Av-Alert: Avalanche Risk Analysis System
Client: Steep Mountaineering

Requirements Specification Document 1.0

Snowlutions

Chua, Jerusha / Eng, Andrew / Joy, Samuel / Schell, Alexander /
Siemens, Derek / Voorthuyzen, Sho Ya / Yang, Charles

October 15th, 2019

Revision History

Name	Date	Reason for Changes	Version
Chua, Jerusha / Eng, Andrew / Joy, Samuel / Schell, Alexander / Siemens, Derek / Voorthuyzen, Sho Ya / Yang, Charles	Sept 25, 2019	Initial Draft. Interpreting elicitation notes and creating outlines of each section.	RD 0.7
Chua, Jerusha / Eng, Andrew / Joy, Samuel / Schell, Alexander / Siemens, Derek / Voorthuyzen, Sho Ya / Yang, Charles	Sept 26, 2019	Filled out each section from initial outline.	RD 0.8
Chua, Jerusha / Eng, Andrew / Joy, Samuel / Schell, Alexander / Siemens, Derek / Voorthuyzen, Sho Ya / Yang, Charles	Sept 30, 2019	Sections commented and ready for review by team members.	RD 0.9
Chua, Jerusha / Eng, Andrew / Joy, Samuel / Schell, Alexander / Siemens, Derek / Voorthuyzen, Sho Ya / Yang, Charles	Sept 30, 2019	Complete and reviewed document, ready for review by Steep Mountaineering.	RD 1.0
Joy, Samuel	Oct 12, 2019	Expanded upon and formatted Use Cases 1-6. Created alternate flow cases.	RD 1.07
Siemens, Derek	Oct 12, 2019	Apply review changes from graded submission	RD 1.08
Voorthuyzen, Sho Ya	Oct 15, 2019	General edit and formatting	RD 1.09
Chua, Jerusha / Eng, Andrew / Joy, Samuel / Schell, Alexander / Siemens, Derek / Voorthuyzen, Sho Ya / Yang, Charles	Oct 15, 2019	Finalize Requirements Document	RD 1.1
Chua, Jerusha / Eng, Andrew / Joy, Samuel / Schell, Alexander / Siemens, Derek / Voorthuyzen, Sho Ya / Yang, Charles	Oct 15, 2019	Combine RD with use cases to create RSD 1.0	RSD 1.0

1 Introduction

1.1 Purpose

This document outlines the requirements specifications necessary for version 1.0 of Av-Alert, a new Avalanche Risk Analysis System for the client Steep Mountaineering. Steep Mountaineering's current system relies on manual collection and analysis of snow pit data, which makes real-time risk analysis impossible. Av-Alert's objectives are to make avalanche risk analysis available to Administrators and Public Users in real-time, and to replace manual data collection and analysis with an automated system.

1.2 Project Scope

There are three major objectives for Av-Alert. Av-Alert's first objective is to automate the collection of Avalanche Risk Analysis Data required to track and analyze potential avalanche conditions. Steep Mountaineering's current system requires an employee to dig multiple snow pits and manually record the data for later analysis. Av-Alert will remove the need for manual data collection, reduce cost and time spent doing so, and improve employee safety. Av-Alert's second objective is to provide frequent updates and alerts about the probability of an avalanche occurring. Av-Alert will eliminate manual analysis and will update calculated probabilities when new Avalanche Risk Analysis Data becomes available, increasing safety and marketability by allowing users to make informed decisions with up to date avalanche risk information. Av-Alert's third objective is to create an interface for the Avalanche Risk Analysis results. By creating an interface that can convey current avalanche risk information, Steep Mountaineering will be able to reach a wider user base with a product that requires no specialized knowledge for analyzing Avalanche Risk Analysis Data.

1.3 Glossary of Terms

Administrative Portal	A website that is designed for administrators to conveniently access important and useful information and functions of a system.
Administrator	System Administrator or Resort Administrator.
API	An Application Programming Interface specifies how software components will interact.
APRS	Automatic Packet Reporting System, a system of encoding data for transmission over standard radio systems.
Avalanche Risk Analysis Data	The correlated and analyzed data from topological maps, remote sensors, and weather reports.
Cloud Storage	The storage of data within a data warehouse offsite.

Consumer Environment	The public, front facing interface of the system.
Forecasting Agencies	Weather stations that provide data about the weather conditions at a location.
Historical Data	Data taken from past events over a long period of time. This data can be used to help predictive modelling.
Multi-Factor Authentication	An authentication method that requires more than one user credential, satisfying two of the following: Something the user has, Something the user knows, and Something the user is.
Predictive Models	Statistics are used to predict outcomes. Training data is modelled and adjusted to output the best prediction. The predictive models become more accurate as more training data is run through.
Public Users	Users who use Av-Alert but are not employed by Steep Mountaineering or a resort utilizing Av-Alert.
Resort	A commercial establishment created for skiing, snowboarding and other winter activities.
Resort Administrator	A subset of resort staff with privileged access to Av-Alert to perform applicational tasks.
Resort Profile	A Resort Profile is made up of a collection of resort specific information such as name, location, Resort Administrators and data sources.
Resort Staff	Employees who work at a resort where Av-Alert is utilized.
Slope	A sloping surface or area which can be skied or snowboarded upon.
Snow Pit	A snow pit is a trench exposing a flat, vertical snow face from the snow surface to the ground. It allows people to study the characteristics of the different layers of the snowpack that have developed as the snow has changed due to compaction and weather changes [1].
System Administrators	People who are responsible for managing, maintaining, and configuring the reliability of multiple systems.
Topological maps	A detailed description of the natural and artificial features of an area.

