displayed
Alternate Paths	3. a1) User account credentials are invalid. 3. a2) An invalid login error is returned. 3. a3) System displays login page.

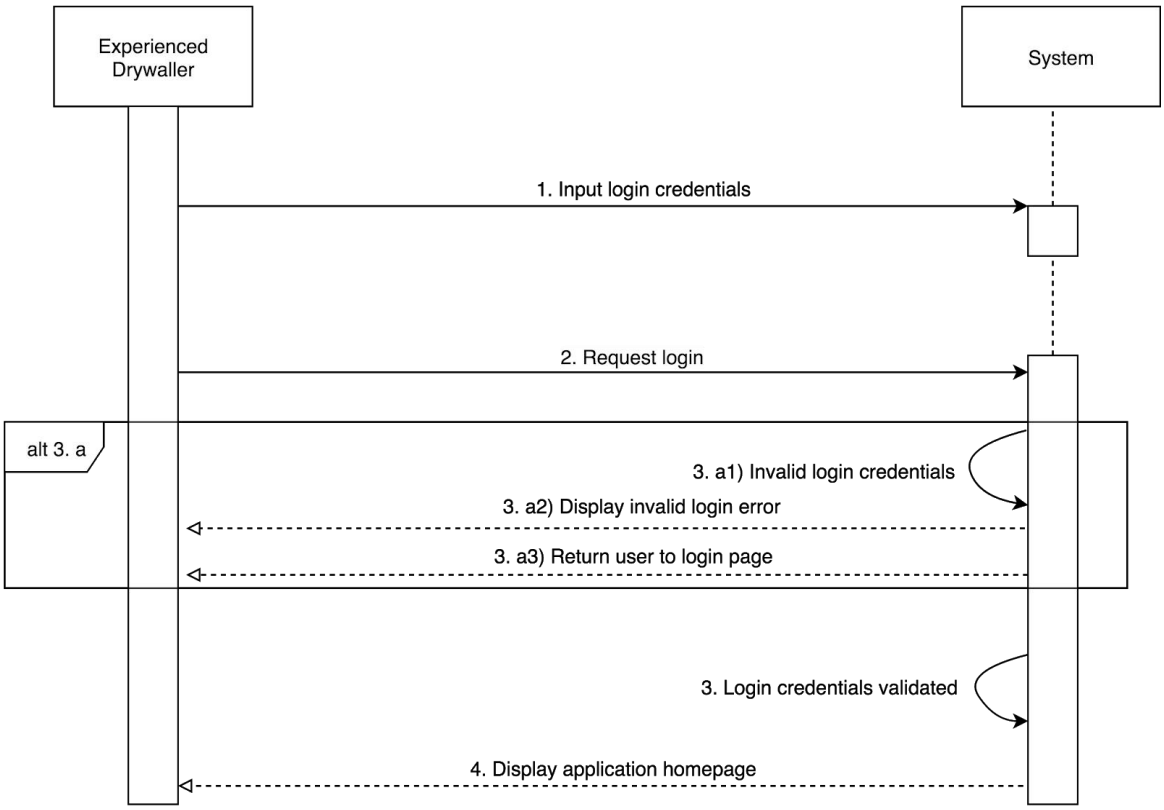


Figure 1: Sequence Diagram for Use Case 1

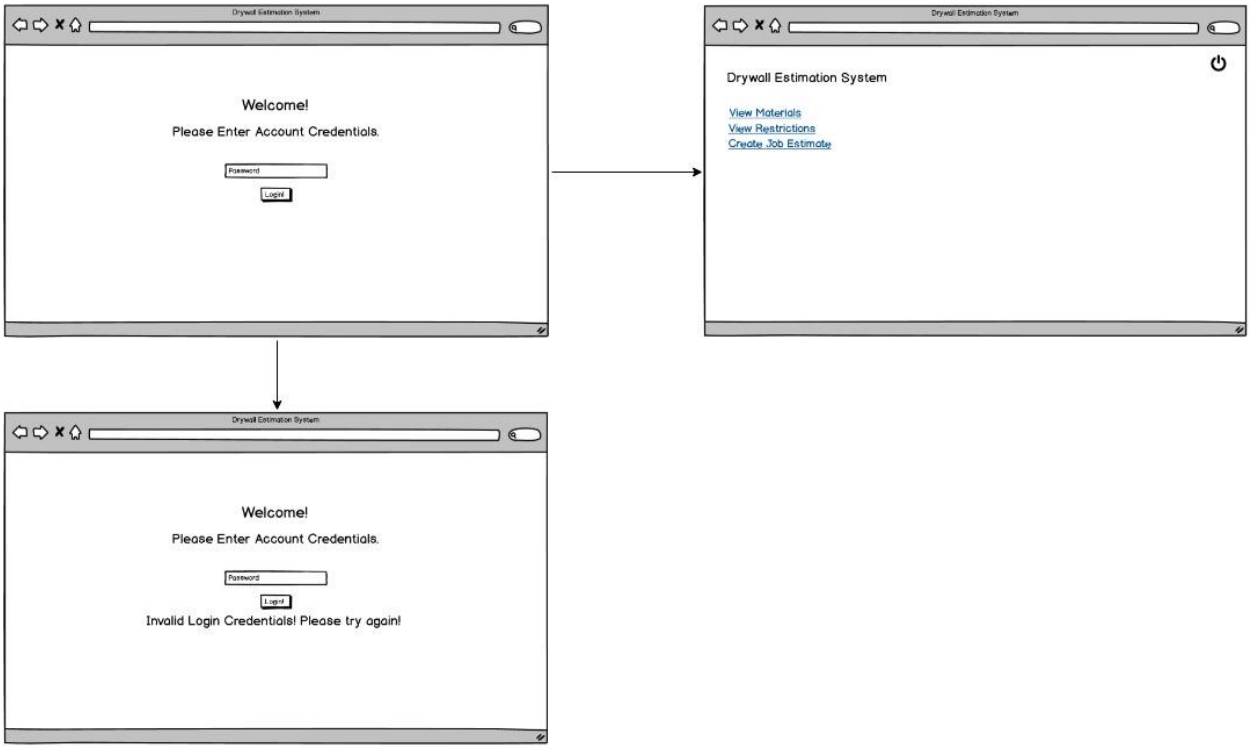


Figure 2: Storyboard for Use Case 1

Table 4: Use Case 2: *Logout*

Actors	User (Experienced Drywaller)
Preconditions	● User is logged in ● User is on the application home page
Steps	1. User requests to logout 2. System prompts user to confirm logout request 3. User confirms to logout 4. System displays login page
Success Conditions	● User is logged out ● The login page is displayed
Alternate Paths	3. a1) User requests to cancel logout 3. a2) System displays application home page

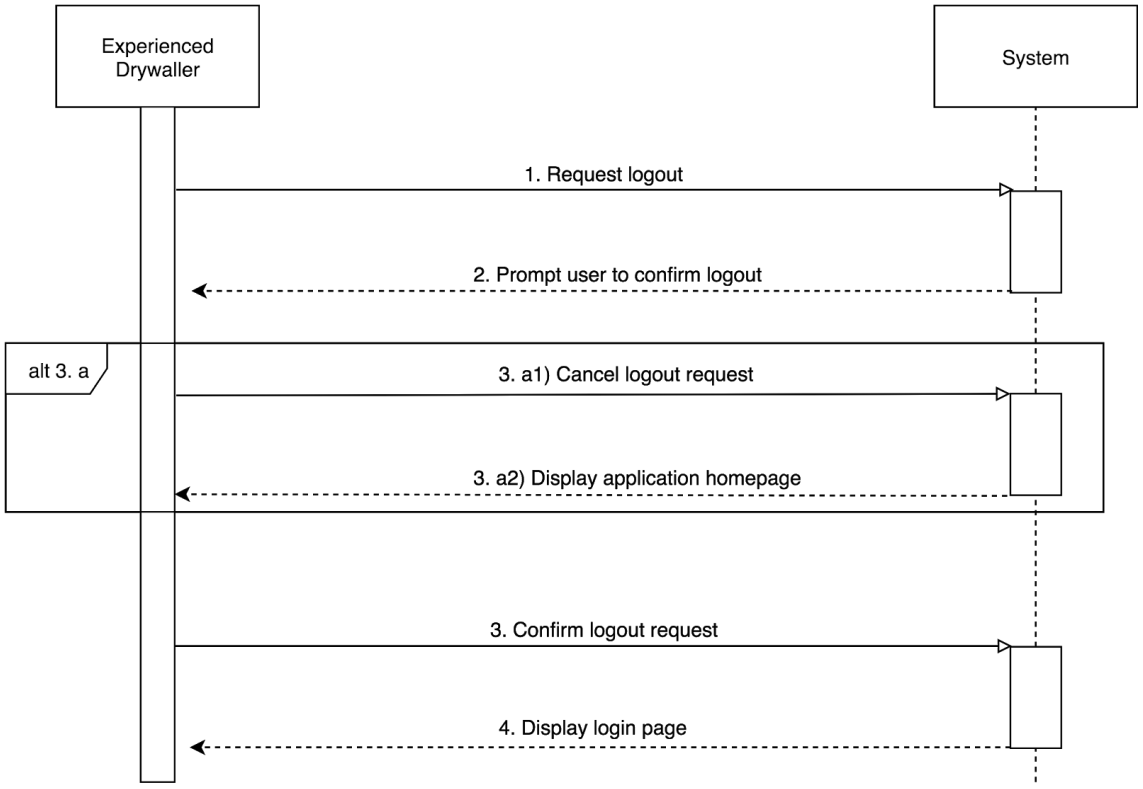


Figure 3: Sequence Diagram for Use Case 2

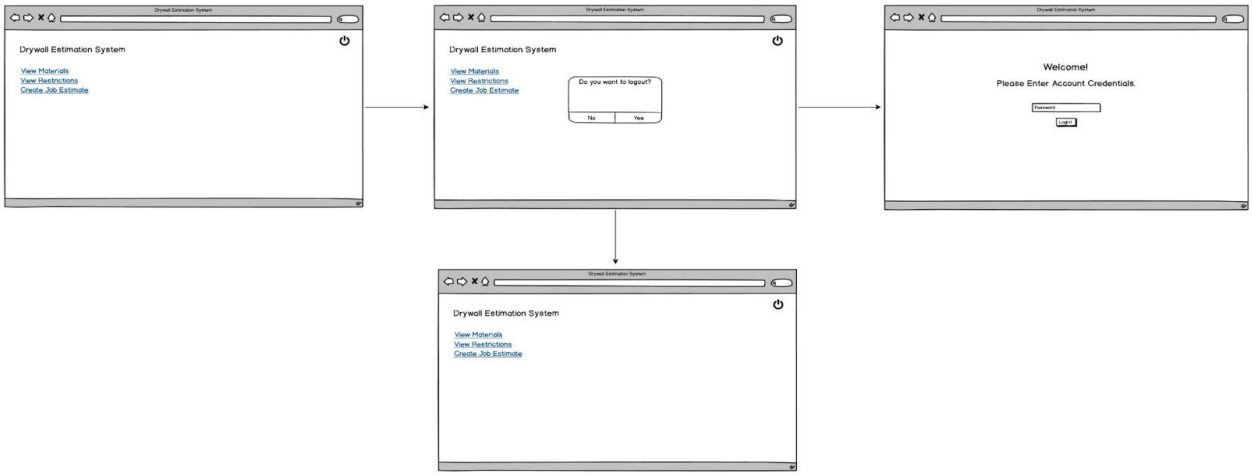


Figure 4: Storyboard for Use Case 2

3.2 Generate Drywall Job Cost Estimate

3.2.1 Description and Priority

Allow the user to input measurements of the job site, required materials, and estimated work hours needed. Each estimate are generated based off of these factors and current building material prices.

