# High-Level Business Requirements Document

# Feature Extraction from Aerial Imagery Initiative

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|---|---|
| Client name: DCS Spatial Services | Proposal number: |
| Date: Friday, March 26, 2021 | |

## Contact details



| | |
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# Table of Contents


**Contact details** 1

**Table of Contents** 2

**1. Overview** 3

1.1 Purpose 3
1.2 Background 3
1.3 Objectives 3
1.4 Justification 3
1.5 Critical Success Factors 3
1.6 Scope Items 4
1.6.1 In Scope 4
1.6.2 Out of Scope 4
1.7 Assumptions 4
1.8 Constraints 4
1.9 Interdependences 5
1.10 Key Interactions Groups 5

**2 Requirements** 6

2.1 Business Requirements 6
2.2 Functional Requirements 7
2.3 Non-Functional Requirements 8

**3 Document Information** 9

3.1 Stakeholders 9
3.2 Reviewers 9
3.3 Acronyms 9

# Overview

## 1.1 Purpose

*Provide summary on why this project & requirements are needed*

The NSW Spatial Services division of the DCS collects aerial and LiDAR images of the NSW landscape and is responsible for providing reliable spatial information to NSW Emergency Service Organisations. In order to better facilitate rapid responses and recovery efforts to emergency events such as bushfires and floods, this project aims to develop a machine learning platform that will analyse aerial and LiDAR imagery to detect areas affected by natural disasters.

## 1.2 Background

*Explain why the project has come about (e.g., as a result of a strategic study or as a result of findings from another project)*

Programs that are able to generalise relationships between input variables and output variables through inductive inference, whether through supervised, unsupervised, or reinforcement learning algorithms, are categorised as machine learning programs (Guo et al., 2020). Many of the difficulties in contemporary areas of machine learning research deal with defining problems that are simple for people to perform but hard to formally describe because they entail a high level of intuitive and subjective knowledge of the world, such as recognising faces in an image (Goodfellow, 2016). One class of problems that machine learning programs are proving to be effective at solving are classification problems through the use of models such as convolutional neural networks and support-vector machines (Hasan et al., 2019). If a machine learning model is capable of analysing images of landscape and classifying them as affected or unaffected by natural disaster events such as bushfires and floods, then this has the potential to greatly assist decision-making capabilities for government authorities managing and monitoring recovery and disaster-relief efforts.

## 1.3 Objectives

To develop a service that is able to analyse LiDAR and aerial imagery and detect specific features using Machine Learning (ML). Initially the project will aim to focus on detecting features specific to those left after a flood or fire.The identification of these features will identify areas in need of assessment and resources. This information can be passed on to SES, RFS and other services that require on the ground information and mapping of affected areas.

## 1.4 Justification

*e.g. Legislation, regulation compliance or change, etc.*

| ID | Description |
|---|---|

| | |
|---|---|
| 1 | 2019-20 Bushfires - Aid in destruction identification, animal recovery, affected areas, equipment destruction, grazing land lost, post disaster analysis |
| 2 | 2021 Floods - Aid in destruction identification, animal recovery, affected areas, equipment destruction, grazing land lost, post disaster analysis, clean up areas |
| 3 | |

## 1.5 Critical Success Factors

*What factors will make this project as success*

| ID | Description |
|---|---|
| 1 | Accurately identify fire and flood features from aerial and LiDAR imagery |
| 2 | ML model executes with efficiency and with a reasonable amount of resources (memory, compute, storage) |
| 3 | Project is finished within time allocated, current deadline being end 2021 |
| 4 | Service can be successfully handed over to end users as the end of the project. |

## 1.6 Scope Items

*Where it is yet undecided as to whether a component is to be either included or excluded from scope, The major areas, functions, process etc. to be addressed are:*

User training, ongoing costs

### 1.6.1 In Scope

| ID | Description |
|---|---|
| 1 | Pre process and organise data/images for ML |
| 2 | Isolation of feature vectors unique to flood and fire on aerial and LiDAR imagery |
| 3 | Development training of ML model |
| 4 | Develop a service to utilise ML model |
| 5 | Develop documentation on ML service |
| 6 | Deliver ML service and Documentation |

### 1.6.2 Out of Scope

| ID | Description |
|---|---|
| 1 | Development / research of new ML algorithms |
| 2 | Development / research of technologies to supersede those currently available |
| 3 | Collection of new data |

## 1.7 Assumptions

*Define assumptions that have been pre-determined at the time of writing.*

| ID | Description |
|---|---|
| 1 | Data generated by the service will be of relevance to users when project is finished |
| 2 | There exists a sufficient amount of data to perform training and verification with an acceptable degree of accuracy |
| 3 | Current existing technologies and algorithms are sufficient for the project |
| 4 | Developing team has or can obtain the necessary skills |
| 5 | Developing team will remain consistent throughout development of the project |
| 6 | Project goals and scope will remain consistent with original goals and scope |
| 7 | AWS will continue to support their AWS platform including SageMaker and EC2 |

## 1.8 Constraints

*Types of constraints include; business, legal, cost, organisational, technical, timing, etc.*

| ID | Description |
|---|---|
| 1 | Project to be completed by end of 2021 |
| 2 | Costs ($50 000) |
| 3 | Project to be developed and deployed using AWS environment |
| 4 | Development of project to be managed using the Unified Process framework |
| 5 | Each team member to pass the AWS Certified Cloud Practitioner Exam |