1.4 References

[1] "Avalanche.org Snowpit", Avalanche.org, 2019. [Online]. Available: https://avalanche.org/avalanche-encyclopedia/snowpit/. [Accessed: 26- Sep- 2019].

[2] A. Widforss, “Avalanche Visualisation Using Satellite Radar,” p. 54, 2019.

[3] D. MacDonald, C. Liu, N. Schaufele, J. Sandberg, V. Potrykus and G. Conell, "Requirements Elicitation", UVic, Engineering Lab Wing, B215, 2019.

[4] F. Sabatini, “Setting up and Managing Automatic Weather Stations for Remote Sites Monitoring: From Niger to Nepal,” Renewing Local Planning to Face Climate Change in the Tropics Green Energy and Technology, pp. 21–39, Jul. 2017.

[5] M. of Environment, “Automated Snow Weather Station Data,” Province of British Columbia, 23-Nov-2018. [Online]. Available: https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-science-data/water-data-tools/snow-survey-data/automated-snow-weather-station-data. [Accessed: 26- Sep- 2019].

[6] R. A. Fernandes, F. Canisius, S. G. Leblanc, M. Maloley, S. Oakes, C. Prévost, and C. Schmidt, “Assessment of UAV-based photogrammetry for snow-depth mapping: data collection and processing,” 2017.

[7] Steep Mountaineering, "Avalanche Prediction System - Request for Proposal", Victoria, 2019.

1.5 Overview

This document contains seven sections plus an appendix. The second section describes Av-Alert, including an overview of current systems, major features, user classes, operating environment, as well as constraints to design and implementation. Following that, the third section provides in-depth descriptions of the major system features required by Steep Mountaineering. Next, the fourth section outlines the interfaces required by Steep Mountaineering for user interaction with Av-Alert. The fifth section outlines any non-functional requirements that Av-Alert must meet. The sixth section specifies any additional requirements necessary for Av-Alert. Finally, the seventh section outlines our User Cases and with a diagram, shows their connection. The appendix contains a list of yet to be resolved requirements issues.

2 Overall Description

2.1 Product Perspective

Av-Alert is a replacement for Steep Mountaineering’s current system of manual data collection for avalanche risk monitoring. Manual data-collection techniques for avalanche risk assessment are subjective, time-intensive, can put data collectors at risk, and are not able to provide real-time data[3][7]. Av-Alert will allow for the manual data collection to be replaced with remote sensing instruments placed

in the field, measuring changes in conditions, thus providing objective, safer, and up to date Avalanche Risk Analysis Data. Included below are figures representing Steep Mountaineering's current system (Figure 2.1.1), as well as a figure representing Av-Alert (Figure 2.1.2).

