Internal Design Document

07, April 2020

ASSOCIATED ENGINEERING

Version:
1.0

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AE3: Team Turtle

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Changelog:

04-07-2020, v1.0

Changed assumptions on Algorithms

04-07-2020, v0.3

Added Api, Environments and Algorithms.

04-06-2020, v0.2

Changed Data Dictionary and UI View

02-07-2020, v0.1

Documenting the first implementation of the Design Document.

Table of Contents

1. Introduction

The end-goal of the project is to have a secure web-based resource management system for all employers and clients of the Associated Engineering firm. The system should be able to manage resources to the authenticated users, update user profile or existing projects, forecast based on current resource utilization and be accessed only by the authorized individuals.

1.1 Purpose

The purpose of this document is to showcase a detailed description of the designs of the CPSC319 AE's Resource Management System. Essentially, this document is intended for our own group to use as guidelines to implement the project. Moreover, this document will be assessed by the selected representatives to comment and update the current design of the project.

1.2 Scope

This document gives a detailed description of the overall design of the project. It describes an environment for programming, production, and testing. Additionally, it presents a detailed description of the software architecture, the structure of database, the user interface design and the API design.

2. Design Consideration

2.1 Assumptions

The user of the AE resource management system is registered in the Azure Active Directory system. Moreover, the user is informed of the principal operations of a computer and general web-based applications.

2.2 Constraints

The system is only accessible by a registered user or an admin. The system should be runnable and optimized for IE 11 and Google Chrome.

2.3 System Availability

Technically, the project is built to work on all operating systems as it is web-based. The application is always available through any PCs, that is connected to the organization's internal network. However, if the server hosting the data shuts down unexpectedly, it might

not update changes on the system.

2.4 Design Methodology

The system will be open to further development and modification in the future. The adopted design pattern is combination of MVC (Model-View-Control) and Façade (Wrapped) Design Pattern. Therefore, the system has several controllers, however these controllers are wrapped by the main Facade UI. Lastly, all components in the system are built with abstraction.

3. Project Development Environment

3.1 Programming Environment

The list may be updated as the project proceeds.

Application	Version	Usage
Visual studio code	Ver. 1.42	IDE
GitLab	Latest	For cloning repo, version control
JavaScript	Ver. 9	Programming language for the front-end development
C#	Ver. 8.0	Programming language for the back-end development
.NET Core 3.0	Ver 3.0	.NET Framework
SQL server Express	14.0.1000.169	For database
Node.js/NPM	Latest LTS version	For client
Slack	Latest Slack application	For communication between the team
Lucid Chart	Latest draw.io version	For diagram (UML)
C# Unit Testing Frameworks	Latest version	For unit tests
Windows 10	Ver. 1909	For system tests and development
macOS	Ver. 15.3 (Catalina)	For development

3.2 Production and Test Environments

Details about Testing will be elaborated in the upcoming Test Plan Document. Following is a brief description of the tests we are going to apply in this project:

1. Unit Test

   Unit test will be performed on major functions on each class to ensure all behaviours of classes are expected and work properly. Modularity is key here.

2. UI Test

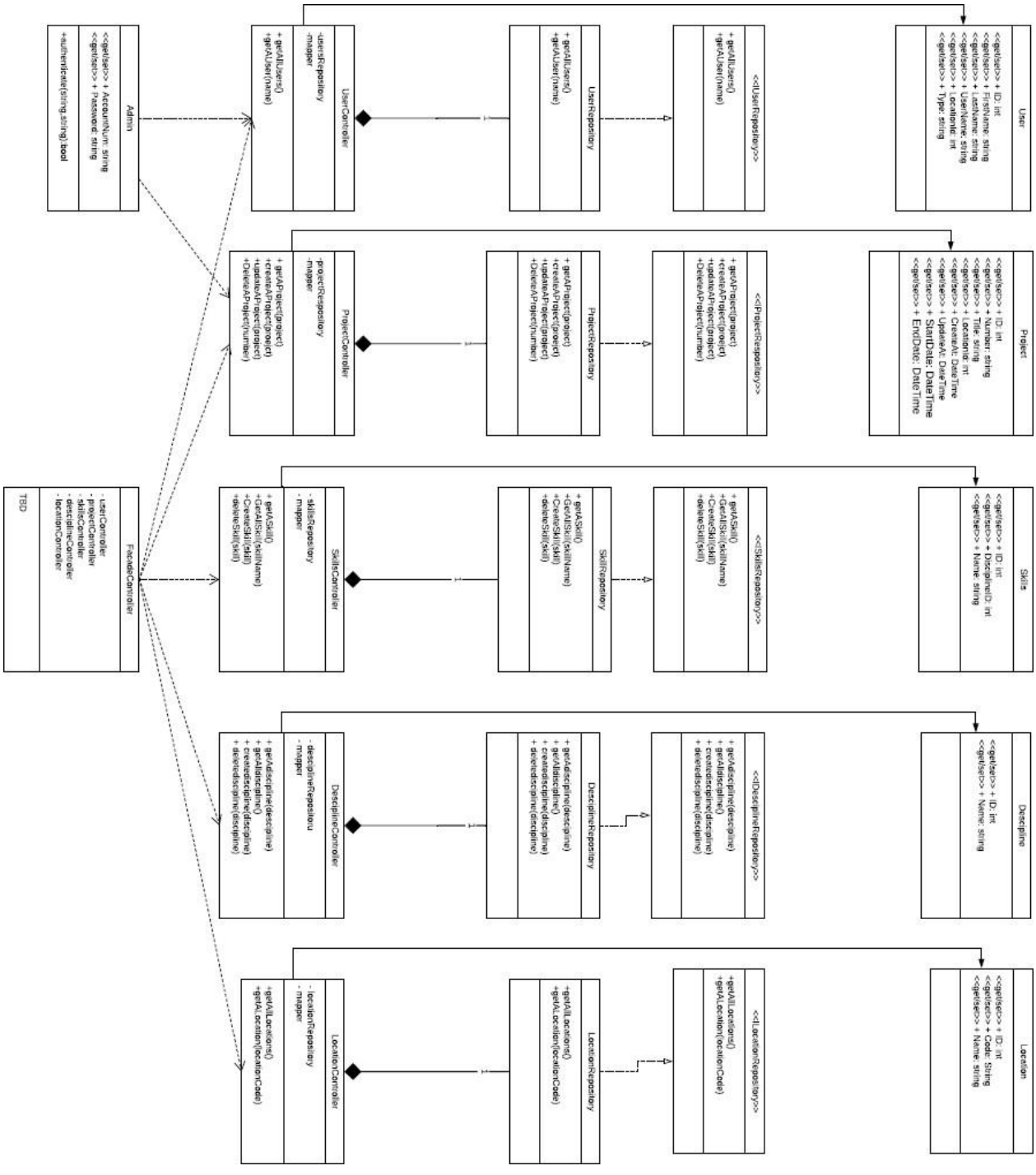
   UI testing will be done manually to ensure all operations run as expected. Moreover, whether there is any unexpected behaviour of user interface on various platforms will also be tested.