Priority: Very High

3.2.2 Functional Requirements

R-F-01: Cost estimates shall be produced based off of user inputted measurements.

R-F-02: Estimated employee working hours shall be inputted manually by the user.

R-F-03: The drywall estimation process shall be accessible through an internet connection.

R-F-04: Cost estimates shall be within a +/-10% range of the actual cost.

3.3 Generating Invoice for Client

3.3.1 Description and Priority

Allow the user to format the price estimate into an invoice. The newly created invoice will be downloaded, and the user can then email the invoice to the client. This feature aims to reduce the user's reliance on a separate invoice formatting software such as Sage.

Priority: High

3.3.2 Functional Requirements

R-F-08: The user shall be able to make changes to the invoice prior to the finalization and approval of the invoice.

R-F-09: Inputted data shall be formatted to match the invoice template.

R-F-10: Generated invoices shall be emailable to the client.

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

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

Actors	User (Experienced Drywaller)
Preconditions	● User has a valid account ● User is logged in ● User is on the application home page
Steps	1. User requests to create an estimate 2. System displays the region selection page 3. User selects region where the project is taking place 4. System displays any restrictions that apply to the selected area 5. System queries user for project attributes 6. User inputs project attributes. (Dimensions, material) 7. User requests to generate a emailable estimate file 8. A file preview of the completed estimate is shown 9. User requests download of the invoice file displayed 10. The invoice file is downloaded
Success Conditions	● Invoice file is successfully generated and downloaded
Alternate Paths	7. a1) The user requests to cancel 7. a2) User is returned to the homepage 8. a1) The system displays an error message indicating either not all necessary fields are filled in. 8. a2) The system indicates all necessary fields that still require input

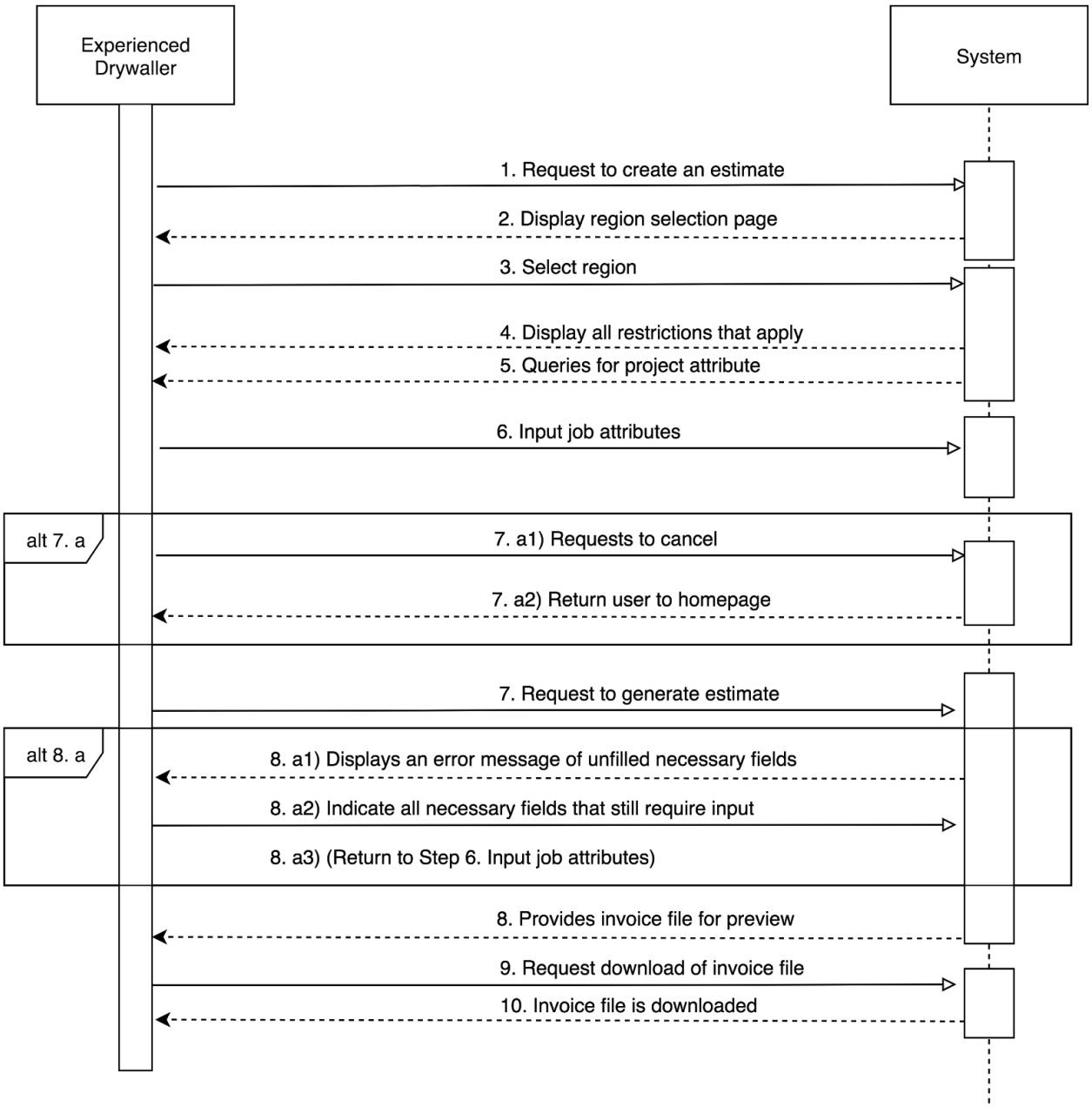


Figure 5: Sequence Diagram for Use Case 3

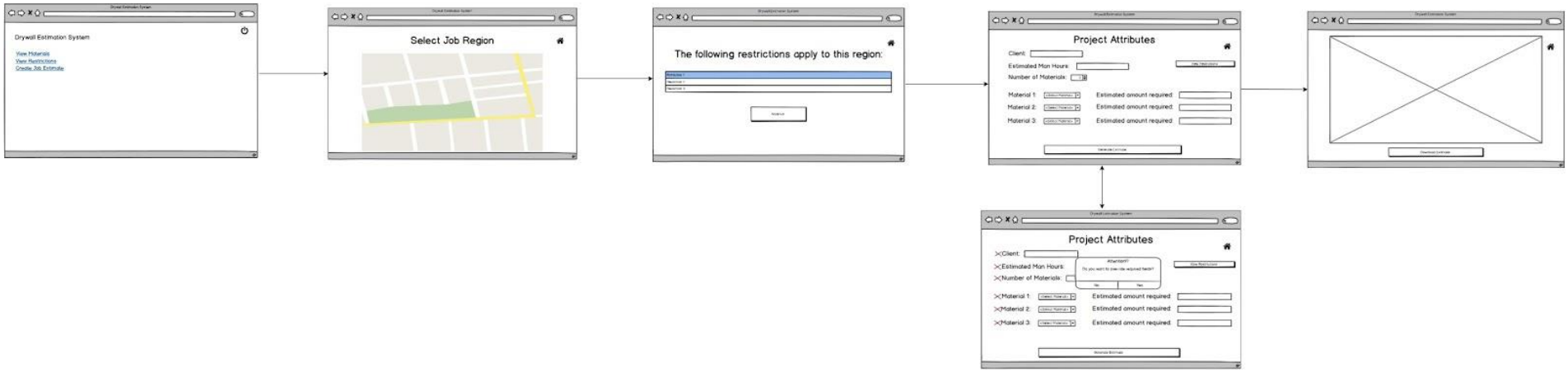


Figure 6: Storyboard for Use Case 3

3.4 Maintain an Inventory of Materials

3.4.1 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 websites (see section 3.4.1), but will also allow for the manual override of these prices.

Priority: High

3.4.2 Functional Requirements

R-F-13: The user shall be able to access an inventory of materials.

R-F-14: Each material shall have a URL from which pricing data can be automatically retrieved.

R-F-15: The user shall be able to view each material's name, price, and URL.

R-F-16: The user shall be able to edit the attributes of materials in the inventory.

R-F-17: The user shall be able to add new materials to the inventory.

R-F-18: The user shall be able to delete materials from the inventory.

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

Table 6: Use Case 4: *View Material*

Actors	User (Experienced Drywaller)
Preconditions	● User is logged in ● User is on the application home page
Steps	1. User requests list of materials 2. System displays list of materials 3. User requests for details on the desired material (from the displayed list) 4. System displays details of desired material
Success Conditions	● Details of desired material is displayed
Alternate Paths	N/A