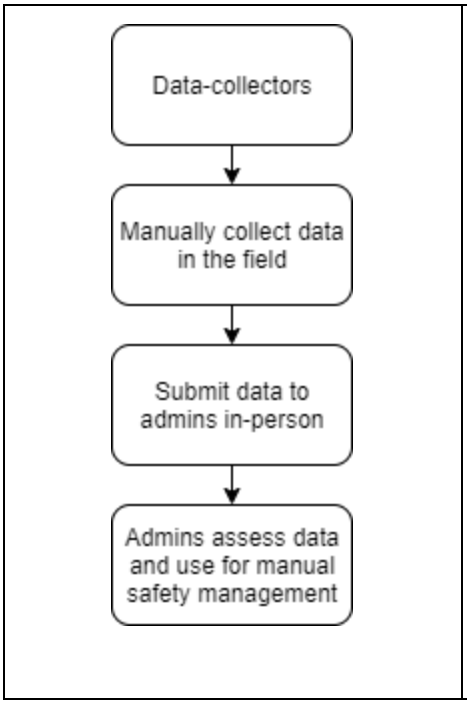


Figure 2.1.1: Steep Mountaineering's current system

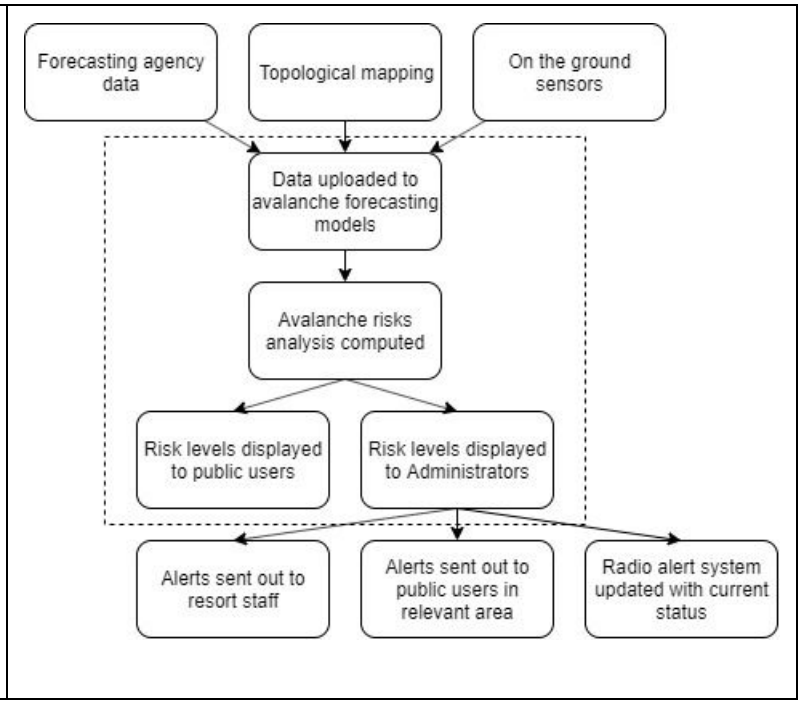


Figure 2.1.2: Av-Alert

2.2 Product Features

Av-Alert consists of five main features. First, our Data Collection feature scrapes information from such as remote sensors, weather institutions, and topological maps, to create a robust Avalanche Risk Analysis Data set which Av-Alert will use to base its risk analysis on. Second, the Avalanche Risk Analysis feature uses Predictive Models to create risk analysis forecasts on slopes in the given area. Third, the Radio Alert feature is used to transmit high priority information such as rapid changes to snow conditions or updates concerning areas for which Av-Alert has forecasted a high-risk of an avalanche. Fourth, the Interactive Topological Map feature displays the terrain around a user's desired location with the current status of conditions displayed on the terrain. Users can then explore the map, viewing the avalanche risk for different slopes around them. The Interactive Topological Map feature is also downloadable for offline use. Finally, Av-Alert provides an Avalanche Training feature which provides informational material regarding avalanche safety, and what to do if you are caught in one.

2.3 User Classes and Characteristics

There are three user classes for the new system: System Administrators, Resort Administrators, and Public Users.

2.3.1 Administrators

2.3.1.1 System Administrators

System Administrators have high privilege access on Av-Alert. With high privilege access, System Administrators have full access across Av-Alert and are able to add, delete, or modify Resorts and Resort Administrators. Additionally, they are able to change the Avalanche Risk Analysis Data sources based on the region of a given resort. The primary tasks of the System Administrator are to manage and maintain Av-Alert, its Resorts, Avalanche Risk Analysis Data sources and other Administrators, ensuring its availability to Public Users. In order for System Administrators to access Av-Alert, they must be authenticated using Multi-Factor Authentication through an administrative website.

2.3.1.2 Resort Administrators

Resort Administrators are experts in identifying stable snow packs with medium privilege access on Av-Alert. With medium privilege access, Resort Administrators are able to add other Resort Administrators, monitor mountain conditions, alert staff and resort guests of potential avalanches, upload additional news and information feeds, and manage safety and training artifacts. In order for Resort Administrators to access Av-Alert, they must be authenticated using Multi-Factor Authentication through an administrative website.Resort Administrators may update Av-Alert with a local alert if they receive information through pre-existing local communication channels outside of Av-Alert, such as ski patrol radioing in.

2.3.2 Public Users

Public users do not require any technical knowledge and have low privilege access on Av-Alert. Due to low privilege access of Public Users, they have read-only access to generic information on Av-Alert. Generic information includes: a geographical map interface of potential avalanches, news and information feeds, and safety and training artifacts. Public Users include resort staff like ski patrol who also receive updates through the app or radio

2.4 Operating Environment

Av-Alert will receive data from topological maps, remote sensors, and weather reports. Weather report data will be retrieved through APIs provided by forecasting agencies. Avalanche Risk Analysis Data is stored on Av-Alert's cloud storage. Av-Alert will analyze, correlate and map the Avalanche Risk Analysis Data to produce a geographical map interface displaying the avalanche forecast for the

corresponding region. Every four hours, Av-Alert will receive an updated Avalanche Risk Analysis Data set. The updated Avalanche Risk Analysis Data set will be analyzed, correlated, and mapped to update the existing geographical map interface displaying the avalanche forecast for the corresponding region.

The Administrators will access the Av-Alert interface through the Av-Alert Administrative Portal on the Av-Alert website. The Administrators must be verified through a username and password verification method. Av-Alert will request two verification methods from the Administrator attempting to access Av-Alert. The first verification method is the Administrator's username and password. The second verification method is a verification code sent to the Administrator's mobile device. The Administrator must enter their username and password. Upon successfully passing the first verification method Av-Alert will send a verification code to the Administrator's mobile device. The Administrator must enter the verification code sent to their mobile device in order to access the Av-Alert Administrative Portal.

The Public Users will access the Av-Alert interface through the Av-Alert mobile application on their mobile devices. The Av-Alert mobile application must support the latest supported versions of the Apple iOS platform and the latest supported version of the Android operating system.

2.5 Design and Implementation Constraints

There are three major design and implementation constraints on Av-Alert:

C-1: Changes in mountain conditions must be updated several times a day at key intervals: 6:00am, 12:00pm, and 6:00pm.

C-2: System hardware, such as remote sensors, must be able to maintain full functionality for 72 hours without access to its primary power source.

C-3: Av-Alert must stay within the implementation budget of four million CAD.

2.6 Assumptions and Dependencies

The following sections, 2.6.1-2.6.2, outline the assumptions and dependencies of Av-Alert.

2.6.1 Assumptions

Steep Mountaineering will be receiving and collecting Avalanche Risk Analysis Data from news outlets, government agencies, and research groups regarding avalanche reports and historical data. If Avalanche Risk Analysis Data received from a source external to Av-Alert contains inconsistencies or is erroneous, such as contrasting data types, measurement units, or values outside of a reasonable range, incorrect analysis of the current conditions may occur.

A-1: Avalanche Risk Analysis Data is standardized and is free of inconsistencies and errors.

A-2: Av-Alert's data, such as user, application, and Avalanche Risk Analysis Data is not required to reside in a single physical location.