3. End to End Test

   End to End testing is necessary to ensure the end product meets the criteria of the required MVP (Minimum Viable Product) as we set up from the early phase of the project.

4. Software Architecture.

This UML diagram shows overall class relationship and their functionalities:



5. Data Design

5.1 Data Dictionary

We have 2 databases; Corrected and Resource Management. Resource Management contains the legacy databases. Whereas, the Corrected Database contains new databases which have been updated to the requirements of the project and our changing understanding of the requirements.

/* An Admin table is added for the purposes of registry. Each Admin is identified by its Username. For the purposes of the demo there is only 1 admin. */

```
CREATE TABLE [dbo].[Admin](
        [Username] NVARCHAR(50) NOT NULL PRIMARY KEY,
        [Password] NVARCHAR(50) NOT NULL)
```

/* The Disciplines table has 47 tuples */

```
CREATE TABLE [dbo].[Disciplines]
(
    [Id] INT NOT NULL IDENTITY(1,1) PRIMARY KEY,
    [Name] NVARCHAR(100) NOT NULL
)
```

/* The Locations table has 17 unique Locations. */

```
CREATE TABLE [dbo].[Locations](
    [Id] [int] NOT NULL IDENTITY(1,1),
    [Code] [nvarchar](10) NOT NULL,
    [Name] [nvarchar](100) NOT NULL
 CONSTRAINT [PK_Locations] PRIMARY KEY CLUSTERED ([Id]),
 CONSTRAINT [UK_Locations_Code] UNIQUE ([Code]),
 CONSTRAINT [UK_Locations_Name] UNIQUE ([Name])
)
```

/* The Projects table doesn't have the StartDate, EndDate and Hours keys anymore. Title is now also a Unique Key. There are 100 projects*/

```
CREATE TABLE [dbo].[Projects](
    [Id] [int] NOT NULL IDENTITY(1,1),
    [Number] [nvarchar](50) NOT NULL,
    [Title] [nvarchar](255) NOT NULL,
    [LocationId] [int] NOT NULL,
    [CreatedAt] DATETIME2 NOT NULL DEFAULT SYSUTCDATETIME(),
    [UpdatedAt] DATETIME2 NOT NULL DEFAULT SYSUTCDATETIME(),
    -- [StartDate] DATE NOT NULL DEFAULT CONVERT(date, SYSUTCDATETIME()),
    -- [EndDate] DATE NOT NULL DEFAULT CONVERT(date, SYSUTCDATETIME()),
    -- [Hours] nvarchar(4000) NOT NULL
 CONSTRAINT [PK_Projects] PRIMARY KEY CLUSTERED ([Id]),
```

```
 CONSTRAINT [FK_Projects_Locations] FOREIGN KEY ([LocationId]) REFERENCES [Locations]([Id]),
 CONSTRAINT [UK_Projects_Number] UNIQUE ([Number]),
 CONSTRAINT [UK_Projects_Title] UNIQUE ([Title])
/*
```