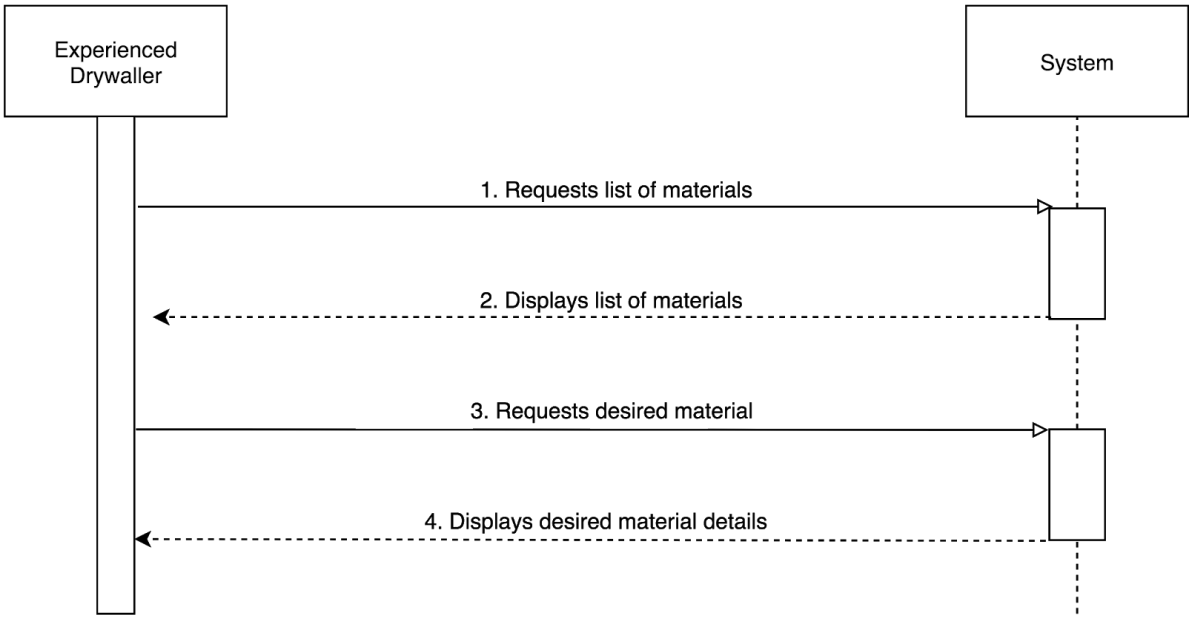


Figure 7: Sequence Diagram for Use Case 4

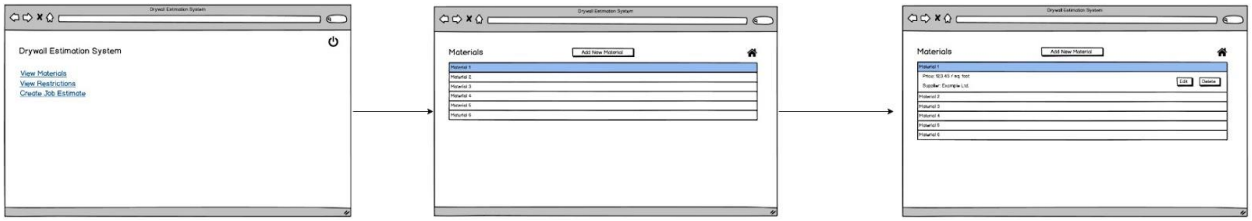


Figure 8: Storyboard for Use Case 4

Table 7: Use Case 5: *Edit Material*

Actors	User (Experienced Drywaller)
Preconditions	● User is logged in ● User is on the application home page
Steps	1. User requests for list of materials 2. System displays list of available materials 3. User requests for details on the desired material 4. System displays details of desired material 5. User requests to edit desired material 6. System queries user for edits to desired material 7. User inputs desired edits 8. User requests to save changes 9. User is returned to an updated list of materials
Success Conditions	● Details of desired material are updated ● System displays the updated list of materials
Alternate Paths	8. a1) User requests to cancel edits 8. a2) User is returned to a list of materials

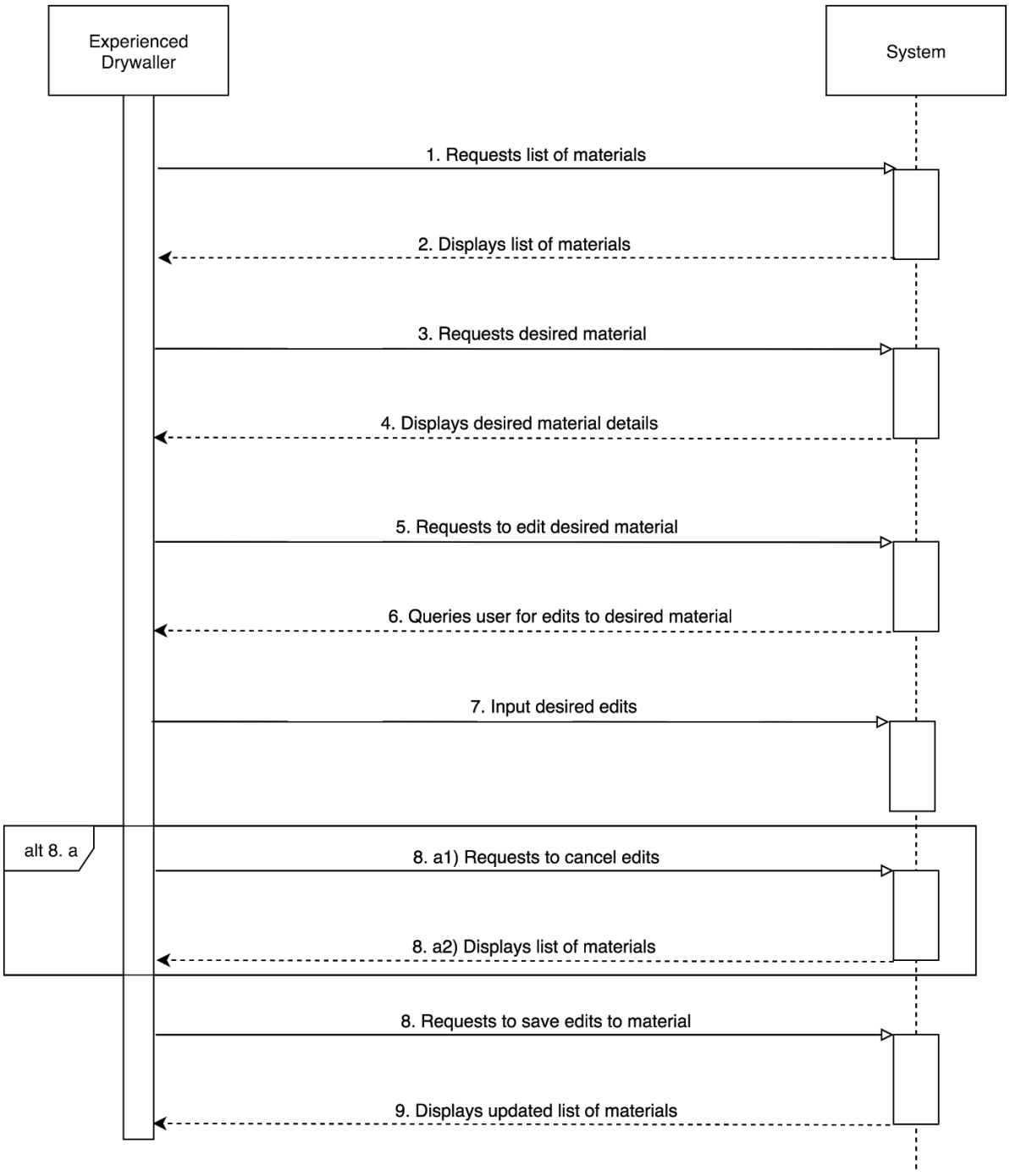


Figure 9: Sequence Diagram for Use Case 5

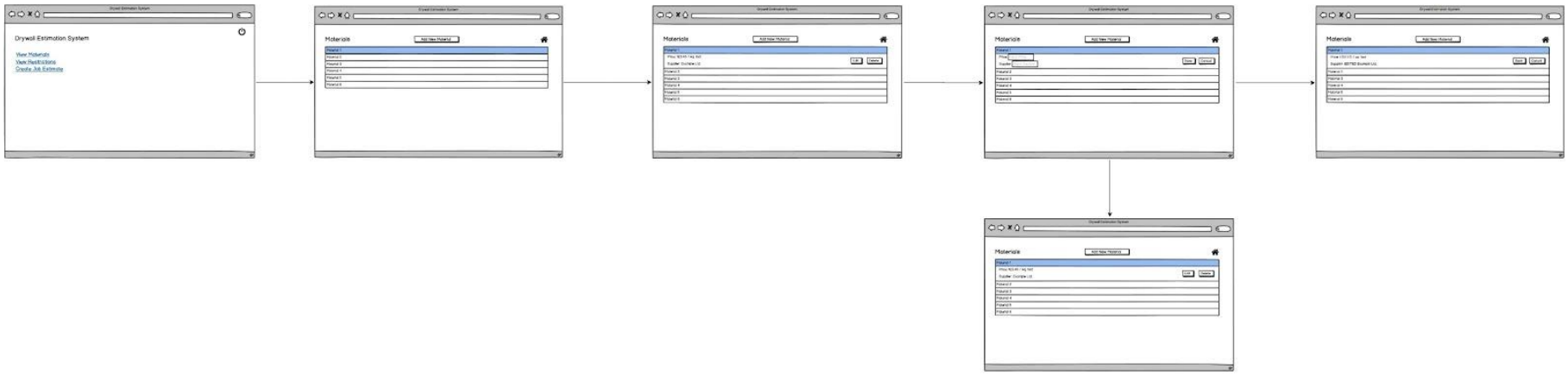


Figure 10: Storyboard for Use Case 5

Table 8: Use Case 6: *Delete Material*

Actors	User (Experienced Drywaller)
Preconditions	● User is logged in ● User is on the application home page
Steps	1. User requests for list of materials 2. System displays list of available materials 3. User requests for details on the desired material 4. System displays details of desired material 5. User requests to delete the material 6. User is prompted to confirm the deletion of material 7. User confirms to delete material 8. System deletes material from list of materials 9. User is returned to an updated list of materials
Success Conditions	● Material is successfully deleted
Alternate Paths	7. a1) User requests to cancel deletion 7. a2) User is returned to the details of the selected material