## 1.9 Interdependencies

*Identify any internal or external interfaces (such as systems, departments) to this project including any links to other projects or programs. See the Portfolio Managers for projects to be included*

| ID | Description |
|---|---|
| 1 | AWS Sagemaker – machine learning services developed and deployed by Amazon Web Services (AWS) |
| 2 | NSW Spatial Services Business Technology Services team - sub-division of DCS that will provide the images necessary for training and testing the ML model |
| 3 | Intellify - Engaged by DCS to create the AWS environment and upskill DCS staff. |

## 1.10 Key Interactions Groups

*Identify any groups internal or external that will use the solution in providing data or receive data outputs including reports*

| ID | Description |
|---|---|
| 1 | Department of Customer Service (DCS) |
| 2 | Charles Sturt University (CSU) - David Tien + students |
| 3 | Intellify |

# 2 Requirements

## 2.1 Business Requirements

Each requirement needs a priority based on the business need.

| Code | Priority | Definition |
|---|---|---|
| **M** | Mandatory | It is essential for the system to implement this requirement |
| **HD** | Highly Desirable | While not essential, this function is seen as very important. Having the feature implemented will increase the effectiveness and value of the business solutions |
| **O** | Optional | This option is seen as desirable and its presence will contribute to the value of the business solution |

| ID | Topic/Area | Business Requirement | Priority |
|---|---|---|---|
| | *E.g. Security and User Access, Search and Discover, Usability, Compliance & Auditing, Navigation, Support* | | |
| | | | |
| | | | |

## 2.2 Functional Requirements

Each requirement needs a priority based on the business need.

| Code | Priority | Definition |
|---|---|---|
| **M** | Mandatory | It is essential for the system to implement this requirement |
| **HD** | Highly Desirable | While not essential, this function is seen as very important. Having the feature implemented will increase the effectiveness and value of the business solutions |
| **O** | Optional | This option is seen as desirable and its presence will contribute to the value of the business solution |

| ID | Topic/Area | Functional Requirement | Traceability | Priority |
|---|---|---|---|---|
| 1 | | Service will be able process aerial and LiDAR imagery in search for specific features related to fires and flood | | M |
| 2 | | Service will be able to locate flood and fire affected areas | | M |
| 3 | | Ability to upload data to the service or tell the service where to locate data | | M |
| 4 | | Ability to express to the service the outcome intended by the user | | M |
| 5 | | Service will output data in specified format (TBD) | | M |
| 6 | | Service to be built in the AWS ecosystem using ML systems (Sage Maker, EC2) | | HD |
| 7 | | Delivery of documentation on service usage | | M |

## 2.3 Non-Functional Requirements

Each requirement needs a priority based on the business need.

| Code | Priority | Definition |
|---|---|---|
| **M** | Mandatory | It is essential for the system to implement this requirement |
| **HD** | Highly Desirable | While not essential, this function is seen as very important. Having the feature implemented will increase the effectiveness and value of the business solutions |
| **O** | Optional | This option is seen as desirable and its presence will contribute to the value of the business solution |

| ID | Topic/Area | Non-Functional Requirement | Traceability | Priority |
|---|---|---|---|---|
| | *Data Storage* | *List what should or should not be stored for historical purposes, in what format and how it is going to be used in the future and when. Do not rely on current defaults as they may change.* | | |
| | *Data Validation* | *List any Data Validation requirements, rules, checks, etc., as applicable for the project.* | | |
| | *Data and User Access* | *Identify the user hierarchy, who should be allowed to see and update what type of data.* | | |
| | *Auditing* | *How will the user access to the data and the data being modified or used for reporting be tracked, logged and reported.* | | |
| | *Usability* | *This section should include all of those requirements that affect usability.* | | |
| | *Reliability* | *Requirements for reliability of the system.* | | |
| | *Performance* | *The performance characteristics should be outlined.* | | |
| | *Supportability* | *Any requirements that will relate to the supportability or maintainability.* | | |
| | *System Availability* | *Operational requirements.* | | |

# Document Information

## 2.4 Stakeholders

The list of stakeholders includes:

| Division | Team | Reason |
|---|---|---|
| NSW DCS | ? | DCS is the client who will utilise the finished project. |
| Intellify | | Intellify have been contracted by DCS to manage the AWS platform development environment. |
| Dr. David Tien | | Dr. Tien is the supervisor of the CSU student team. |

## 2.5 Reviewers

This document has been distributed to:

| Name | Title / Role | Business Unit |
|---|---|---|
| | | |
| | | |
| | | |

## 2.6 Acronyms

*List all acronyms and the meanings*

| Acronym | Description |
|---|---|
| ESP | Environmental Spatial Services |
| CSU | Charles Sturt University |
| DCS | Department of Customer Service |
| ML | Machine Learning |
| AWS | Amazon Web Services |
| EC2 | Elastic Cloud Compute |
| SES | State Emergency Services |

| | |
|---|---|
| RFS | Rural Fire Service |

# References


Goodfellow, I. (2016). *Deep Learning*. MIT Press. https://www.deeplearningbook.org/

Guo, H., Wu, S., Tian, Y., Zhang, J., & Liu, H. (2020). Application of machine learning methods for the prediction of organic solid waste treatment and recycling processes: A review. *Bioresource Technology*, *319*, 124114 - 124125. https://doi.org/10.1016/j.biortech.2020.124114

Hasan, H., Shafri, H., & Habshi, M. (2019). A comparison between Support Vector Machine (SVM) and Convolution Neural Network (CNN) Models for Hyperspectral Image Classification. *IOP Conference Series: Earth and Environmental Science,* 357, 012035-012046. https://doi.org/10.1088/1755-1315/357/1/012035