- The ProjectStatus table describes the current status of the project.
- A project can have only 1 status per year.
- However, it can go on for many years. Therefore, the corresponding ID of the project and the year are considered as Primary Keys for The Project.
- It can have three different statuses; Active, Inactive and Forecast.
- PM refers to the Project Manager of the Project. Since, Project Manager is a user. Henceforth, the constraint references a User from the User table.
- OrganizationId refers to the Organization that the Project belongs to. Henceforth, it refers to the Organization Table.
- As of right now, there are 200 Project Statuses tuples representing 100 different projects.
- The number under each column represents the

```
*/


CREATE TABLE [dbo].[ProjectStatus](
  [Id] INT NOT NULL,
  [FromDate] DATE NOT NULL DEFAULT CONVERT(date, SYSUTCDATETIME()),
  [ToDate] DATE NOT NULL DEFAULT CONVERT(date, SYSUTCDATETIME()),
  [Status] NVARCHAR(10) CHECK ([Status] IN ('Active', 'Inactive', 'Forecast')),
  [PM] INT NOT NULL,
  [DisciplineId] INT NOT NULL,
  [OrganizationId] INT NOT NULL,
  [Year] [int] NOT NULL,
    [Jan] [int] NOT NULL,
    [Feb] [int] NOT NULL,
    [Mar] [int] NOT NULL,
    [Apr] [int] NOT NULL,
    [May] [int] NOT NULL,
    [Jun] [int] NOT NULL,
    [Jul] [int] NOT NULL,
    [Aug] [int] NOT NULL,
    [Sep] [int] NOT NULL,
    [Oct] [int] NOT NULL,
    [Nov] [int] NOT NULL,
    [Dec] [int] NOT NULL
CONSTRAINT [PK_ProjectsStatus] PRIMARY KEY ([Id], [Year]),
CONSTRAINT [FK_ProjectsStatus_Projects] FOREIGN KEY ([Id]) REFERENCES [Projects]([Id]),
CONSTRAINT [FK_ProjectsStatus_DisciplineId] FOREIGN KEY ([DisciplineId]) REFERENCES [Disciplines]([Id]),
CONSTRAINT [FK_ProjectsStatus_PM] FOREIGN KEY ([PM]) REFERENCES [Users]([Id]),
CONSTRAINT [FK_ProjectsStatus_OrganizationId] FOREIGN KEY ([OrganizationId]) REFERENCES [Organizations]([
Id]) ON DELETE CASCADE
)



/* The Organizations table represent the Organizations to which Project can belong to. As of now, there are 9 unique
```

projects*/

```
) CREATE TABLE [dbo].[Organizations](
    [Id] [int] NOT NULL IDENTITY(1,1),
    [Name] [nvarchar](50) NOT NULL
 CONSTRAINT [PK_Organizations] PRIMARY KEY CLUSTERED ([Id]),
 CONSTRAINT [UK_Organizations_Name] UNIQUE ([Name])
)

/* The Skills table remains the same. It has 1137 tuples */
CREATE TABLE [dbo].[Skills](
    [Id] INT NOT NULL IDENTITY(1,1),
    [DisciplineId] INT NOT NULL,
    [Name] NVARCHAR(100) NOT NULL
CONSTRAINT [FK_Skills_Disciplines] FOREIGN KEY ([DisciplineId]) REFERENCES [Disciplines]([Id]) ON DE
LETE CASCADE,
CONSTRAINT [PK_Skills] PRIMARY KEY ([DisciplineId], [Id])
)


/* The User table now also has a DisciplineID which refers to the Discipline. It has  81 tuples representing; 9 users, 2
disciplines and  10 skills */
CREATE TABLE [dbo].[UserHasSkills](
    [UserId] INT NOT NULL,
    [DisciplineId] INT NOT NULL,
    [SkillId] INT NOT NULL
CONSTRAINT [PK_UserHasSkills] PRIMARY KEY ([UserId], [DisciplineId], [SkillId]),
CONSTRAINT [FK_UserHasSkills_Users] FOREIGN KEY ([UserId]) REFERENCES [Users]([Id]) ON DELETE CASCAD
E,
CONSTRAINT [FK_UserHasSkills_Skills] FOREIGN KEY ([DisciplineId], [SkillId]) REFERENCES [Skills]([Di
sciplineId], [Id]) ON DELETE CASCADE
)


/* The UserHours table represents the Hours Allocated to the user by Project, Month and Year. */
CREATE TABLE [dbo].[UserHours](
    [UserId] INT NOT NULL,
    [ProjectId] INT NOT NULL,
    [Year] INT NOT NULL,
    [Month] INT NOT NULL,
    [Hours] INT NOT NULL
CONSTRAINT [PK_UserHours] PRIMARY KEY ([UserId], [ProjectId], [Year], [Month]),
CONSTRAINT [FK_UserHours_Users] FOREIGN KEY ([UserId]) REFERENCES [Users]([Id]) ON DELETE CASCADE,
CONSTRAINT [FK_UserHours_Projects] FOREIGN KEY ([ProjectId]) REFERENCES [Projects]([Id]) ON DELETE C
ASCADE
)

/* The Users table now has 2 new kays; Type and OrganizationID. OrganizationID refers to the organization to which
```