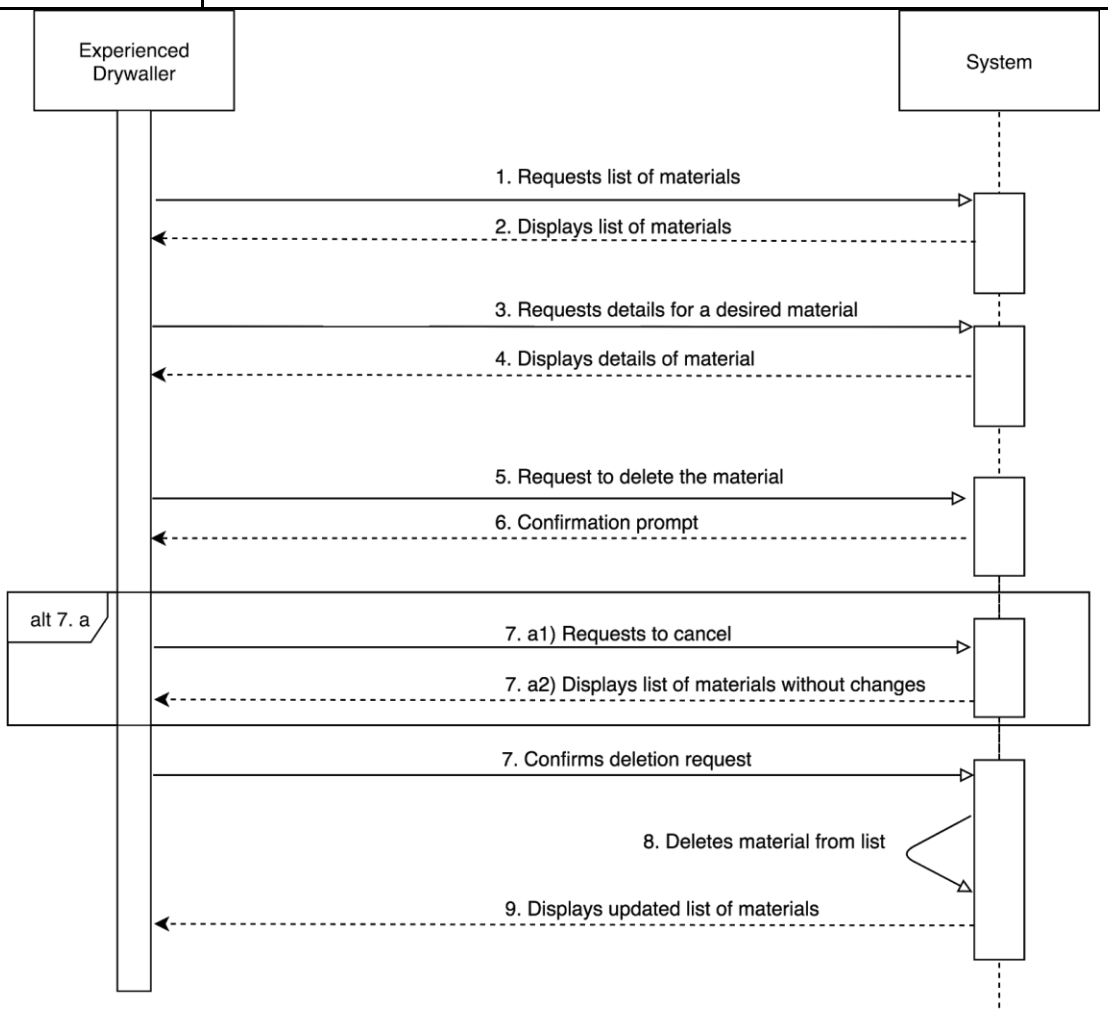


Figure 11: Sequence Diagram for Use Case 6

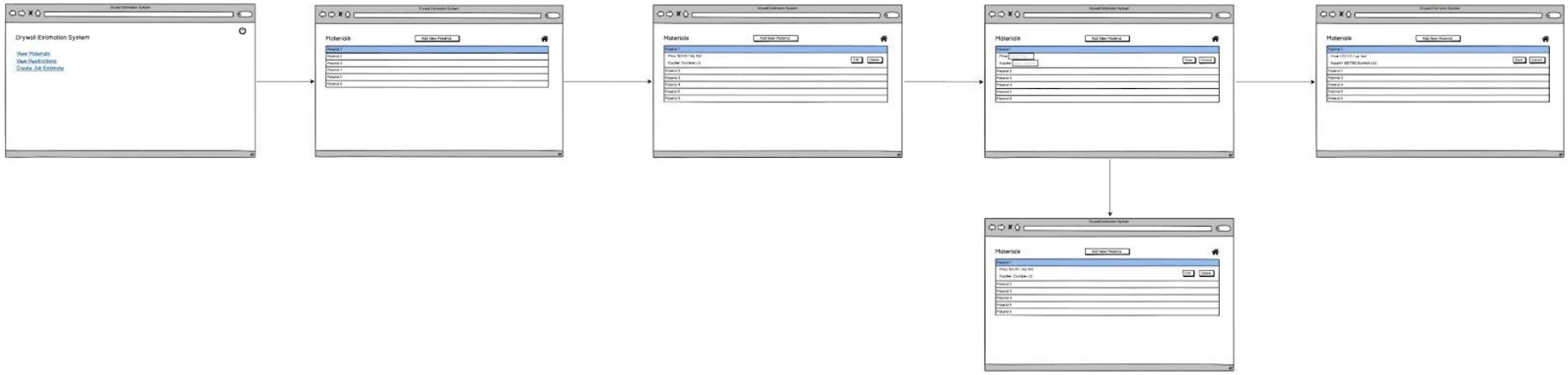


Figure 12: Storyboard for Use Case 6

Table 9: Use Case 7: *Add Material*

Actors	User (Experienced Drywaller)
Preconditions	● User has a valid account ● User is logged in ● User is on the application home page
Steps	1. User requests for list of materials 2. System displays list of available materials 3. User requests to add a new material 4. System queries user for material attributes 5. User fills in details 6. User requests to save changes 7. System adds new material into list of materials 8. User is returned to an updated list of materials
Success Conditions	● The new material is added to the system
Alternate Paths	6. a1) User requests to cancel 6. a2) User is returned to the list of materials

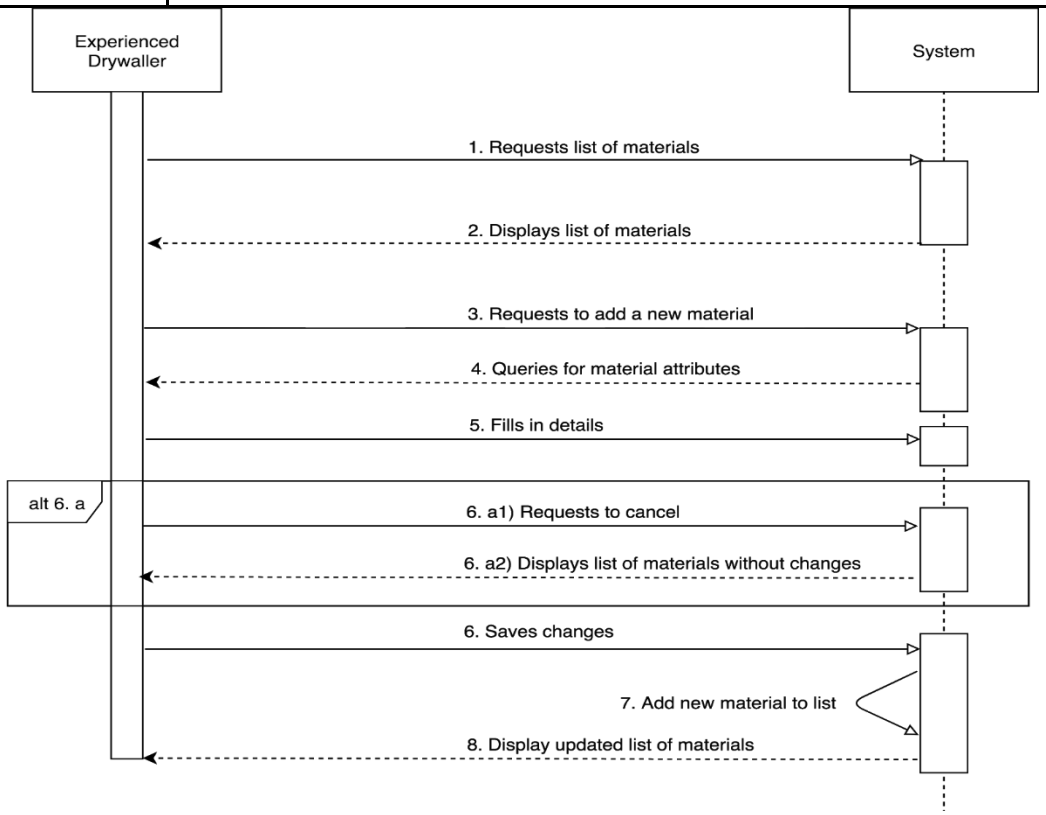


Figure 13: Sequence Diagram for Use Case 7

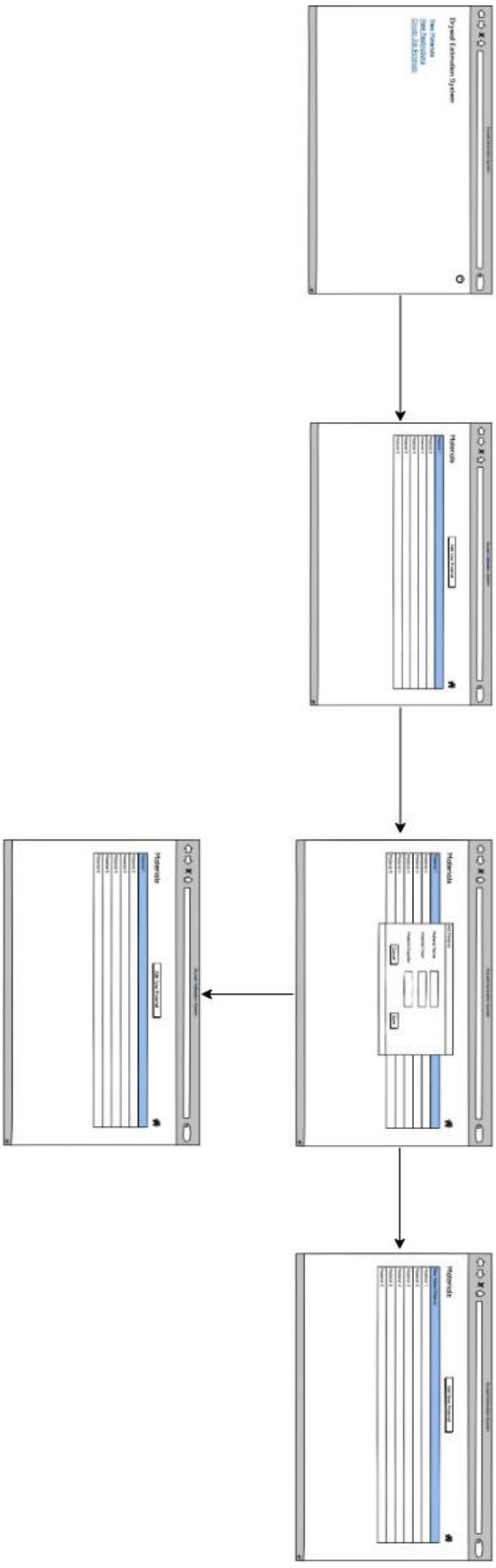


Figure 14: Storyboard for Use Case 7

3.5 Maintain an Inventory of Applicable Input-Restricting Legislation

3.5.1 Description and Priority

The system shall store an editable list of input-restricting legislation in the database.The system will then have the option to allow user to view the restriction list.This system should detect incorrect user inputs based on current restriction list, and prompt user to verify these inputs. This should also detect defective output values which violate regulations concerning a combined combination of materials. This function is to minimize possible user input error.

Priority: High

3.5.2 Functional Requirements

R-F-17: The system shall store a database of input-restricting legislation.

R-F-17: The user shall be able to update the list of restrictions.

R-F-18: The system shall display the list of input-restricting legislation to the user prior to the start of an estimation.