2.6.2 Dependencies

The alert and Avalanche Risk Analysis Data transmission of Av-Alert is dependent on a multimodal data transmission model. The transmission model attempts to send alerts and Avalanche Risk Analysis Data through cellular towers and radio transmissions.

D-1: Av-Alert must have a data transmission model available at all times.

Remote sensors must have at least two power supplies for redundancy. When a power outage occurs, remote sensors must be powered by a secondary power supply.

D-2: Remote sensors must have a secondary power supply.

3 System Features

3.1 System Feature 1 - Data Collection

3.1.1 Description and Priority

The Data Collection feature collects Avalanche Risk Analysis Data from multiple sources, such as remote sensing instruments and weather stations. After collection, this feature turns the Avalanche Risk Analysis Data into a standardized data set. The Avalanche Risk Analysis Data is then further used by the Avalanche Risk Analysis feature. The Data Collection feature is of high priority as the Avalanche Risk Analysis Data it collects provides the basis for Av-Alert's Avalanche Risk Analysis feature.

3.1.2 Functional Requirements

As aspects of any system can temporarily go down, so it is important to make sure that in such an event, the Data Collection feature continues to function as normal.

DC-1: Data Collection must not halt or fail if one of the sources is unreachable.

As the Data Collection feature fetches information from its sources, the information will naturally come in different forms. To prevent errors during the creation of avalanche risk analysis forecasts, data types and measurement units should be standardized.

DC-2: The Data Collection feature must standardize all data types and measurement units it collects from varying information sources.

3.2 System Feature 2 - Avalanche Risk Analysis

3.2.1 Description and Priority

First, the Avalanche Risk Analysis feature is passed the Avalanche Risk Analysis Data collected by the Data Collection feature mentioned previously. This feature then uses predictive modelling

to create risk analysis forecasts for avalanches occurring on individual slopes within the 50km range from a resort which Av-Alert is deployed at. This feature is of high priority as it is imperative that risk analysis forecasts are accurate as an inaccurate forecast could result in the injury or death of misinformed Public Users who may be relying on the forecast.

3.2.2 Functional Requirements

As information is being gathered and computed, it must be stored as it will hold future value. Through its analysis, it can be used to improve the predictive models.

ARA-1: Users must be able to access previously stored risk analysis calculations.

As Avalanche Risk Analysis Data is collected from a large number of sources, there is a chance a source could suffer an outage. It is important to make sure that risk analysis forecasts can still be made and Av-Alert does not fail in such a scenario.

ARA-2: Avalanche risk analysis forecast must be generated when Avalanche Risk Analysis Data is received.

3.3 System Feature 3 - Radio Alert

3.3.1 Description and Priority

The Radio Alert feature delivers alerts and updates on current avalanche risks to resort staff, associated emergency services, and radio-equipped Public Users. A radio update contains the current status of avalanche prone areas in a 50km radius around a resort location, and a radio alert would identify fast changing conditions or areas with high avalanche risk analysis. The Radio Alert feature uses radio as it is an accessible method of communication, radio is available where cell service may not be, and radio requires minimal equipment to receive. Radio also has a lower power draw[4]. The Radio Alert feature is of high priority due to the information on conditions and hazardous areas being important, time sensitive, and could lead to injury if ignored.

3.3.2 Functional Requirements

The information transmitted is indispensable to resort staff and emergency services, therefore making it important that anyone in the measured area can receive these alerts.

RA-1: The Radio Alert feature must transmit data packets in a common format and/or audio warnings and updates for radio users both within the organization and to Public Users.

RA-2: Radio signal must have an effective range equal or greater to the 50km radius around resort location, either through direct transmission, or via repeaters.

3.4 System Feature 4 - Topological Avalanche Map

3.4.1 Description and Priority

The Topological Avalanche Map feature visualizes the forecast made by the Avalanche Risk Analysis feature. The Topological Avalanche Map feature overlays the 3-day forecasts onto a topological map of the given area, colour coding the areas with the computed risk of an avalanche occurring, from green (low-risk) to red (high-risk). The Topological Avalanche Map feature is of high priority as it is one of Av-Alert's main components. (3-day forecast)

3.4.2 Functional Requirements

As the coverage of the Avalanche Risk Analysis Data collection is a 50km radius around the resort, it is important that Public Users are able to easily search for the specific area they are interested in and view information again when offline.

TAM-1: Users must be able to search for different regions.

TAM-2: The Topological Map must be downloadable to allow Public Users to use the map when they don't have cell service or wifi.

Due to the importance of the forecasts, the forecasts must be current so that Public Users can make educated choices in the event of noticeable changes in their close vicinity.

TAM-3: Status of avalanche risk analysis must be updated several times a day.

3.5 System Feature 5 - Avalanche Training

3.5.1 Description and Priority

The Avalanche Training feature serves to provide Public Users with educational material regarding issues such as how to spot high-risk avalanche areas and what to do in the occurrence of an avalanche. The Avalanche Training feature is of medium priority as it is not essential to the core functionality of Av-Alert, however, it is still important as it provides possibly life-saving information for users.

3.5.2 Functional Requirements

AT-1: Video playback must work on a range of devices to allow Public Users to view training and safety videos.

Many regions that Av-Alert cover have limited access to cell service and wifi, and it is important that Public Users have access to this material while in areas at a high risk of an avalanche.

AT-2: Content must be downloadable for offline use by Public Users.