the user belongs to; it refers to the Organization table. The Type refers to the role of the user; “Individual Contributor”, “Project Manager” and “Resource Manager”. There are 82 tuples. */

```
CREATE TABLE [dbo].[Users](
    [Id] [int] NOT NULL IDENTITY(1,1),
    [FirstName] [nvarchar](50) NOT NULL,
    [LastName] [nvarchar](50) NOT NULL,
    [Username] [nvarchar](50) NOT NULL,
    [LocationId] [int] NOT NULL,
    [Type] [nvarchar](50) NOT NULL,
    [OrganizationId] int NOT NULL
 CONSTRAINT [PK_Users] PRIMARY KEY CLUSTERED ([Id]),
 CONSTRAINT [UK_Users_Username] UNIQUE ([Username]),
 CONSTRAINT [FK_Users_Locations] FOREIGN KEY ([LocationId]) REFERENCES [Locations]([Id]),
 CONSTRAINT [FK_Users_OrganizationId] FOREIGN KEY ([OrganizationId]) REFERENCES [Organizations]([Id]
)
)
```

/* The UserHasSkills table now has 1 new keys; DisciplineID. DisciplineId refers to the; it refers to the Organization table. There are 81 tuples; 9 Users, 2 disciplines, 10 skills*/

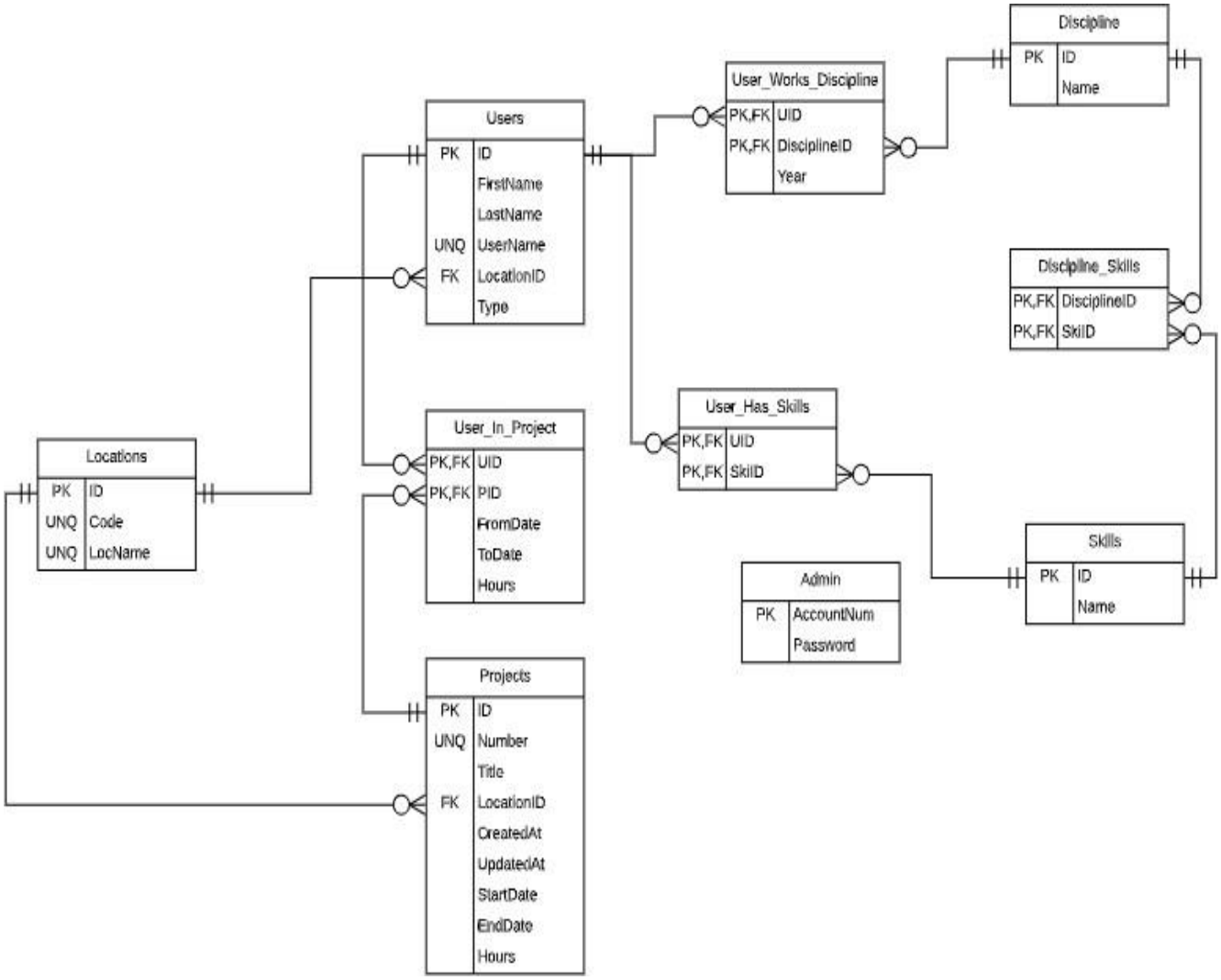
```
CREATE TABLE [dbo].[UserHasSkills](
    [UserId] INT NOT NULL,
    [DisciplineId] INT NOT NULL,
    [SkillId] INT NOT NULL
CONSTRAINT [PK_UserHasSkills] PRIMARY KEY ([UserId], [DisciplineId], [SkillId]),
CONSTRAINT [FK_UserHasSkills_Users] FOREIGN KEY ([UserId]) REFERENCES [Users]([Id]) ON DELETE CASCAD
E,
CONSTRAINT [FK_UserHasSkills_Skills] FOREIGN KEY ([DisciplineId], [SkillId]) REFERENCES [Skills]([Di
sciplineId], [Id]) ON DELETE CASCADE
)
```