R-F-19: The user shall have the option to override any restriction during the input output process

3.5.3 Use Case(s) Associated with Feature or Functional Requirements

Table 10: Use Case 8: *View Input-Restricting Legislation*

Actors	User (Experienced Drywaller)
Preconditions	● User has a valid account ● User is logged in ● User is on the application home page
Steps	1. User requests to view the list of restrictions 2. System returns a list of previously entered restrictions 3. User requests for details on the desired restriction 4. System displays details of desired restriction
Success Conditions	● Details of desired restriction is displayed
Alternate Paths	N/A

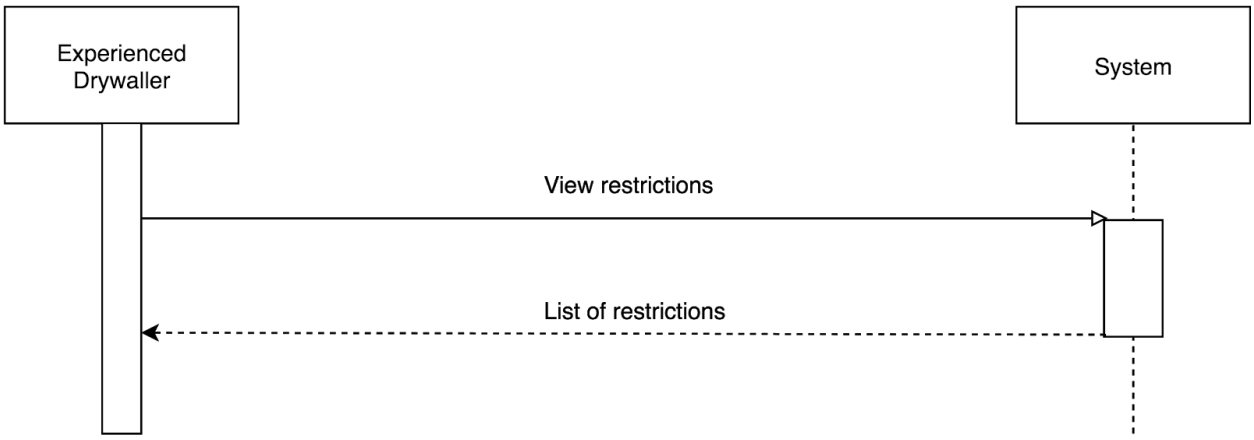


Figure 15: Sequence Diagram for Use Case 8

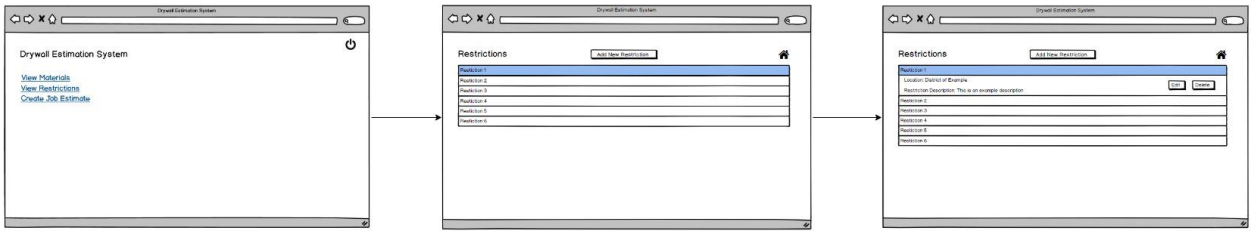


Figure 16: Storyboard for Use Case 8

Table 11: Use Case 9: *Edit Input Restricting Legislation*

Actors	User (Experienced Drywaller)
Preconditions	● User has a valid account ● User is logged in ● User is on the application homepage
Steps	1. User requests to view the list of restrictions 2. System displays list of previously entered restrictions 3. User selects the desired restriction to modify 4. User requests to edit restriction 5. System queries user for restriction edits 6. User inputs edits to restriction 7. User requests to save the changes 8. System saves changes 9. User is returned to the list of restriction
Success Conditions	● List of restrictions is updated to reflect the changes made
Alternate Paths	6. a1) User requests to cancel changes 6. a2) User is returned to the list of restrictions

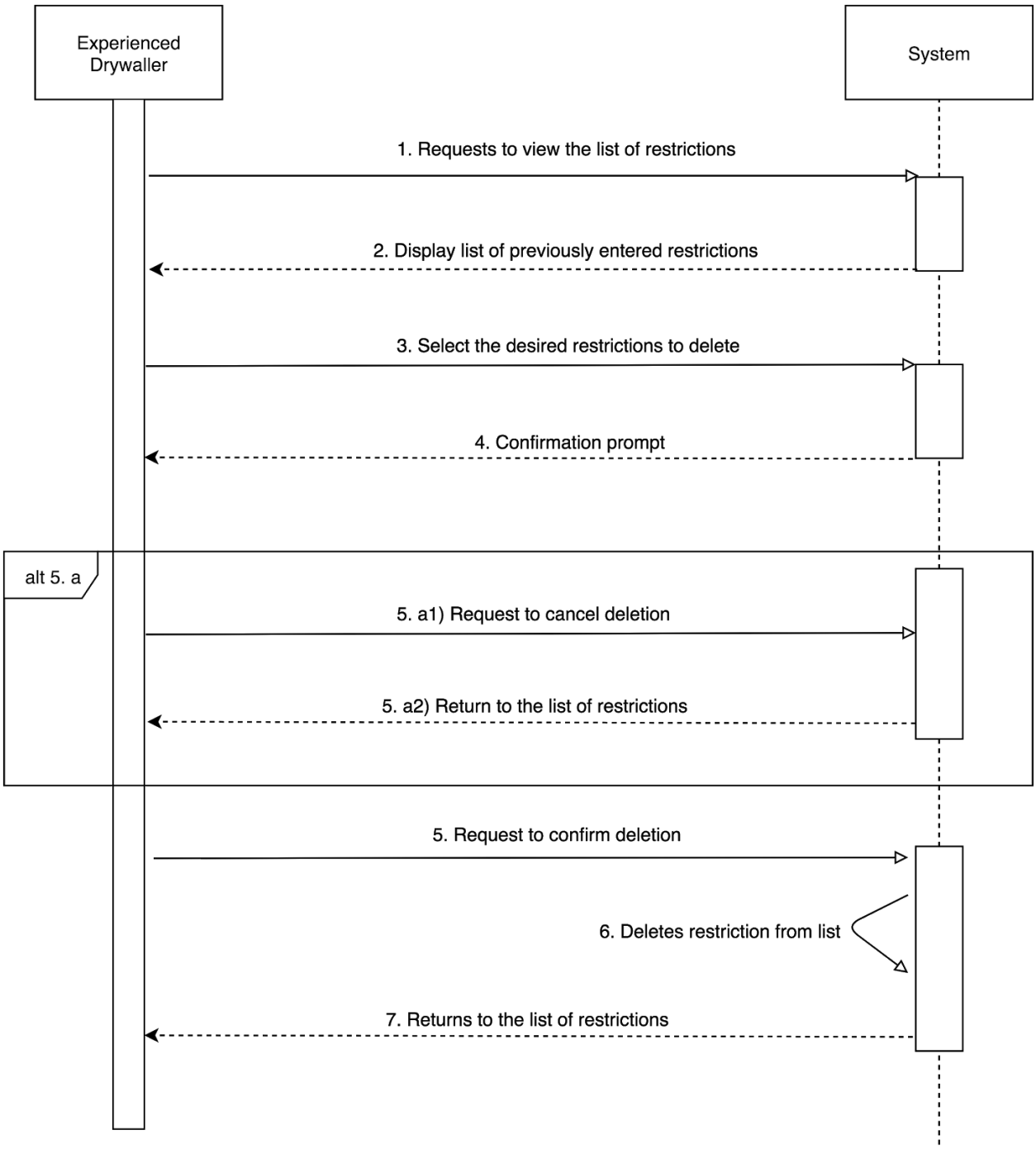


Figure 17: Sequence Diagram for Use Case 9

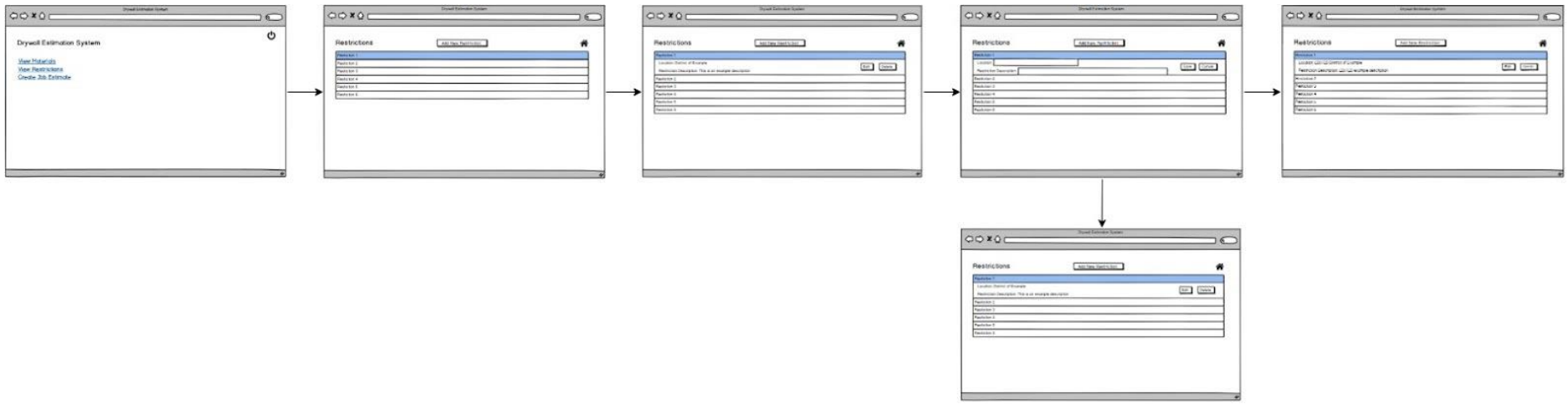


Figure 18: Storyboard for Use Case 9

Table 12: Use Case 10: *Delete Input-Restricting Legislation*

Actors	User (Experienced Drywaller)
Preconditions	● User has a valid account ● User is logged in ● User is on the application home page
Steps	1. User requests to view the list of restrictions 2. System displays list of previously entered restrictions 3. User selects the desired restriction to delete 4. User requests to delete selected material 5. System prompts user for confirmation 6. User requests to confirm the deletion 7. System deletes restriction 8. User is returned to the List of Restriction
Success Conditions	● The requested restriction is deleted from the list
Alternate Paths	5. a1) User requests to cancel the deletion 5. a2) User is returned to the list of restrictions