4 External Interface Requirements

4.1 User Interfaces

4.1.1 Public Interface

The public interface is accessed by Public Users. The public interface only allows for Public Users to read the curated forecasts, avalanche training information and receive alerts provided by Av-Alert.

4.1.2 Administrative Interface

The administrative interface is accessed by System and Resort Administrators and acts as an Administrative Portal. The administrative interface requires Administrators to be authenticated and resembles the public interface but with additional permissions. Authenticated Resort Administrators will be able to affect Av-Alert by sending alerts and news to the public interface. Authenticated System Administrators will be able to affect Av-Alert by adding, deleting, or modifying Resorts and Resort Administrators, and through changing the Avalanche Risk Analysis Data sources as required.

4.2 Hardware Interfaces

The following sections describe the hardware interfaces which Av-Alert will interact with.

4.2.1 Weather Collection Stations

Av-Alert will interact with weather data collection stations to collect meteorological data. The BC Ministry of Environment, has automated weather data collection stations which remotely sense snow and provide meteorological data that is uploaded in near real-time[5]. The meteorological data is uploaded hourly and transmitted through a geostationary satellite network. The meteorological data is freely available to download in csv format.

4.2.2 Remote Sensing Instruments

Remote sensing instruments are capable of acquiring snow depth data over large spatially continuous areas. Land-based laser scanning has already proven its ability to monitor the spatial distribution of snow depth in subsets of single alpine catchments[6]. Air-borne or spaceborne sensors, cover several hundreds of square kilometers in one data acquisition. Preliminary results indicate that snow depth measurements with a precision of 20cm can be obtained, which are confirmed with hand measurement[2].

4.3 Software Interfaces

The Public User will be able to access and view this software user interface but will not be able to delete or modify the data. The Public User and Administrators will see the latest updated risk analysis forecasts at any given time. The Public User and Administrators should have the option to refresh the interface.

This will force Av-Alert to check for new Avalanche Risk Analysis Data and update the forecasts accordingly.

4.4 Communications Interfaces

For radio communication, Av-Alert is to be easily accessible by staff and the public, so it will use a standard format for radio data communication, such as APRS. APRS will require encoding of Avalanche Risk Analysis Data before broadcasting it via Narrow Band FM. Post transmission, depending on the area covered by a Resort, radio signals may be interrupted, so Av-Alert will be designed to either have a large initial broadcast range from the Resort, or have the signal be repeated over the range.

5 Other Non-Functional Requirements

5.1 Performance Requirements

Due to the extreme cold, heavy snow and freeze-thaw cycles found in the problem domain and importance that Av-Alert must be reliable, the hardware must be able to function in any weather condition.

NFR-1: Av-Alert's hardware, such as remote sensing instruments, must work in all weather conditions.

As conditions in Av-Alert's coverage can change quickly, it is important for Public Users to have the current status of the terrain.

NFR-2: Avalanche risk analysis forecasts must be made quickly.

Due to the nature of the environment that Av-Alert will be deployed in, it is required that Av-Alert be able to provide Avalanche Risk Analysis Data for a minimum of 72 hours without primary power.

NFR-3: Av-Alert in-field components such as its remote sensing instruments, must be able to function without their main power source for 72 hours.

5.2 Safety Requirements

If misinformation is spread to resort staff, misunderstanding will occur. Misunderstandings can result in unsatisfactory safety precautions taking place such as closing off a high-risk slope, and can result in Public User injury or death.

NFR-4: Av-Alert must alert resort staff on potential avalanches.

NFR-5: Av-Alert's Radio Alert feature must be tested daily to ensure it stays operational. If critical information is not broadcasted effectively, user injury can occur.

5.3 Security Requirements

Integrity of Avalanche Risk Analysis Data is important. If Avalanche Risk Analysis Data is tampered with, it could result in misinformation or false forecasts leading to user injury and loss of life.

NFR-6: Incoming Avalanche Risk Analysis Data must only come from verified Avalanche Risk Analysis Data collection sources and be secured after entering Av-Alert.

NFR-7: System Administrators must have high access in order to manage and maintain Av-Alert, its Resorts, Avalanche Risk Analysis Data sources and other Administrators.

NFR-8: Administrators must be able to log into Av-Alert securely with user authentication.

NFR-9: Non-authorized users must not be able to gain access to Av-Alert.

As resort staff act as people on the ground in our problem domain, it is important that they have the ability to contribute back to Av-Alert via interactions with their consumer environment.

NFR-10: Resort staff must be able to analyze and upload content to the consumer environment.

NFR-11: Public Users must be able to see Avalanche Risk Analysis Data with no access to the Av-Alert's database.

5.4 Software Quality Attributes

Due to the nature of the risk analyses it is very important that the Public User can understand the avalanche risk analysis presented.

NFR-12: Av-Alert's avalanche risk analysis must be presented in ways that adhere with UI/UX best practices to ensure readability and clarity.

The terrain of the problem domain could prevent ease of access to both resort staff and administrators, making maintenance tasks more complex, thus it is important to maximize maintainability.

NFR-13: Av-Alert must be constructed modularly to ensure that it is easily maintainable.

NFR-14: The Data Collection feature should be capable of receiving and processing large Avalanche Risk Analysis Data inflows from in-field sensors, both scheduled and unscheduled due to issues in collection.

6 Other Requirements

In the unfortunate event of an avalanche, it is important that no liability is held by Snowlutions or the resort using Av-Alert. Av-Alert only provides the risk analysis of an avalanche based on the available Avalanche Risk Analysis Data. It serves only as an approximation of the risk users are exposed to as they make choices for themselves.