/* The UserWorksDisciplines table now has 1 new key; Year. DisciplineId refers to the; it refers to the Organization table. There are 82 tuples; 19 Users, 23 disciplines, 4 Years(1-3 years, 3-5 years, 5-10 years, 10+ years) */

```
CREATE TABLE [dbo].[UserWorksDiscipline](
    [UserId] INT NOT NULL,
    [DisciplineId] INT NOT NULL,
    [Year] [nvarchar](50) NOT NULL
CONSTRAINT [PK_UserWorksDiscipline] PRIMARY KEY ([UserId], [DisciplineId]),
CONSTRAINT [FK_UserWorksDiscipline_Users] FOREIGN KEY ([UserId]) REFERENCES [Users]([Id]) ON DELETE
CASCADE,
CONSTRAINT [FK_UserWorksDiscipline_Discipline] FOREIGN KEY ([DisciplineId]) REFERENCES [Disciplines]
([Id]) ON DELETE CASCADE
)
```

5.2 ER Diagram

This diagram shows the overall database and relationship between entities.



6. Software User Interface Design

6.1 User Interface Description

The system user interface is designed according to several principles.

1. Simplicity: UI is designed to be simple and easy to use.
2. Open to Modifications: UI can be further upgraded and/or modified.
3. Consistency: each main view of the UI is organized in such a way that is related tasks.

6.2 UI Diagram

Planned view of the main User Interface:

Figure 6.1Profile View-Discipline Tab

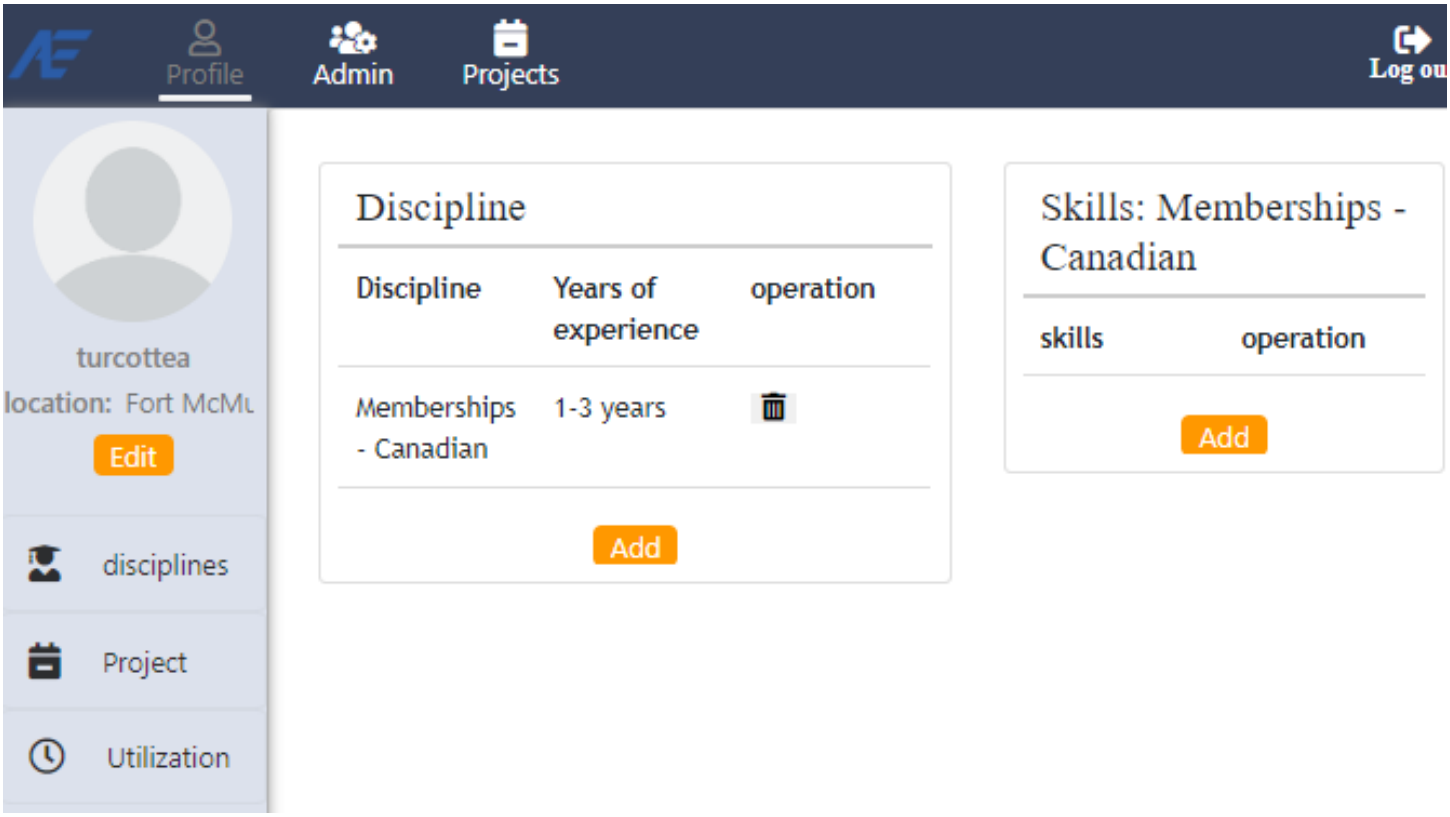


Figure 6.2 Profile View- Project Tab

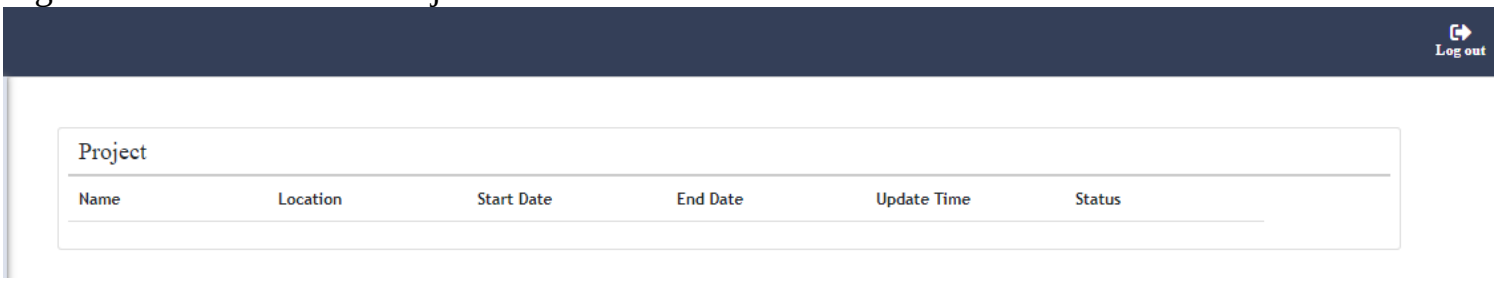