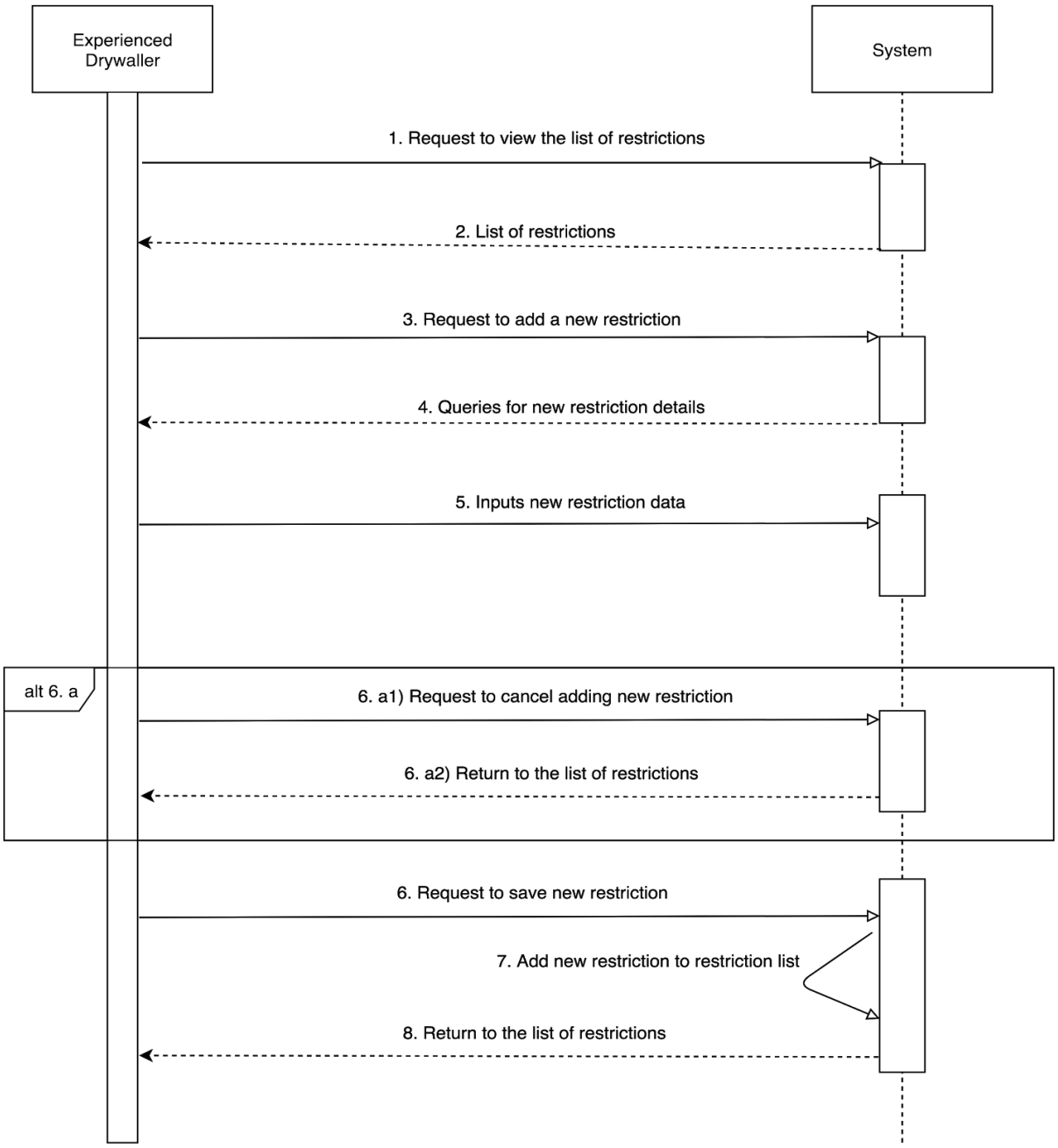


Figure 19: Sequence Diagram for Use Case 10

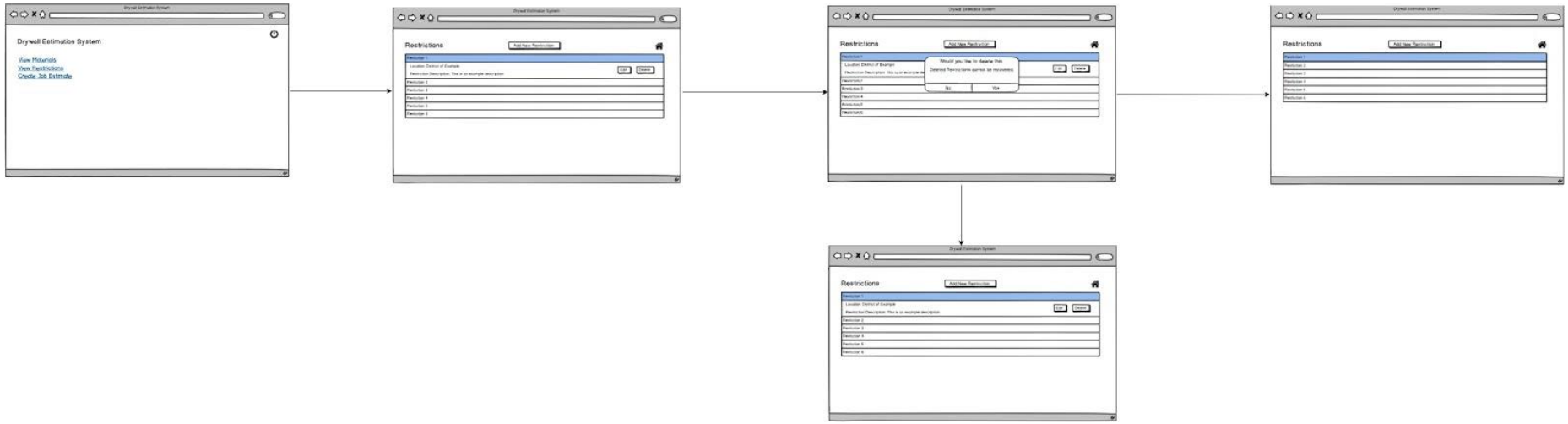


Figure 20: Storyboard for Use Case 10

Table 13: Use Case 11: *Add Input-Restricting Legislation*

Actors	User (Experienced Drywaller)
Preconditions	● User has a valid account ● User is logged in ● User is on the application home page
Steps	1. User requests to view the list of restrictions 2. System displays list of previously entered restrictions 3. User requests to add a new restriction 4. System queries user for new restriction details 5. User inputs new restriction data 6. User requests to save the new restriction 7. System adds new restriction to list of restrictions 8. User is returned to the list of restrictions
Success Conditions	● The new restriction is added to the list of restrictions
Alternate Paths	6. a1) User requests to cancel adding new restriction 6. a2) User is returned to the list of restrictions

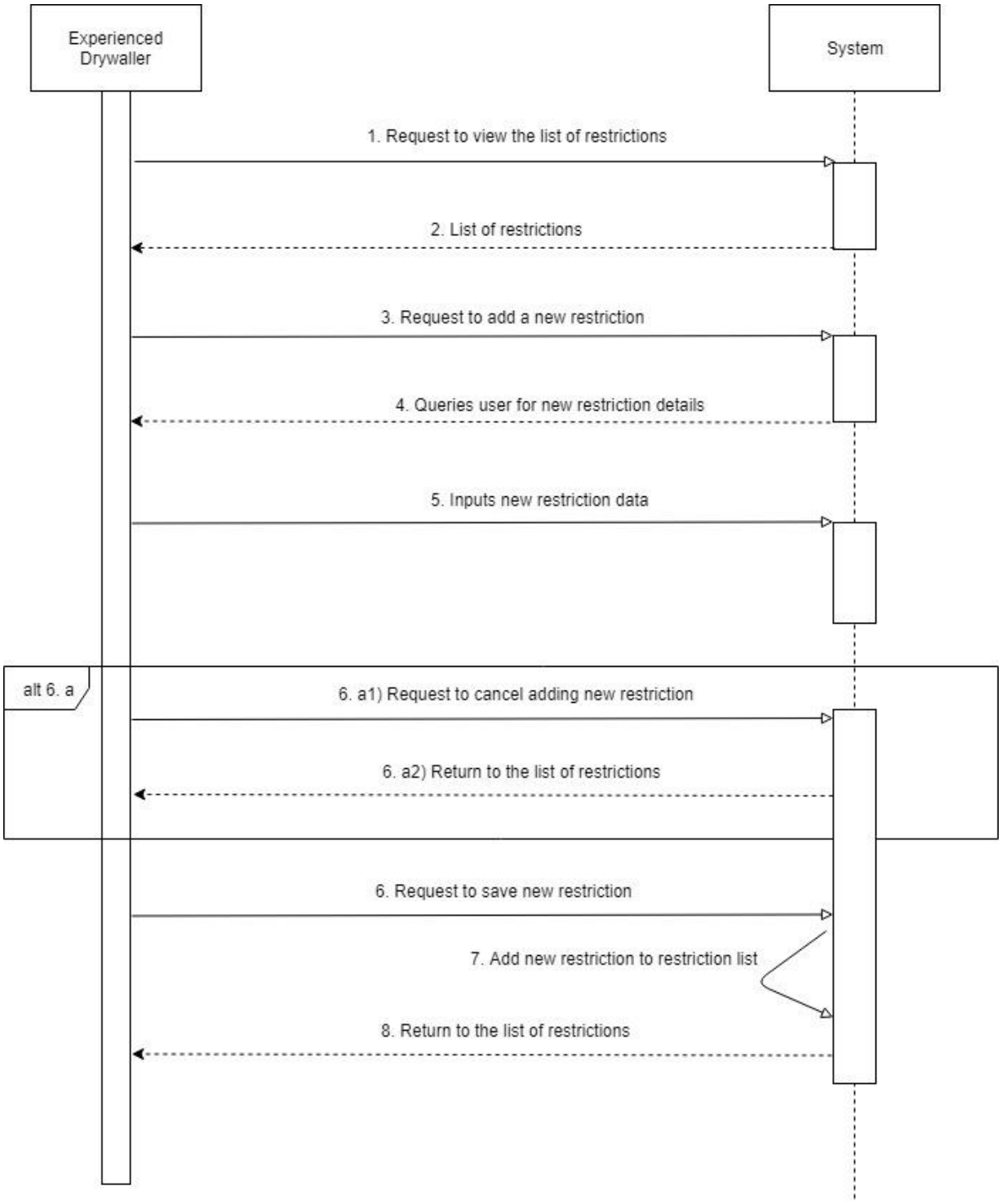


Figure 21: Sequence Diagram for Use Case 11

Figure 22: Storyboard for Use Case 11

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 the user provides an invalid input, the user is immediately notified.
R-EI-03: The user shall be able to efficiently navigate the GUI.

R-EI-04: The user shall be prompted for input.

R-EI-05: The user shall be able to edit any inputted data up to the point of estimate completion.