NFR-15: All users must agree to the Terms and Conditions of using Av-Alert.

NFR-16: Av-Alert's Terms and Conditions must include that in the event of injury or loss of life due to an avalanche.

NFR-17: Av-Alert's Terms and Conditions must include an acknowledgement of Avalanche Risk Analysis Data delay/staleness if necessary, to ensure absolvence of liability in case of misinformation stemming from this Avalanche Risk Analysis Data.

7 Use Cases

The following section outlines the different use cases that a user may follow.

Use Case: ViewAvalancheRiskAnalysisData	
ID:	1
Brief description:	The Public User views Avalanche Risk Analysis Data through the geographical map.
Actor(s):	Public User
Preconditions:	1. The Public User has read-only access to the system. 2. The Public User has GPS location provided to the system.
Main flow:	1. The Public User opens the system. 2. The Public User selects the geographical map. 3. If the Public User zooms or pans the geographical map then: 3.1. The system updates the view of the geographical map shown to the Public User. 4. The Public User taps on a defined area of the geographical map. 5. The system displays a three day forecast of the risk of avalanche for that area.
Postconditions:	None.
Alternative flow(s):	NoLocation UpdateData

Alternative Flow: ViewAvalancheRiskAnalysisData: NoLocation	
ID:	1.1
Brief description:	The Public User has not provided a location to the system.
Actor(s):	Public User
Preconditions:	None.
Alternate flow:	1. The alternate flow begins after step 1 of the main flow. 2. The Public User manually inputs their location on the geographical map. 3. Main flow resumes at step 2.
Postconditions:	1. The system has cached the provided location on the Public Users device.

Alternative Flow: ViewAvalancheRiskAnalysisData: UpdateData	
ID:	1.2
Brief description:	The Public User updates the Avalanche Risk Analysis Data on the geographical map.
Actor(s):	Public User
Preconditions:	None.
Alternate flow:	1. The alternate flow begins at any time. 2. The Public User updates the information on the map by pressing the refresh button. 3. If the system is able to retrieve Avalanche Risk Analysis Data on the geographical map which is newer than the current Avalanche Risk Analysis Data forecast loaded on the system then: 3.1. The Public User's view of the geographical map is updated with the new Avalanche Risk Analysis Data.
Postconditions:	None.

Use Case: DownloadAvalancheMap	
ID:	2
Brief description:	The Public User downloads the geographical map for offline use.
Actor(s):	Public User
Preconditions:	1. The Public User has cell service or Wi-Fi connection
Main flow:	1. The Public User opens the system. 2. The Public User selects the geographical map. 3. The Public User click on the download button displayed in the top right hand corner.
Postconditions:	1. Map is downloaded to the Public Users phone and stored in the application memory.
Alternate flow:	None.

Use Case: ViewAlertOrAdvisory	
ID:	3
Brief description:	The Public User views an alert or report pertaining to an avalanche forecast.
Actor(s):	Public User
Preconditions:	1. The Public User has read-only access to the system.
Main flow:	1. The Public User opens the system. 2. The Public User navigates to the list of alerts and reports. 3. The Public User sees the list of alerts and reports, sorted in order of most recently received. 4. The Public User selects an item from the list of alerts and reports 5. The Public User sees the expanded view of the selected alert or report.
Postconditions:	None.
Alternative flow(s):	AlertReceived

Alternative Flow: ViewAlertOrReport: AlertReceived	
ID:	3.1
Brief description:	The Public User opens a received alert.
Actor(s):	Public User
Preconditions:	1. The Public User has received a push notification on their device notifying them of an alert. 2. The Public User taps on the notification. 3. The system opens and directs the Public User to the received alert.
Alternate flow:	1. Main flow is entered at step 5.
Postconditions:	Alert is now marked as read but remains available for viewing.

Use Case: ViewSafetyAndTraining	
ID:	4
Brief description:	The Public User views safety and training information relevant to avalanche risk.
Actor(s):	Public User
Preconditions:	1. The Public User has read-only access to the system.
Main flow:	1. The Public User navigates to the safety and training section. 2. The Public User sees a list of safety and training materials sorted in order of most recently published. 3. The Public User selects a piece of content. 4. The Public User sees the expanded view of the selected safety or training content. 5. If the selected content contains video content then: 5.1. The Public User presses the play button to start the video.
Postconditions:	None.
Alternative flow(s):	None.

Use Case: SendAlertOrAdvisory	
ID:	5
Brief description:	The Resort Administrator decides the need for an alert or advisory for a particular area.
Actor(s):	Resort Administrator
Preconditions:	1. The Resort Administrator has processed the latest local risk summary and decided there is a need to send out an alert to all users.
Main flow:	1. The Resort Administrator opens the system. 2. The Resort Administrator sees the latest colour-coded risk summary for the surrounding areas on the geographical map. 3. The Resort Administrator selects an area of the geographical map for detailed information on avalanche risk. 4. If the Resort Administrator decides the risk is great enough to warrant an alert to be sent out then: 4.1. The Resort Administrator authorizes an alert for the relevant location. 4.2. The system sends out the authorized alert to reach all Public Users who have their location set to any of the surrounding areas. 4.3. The system broadcasts the authorized alert over the local radio channel reserved for alert information. 5. Else if the Resort Administrator decides the risk is enough to warrant an advisory then: 5.1. The Resort Administrator authorizes an advisory for the relevant location. 5.2. The system sets an advisory for that area of the geographical map.
Postconditions:	1. If an alert has been sent out for an area then: 1.1. The alert has been recorded in the system. 1.2. The Public Users with their location set to the Resort containing the alerted area will receive a notification through the system. 2. Else if an advisory has been set for an area then: 2.1. The advisory has been recorded in the system. 2.2. Public Users with their location set to the Resort containing the area will see the advisory if they select that area of the geographical map.
Alternative flow(s):	None.