Figure 6.3 Profile View- Utilization Tab

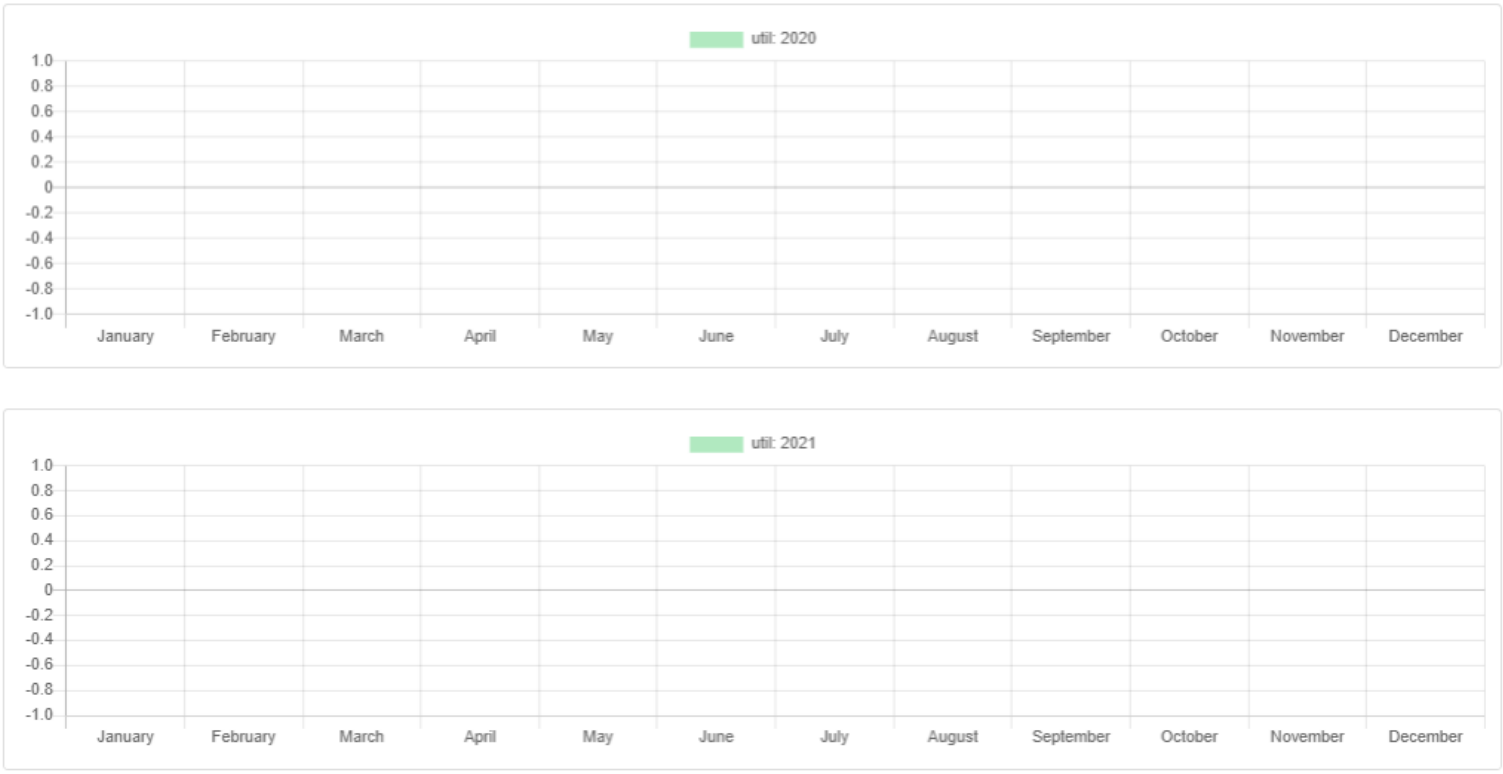


Figure 6.4 Admin View-Login Page

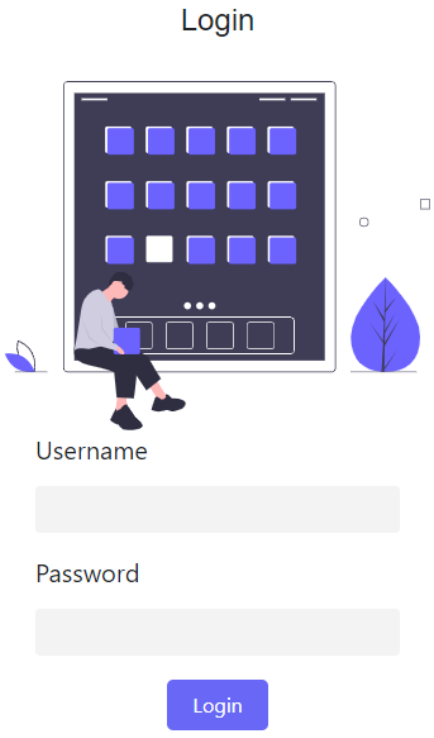


Figure 6.5 Admin View- Default/User Page