4.2 Hardware Interfaces

4.2.1 Description and Priority

The system must be built such that it is compatible with the defined work devices, which are low-end computers and mobile phones. Thus, the system should not demand a high level of hardware performance.

Priority: Low

4.2.2 External Interface Requirements

R-EI-06: The system layout shall be functional with all aspect ratios of the following monitor displays: 5:4, 4:3, 16:10, 16:9.

R-EI-07: The system shall support touch-screen input.

R-EI-08: The system shall support keyboard and mouse inputs.

4.3 Software Interfaces

4.3.1 Description and Priority

The system is required to be compatible with any software that are currently used by Gulf Islands Consulting. Common file types should also be supported. Finally, 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-09: The system shall be able to extract building materials price information from retail websites specified by the user.

R-EI-10: Pricing data shall be imported from user-specified file types.

R-EI-11: The system shall export a detailed price quote as an emailable file.

R-EI-12: The system shall be compatible with any operating system versions released within the past 3 years (Android 7.0+, Windows 10).

4.4 Communications Interfaces

4.4.1 Description and Priority

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 Gulf Island Consulting takes approximately 4 hours according to Gulf Island Consulting's customer's estimates. This process includes measurement, calculation, and invoice completion. The system should reduce the 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 average estimation time, measured from the time the contractor logs onto the website to the time that the quote is finalized, shall last no longer than 2 hours.

5.2 Safety Requirements

5.2.1 Description and Priority

Drywall projects undergone by Gulf Islands Consulting take place in BC, primarily in the Gabriola Islands, and Nanaimo and 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: High

5.2.2 Non-functional Requirements

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

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

R-NF-04: In cases of conflict between BC code and municipal bylaws, the municipal bylaws shall take precedence over the BC code.

R-NF-05: All regulations that restrict user input values shall be made apparent to the user of the system.

5.3 Security Requirements

5.3.1 Description and Priority

Currently, only the owner of Gulf Islands Consulting calculates drywall project estimates. However, it would be of benefit for all Gulf Islands Consulting staff to be able to complete

estimates, thus a verification process should be in place ensure only qualified staff may access and utilize the system.

Priority: Medium

5.3.2 Non-functional Requirements

R-NF-06: No individual, other than approved Gulf Islands Consulting staff with the authentication credentials, shall be able 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-07: All automatically updated prices for: materials, labor, and other factors such as special equipment, shall be updated daily.

R-NF-08: The user shall be able to use the system within 1 hour of use and without formal training.

R-NF09: All system errors including regulation errors, must be logged, stored, and accessible by the user.

6 Other Requirements

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

7 Analysis Models

7.1 Use Case Model

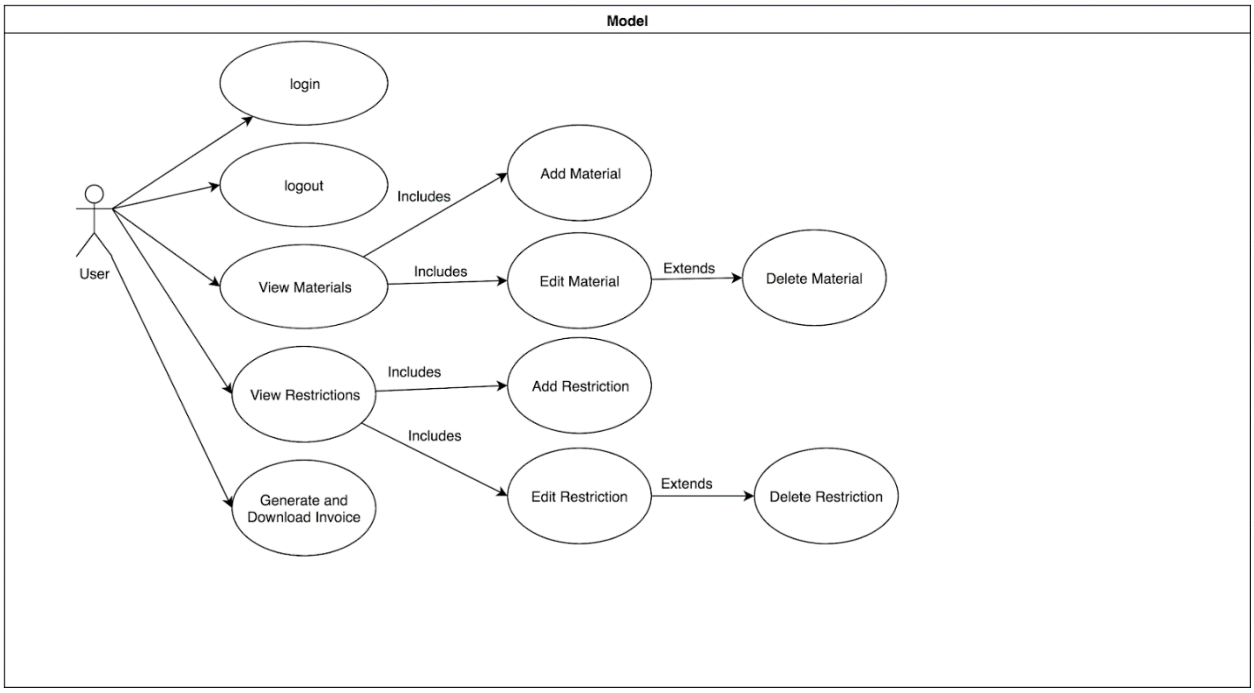


Figure 23: Use Case Model

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.

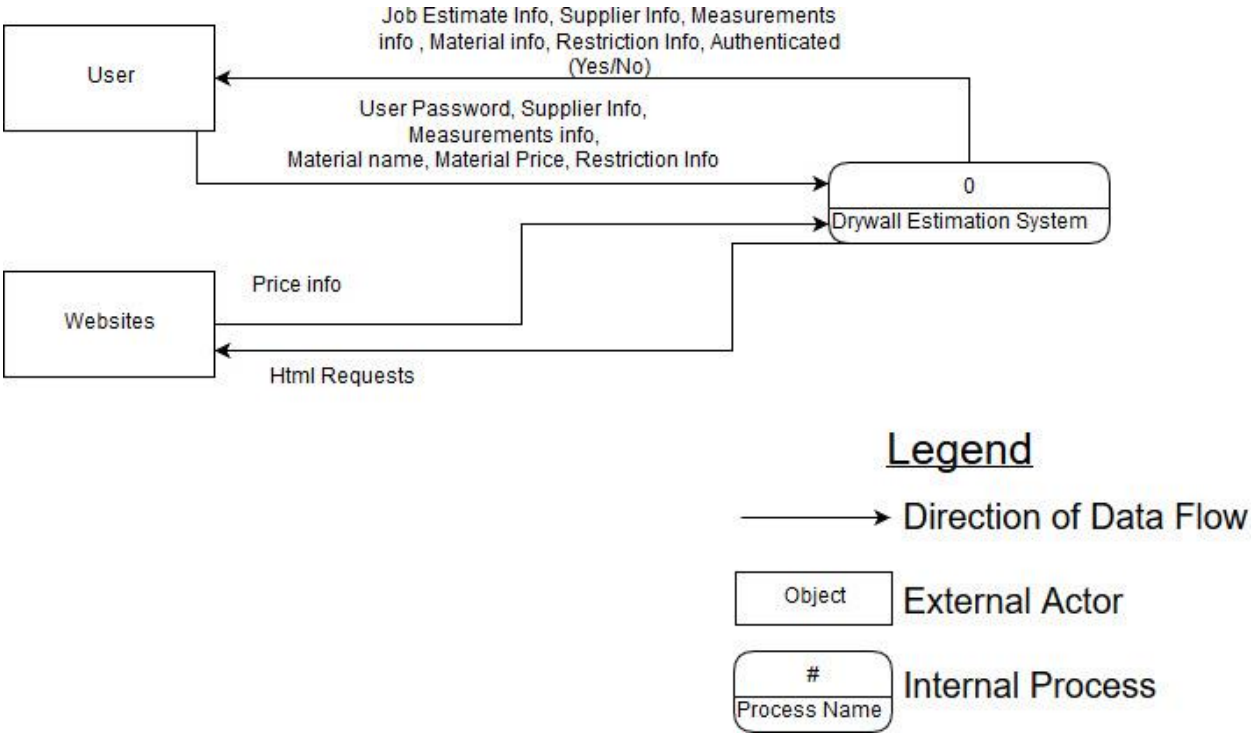


Figure 24: Context Diagram

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.