Use Case: UploadSafetyAndTraining	
ID:	6
Brief description:	The Resort Administrator wants to upload or edit safety and training content.
Actor(s):	Resort Administrator
Preconditions:	1. The Resort Administrator has access to modify safety and training content.
Main flow:	1. The Resort Administrator opens the system. 2. The Resort Administrator selects the safety and training page of the system. 3. The Resort Administrator sees a list of any previously uploaded safety and training content. 4. The Resort Administrator selects add new safety and training content. 5. The Resort Administrator uploads the safety and training content to the system.
Postconditions:	1. The safety and training content has been uploaded to the system.
Alternative flow(s):	EditMaterial

Alternative Flow: UploadSafetyAndTraining: EditMaterial	
ID:	6.1
Brief description:	The Resort Administrator wants to edit pre-existing safety and training content.
Actor(s):	Resort Administrator
Preconditions:	1. Safety and training content has been previously uploaded to the system.
Alternate flow:	1. The alternate flow begins at step 3 of the main flow. 2. The Resort Administrator selects an item from the list of safety and training content. 3. The Resort Administrator selects edit content. 4. The Resort Administrator makes modification to the selected safety and training content. 5. The Resort Administrator selects save changes.
Postconditions:	1. The edits made to the selected safety and training content has been recorded.

Use Case: AnalyzeAvalancheData	
ID:	7
Brief description:	The Resort Administrator analyzes the trend in Avalanche Risk Analysis Data that were collected over a period of time.
Actor(s):	Resort Administrator
Preconditions:	1. The Resort Administrator has access to view the Avalanche Risk Analysis Data.
Main flow:	1. The Resort Administrator opens the system. 2. The Resort Administrator selects the list view of Avalanche Risk Analysis Data. 3. The Resort Administrator sees a list of sets of Avalanche Risk Analysis Data sorted by most recently recorded. 4. The Resort Administrator selects a set of Avalanche Risk Analysis Data from the list. 5. The Resort Administrator sees a detailed view of the Avalanche Risk Analysis Data for the selected time period.
Postconditions:	None.
Alternative flow(s):	None.

Use Case: SignInToPortal	
ID:	8
Brief description:	Administrative User wants to be verified by the system.
Actor(s):	System Administrator, Resort Administrator
Preconditions:	1. The Administrative User has previously created account. 2. The Administrative Userhas access to view the avalanche data.
Main flow:	1. The Administrative User opens the Av-Alert Administrative Portal 2. The Administrative User enters their username and password. 3. While the username and password are incorrect then: 3.1. The Administrative User is prompted to enter their credentials again. 3.2. The Administrative User is verified and signed into their account. 4. The Administrative User enters their verification code.
Postconditions:	1. The Administrative User is now signed into the system.
Alternative flow(s):	3.1 b) Username not recognized. 3.1 c) Password incorrect.

Use Case: CreateResortProfile	
ID:	9
Brief description:	The System Administrator wants to create a new Resort Profile instance.
Actor(s):	System Administrator
Preconditions:	1. The System Administrator is logged into system. 2. The System Administrator has the information to fill out the Resort Profile.
Main flow:	1. The System Administrator selects “add profile”. 2. The System Administrator inputs the Resort information into the respective fields.
Postconditions:	1. A Resort profile has been created.
Alternative flow(s):	CancelResortProfile EditResortProfile

Alternative Flow: CreateResortProfile UseCaseName: CancelResortProfile	
ID:	9.1
Brief description:	The System Administrator cancels the creation of a Resort Profile.
Actor(s):	System Administrator
Preconditions:	None.
Alternate flow:	1. The alternate flow begins at any time. 2. The System Administrator cancels the creation of a new Resort Administrator.
Postconditions:	1. A new Resort Administrator is not created.

Alternative Flow: CreateResortProfile UseCaseName: EditResortProfile	
ID:	9.2
Brief description:	The System Administrator wants to edit a pre-existing Resort Profile. The System Administrator can edit the existing resorts and the data sources from the topological maps, remote sensors, and weather reports to specific resorts.
Actor(s):	System Administrator
Preconditions:	1. A Resort Profile has been previously created.
Alternate flow:	1. The alternate flow begins at the start of the main flow. 2. The System Administrator selects “edit resort”. 3. The System Administrator makes modifications to the Resort Profile information.
Postconditions:	1. The modified Resort Profile has been updated.