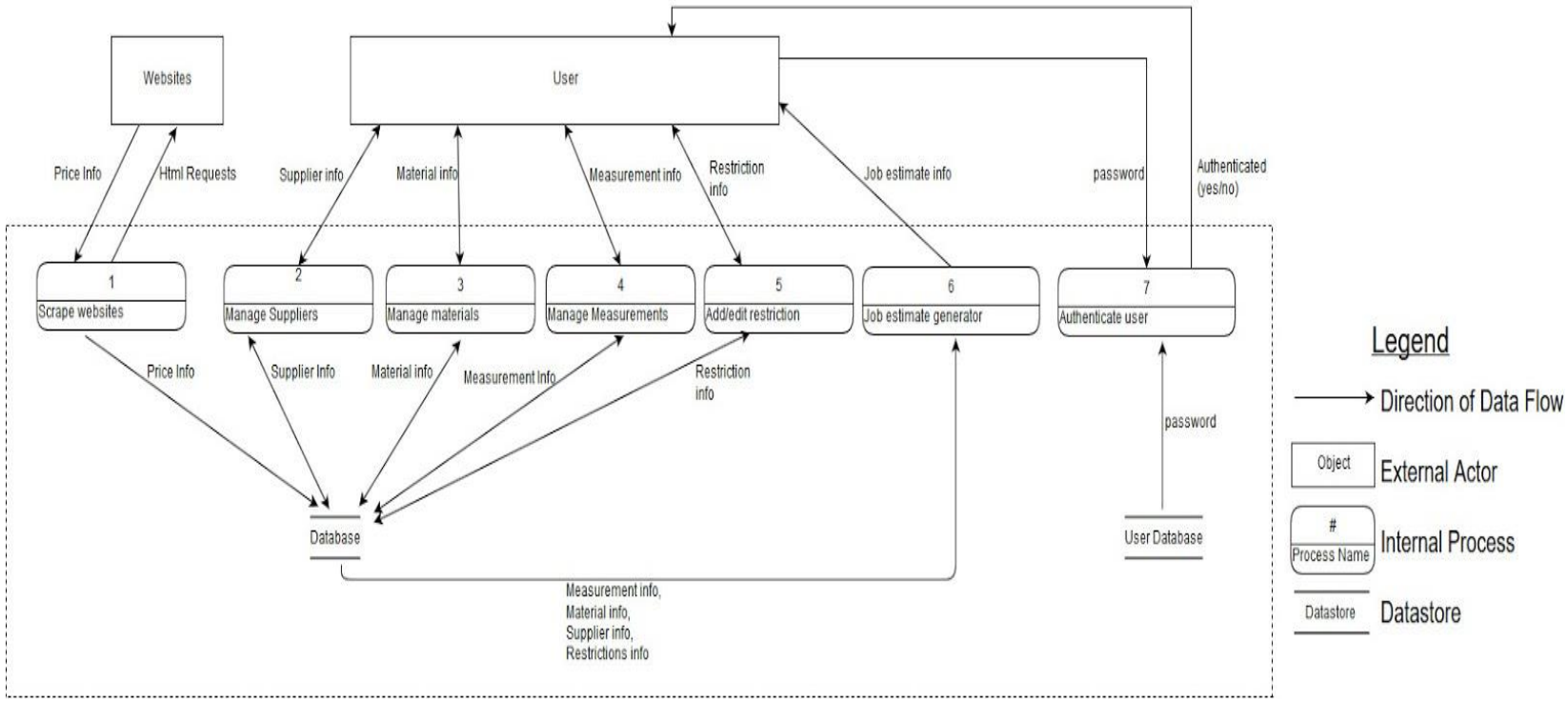
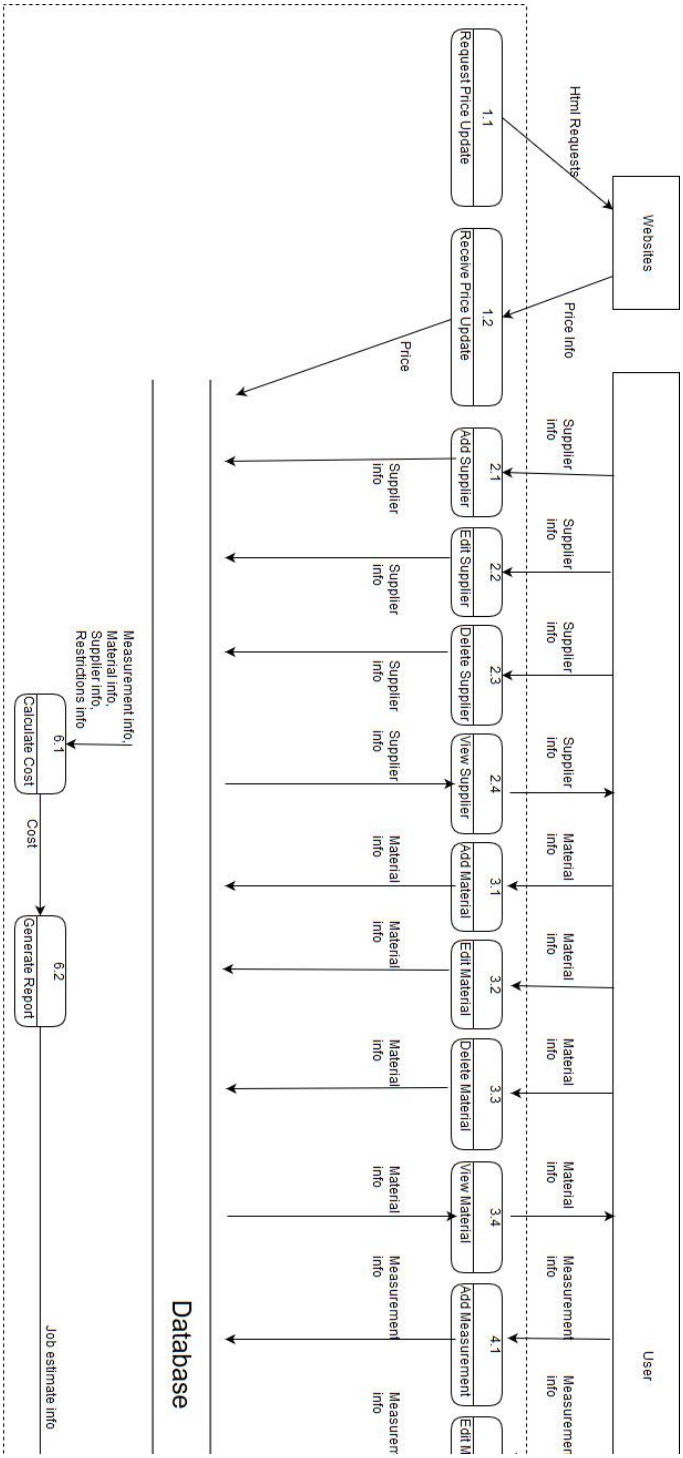


Figure 25: Data Flow Diagram 1.0

7.4 Data Flow Diagram 2.0

This diagram shows a more detailed breakdown of the processes in DFD 1 that has sub components broken down. The user authentication is not shown as it has no more steps to break down. The steps are broken down from manage [table name] to several functions that the manage function has.



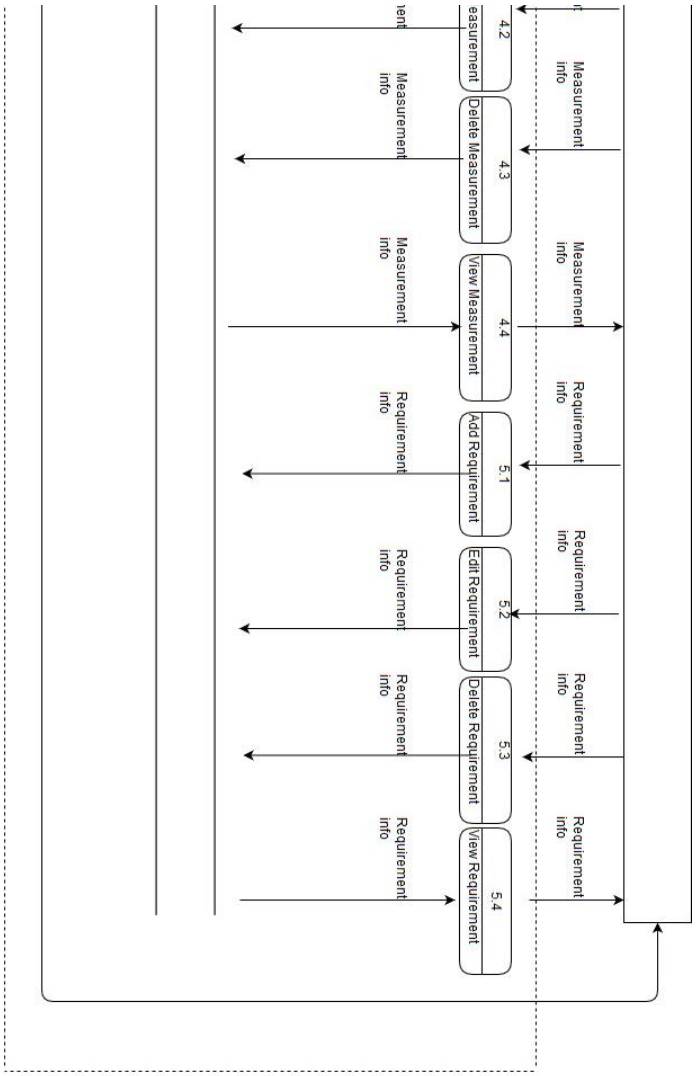


Figure 26: Data Flow Diagram 2.0

7.5 Entity Relationship Diagram

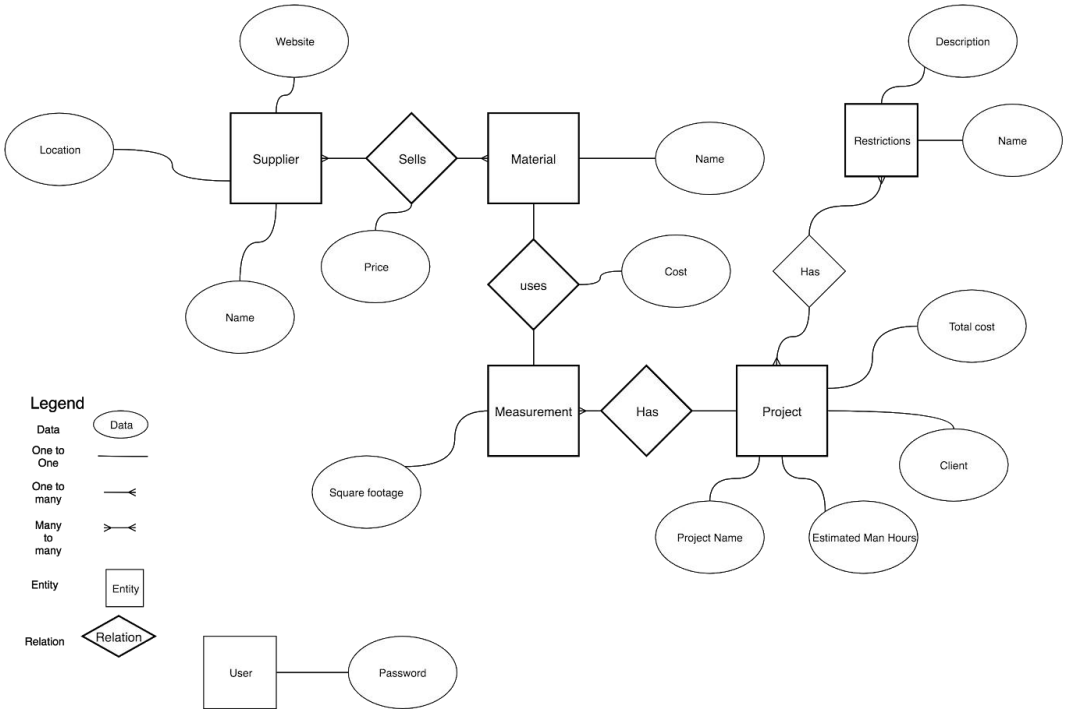


Figure 27: Entity Relationship Diagram

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

7.6 Data Dictionary

Table 14: Data Dictionary

Table	Column	Data Type	References	Not Null	Description
Supplier	Name	String		Y	Name of supplier
Supplier	Website	String		Y	Suppliers website
Supplier	Location	String		N	Location of supplier
User	Password	String		Y	User's password
Restrictions	Description	String		Y	Description of regulation or

					other limitation
Restrictions	Name	String		Y	Name of restriction
Project	Name	String		Y	Project name
Project	Client	String		Y	The name of a Customer for a given project
Project	Total Cost	Double		Y	Projects total cost
Project	Estimated Man Hours	Int		Y	Number of man hours needed to complete project
Measurement	Square Footage	Int		Y	Total square footage of a job
Measurement	Cost	Int	Material	Y	Cost of a given measurement
Materials	Name	String		Y	Name of a material
Materials	Price	Int	Supplier Price	Y	Price of a material

Appendix A: Issues List

There are no issues at this time.

Appendix B: Estimation Formula

The following formula is currently used by Gulf Islands Drywall to estimate project costs:

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

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