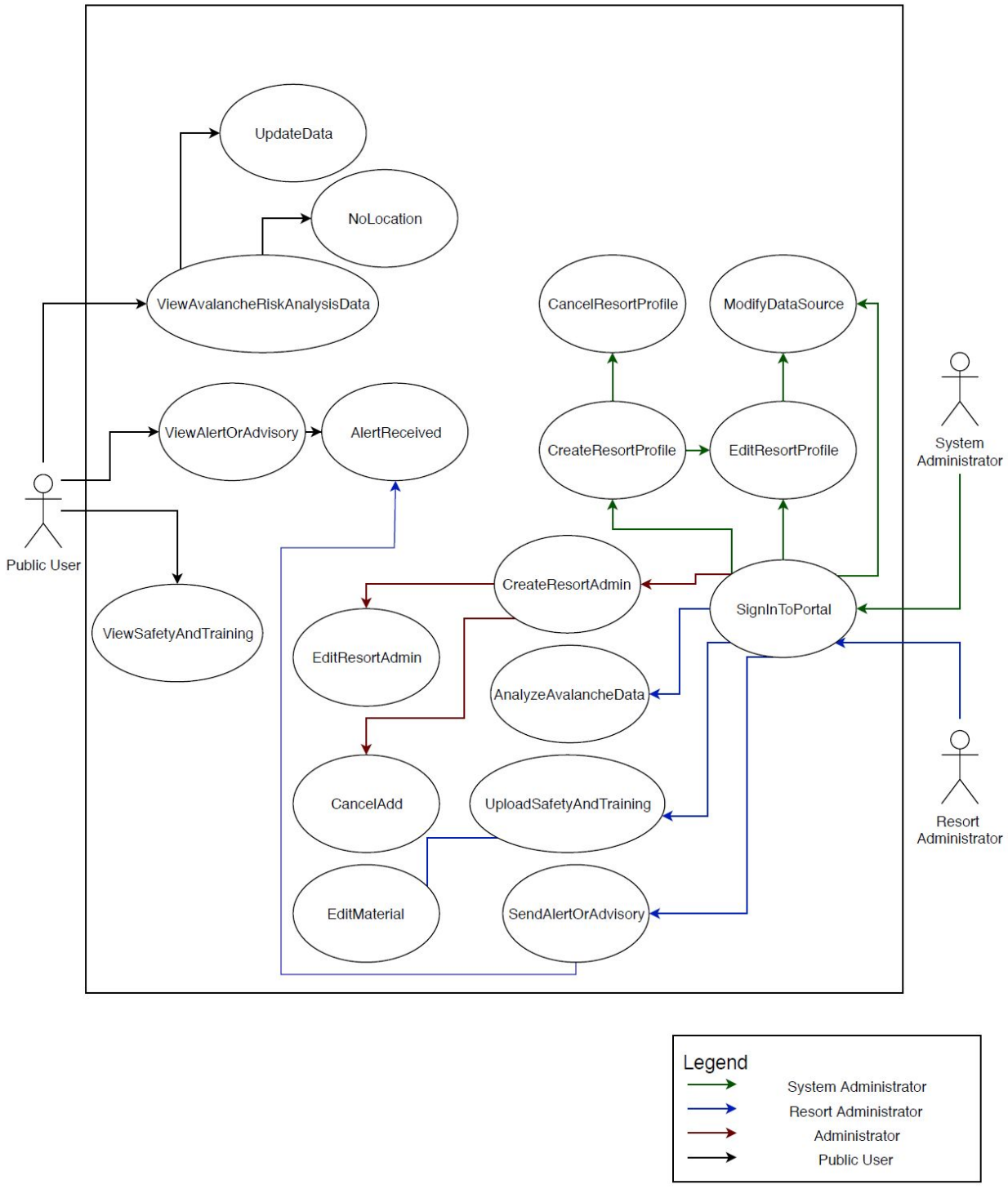
Use Case: ModifyDataSource	
ID:	10
Brief description:	The System Administrator wants to modify the sources which contribute to the Avalanche Risk Analysis.
Actor(s):	System Administrator
Preconditions:	1. The System Administrator must be signed into the Av-Alert Administrative Portal.
Main flow:	1. The System Administrator selects a Resort Profile. 2. The System Administrator sees the Avalanche Risk Analysis Data sources available to use at the selected Resort. 3. If the Avalanche Risk Analysis Data source is not being used at the selected Resort then 3.1. The System Administrator adds the data source to the Resort Profile.
Postconditions:	1. The data sources for the selected Resort has been updated. 2. The Avalanche Risk Analysis now includes the Avalanche Risk Analysis Data source.
Alternative flow(s):	None.

Use Case: CreateResortAdmin	
ID:	11
Brief description:	An Administrative User wants to create a new Resort Administrator for a Resort.
Actor(s):	System Administrator, Resort Administrator
Preconditions:	1. The Administrative User is signed into the system.
Main flow:	1. The Administrative User selects a Resort Profile to add a Resort Administrator to. 2. The Administrative User selects “create new Resort Administrator”. 3. The Administrative User creates the Resort Administrator account.
Postconditions:	1. A new Resort Admin has been created.
Alternative flow(s):	CancelAdd

Alternative Flow: CreateResortAdmin UseCaseName: CancelAdd	
ID:	11.1
Brief description:	The Administrative User cancels the creation of a Resort Administrator.
Actor(s):	System Administrator, Resort Administrator
Preconditions:	None.
Alternate flow:	1. The alternate flow begins at any time. 2. The Administrative User cancels the creation of a new Resort Administrator.
Postconditions:	1. A new Resort Administrator is not created.

Alternative Flow: CreateResortAdmin UseCaseName: EditResortAdmin	
ID:	11.2
Brief description:	The System Administrator wants to edit a pre-existing Resort Administrators details.
Actor(s):	System Administrator
Preconditions:	1. A Resort Administrator has been previously created.
Alternate flow:	1. The System Administrator selects a resort. 2. The System Administrator sees the Resort Administrators for that Resort. 3. The System Administrator selects a Resort Administrator. 4. The System Administrator edits the Resort Administrators details.
Postconditions:	1. The Resort Administrator has been updated.

7.1 Use Cases Diagram



Appendix: Issues List

I-1: No user interface guidelines provided by the client.