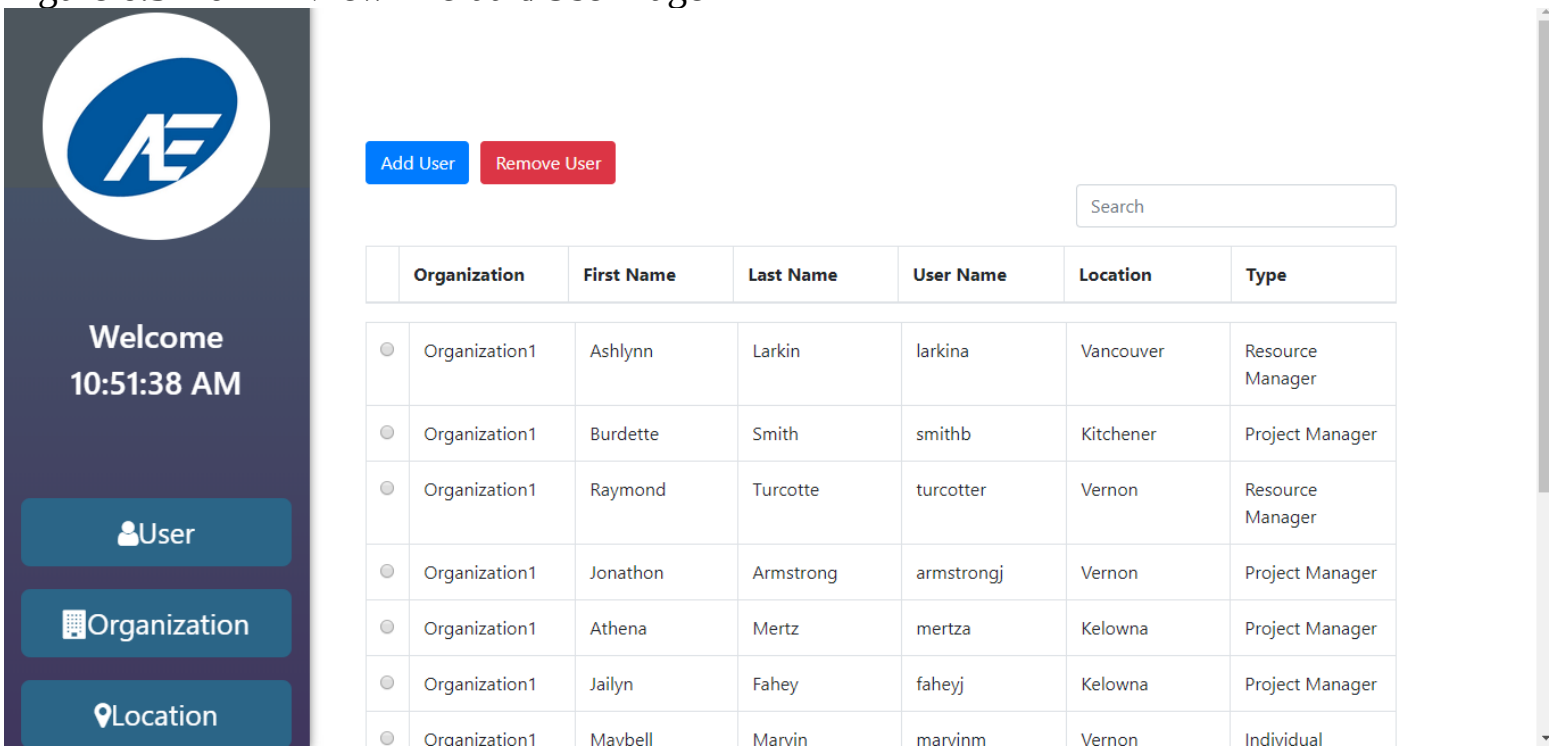


Figure 6.6 Admin View – Organization Page

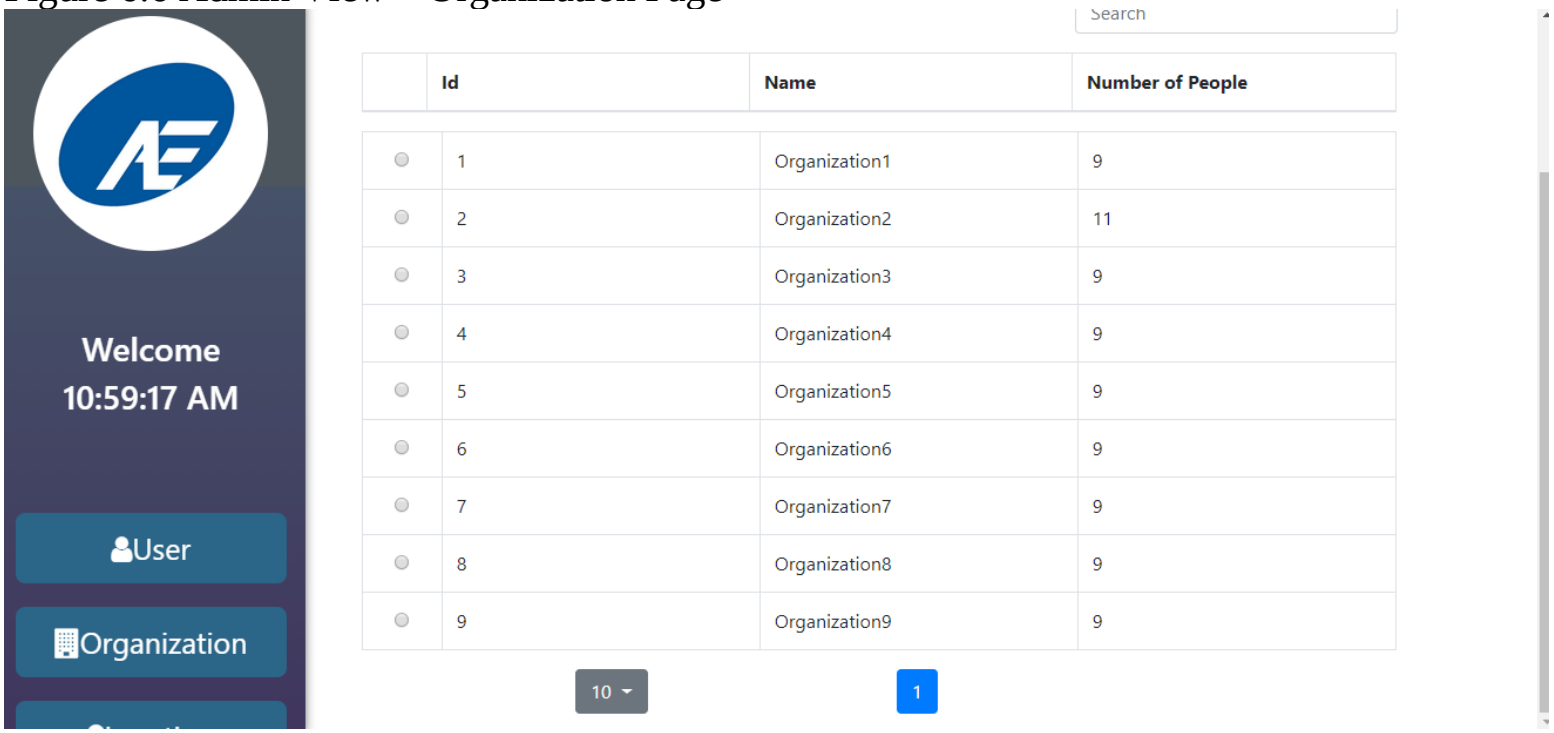


Figure 6.7 Admin View – Location Page

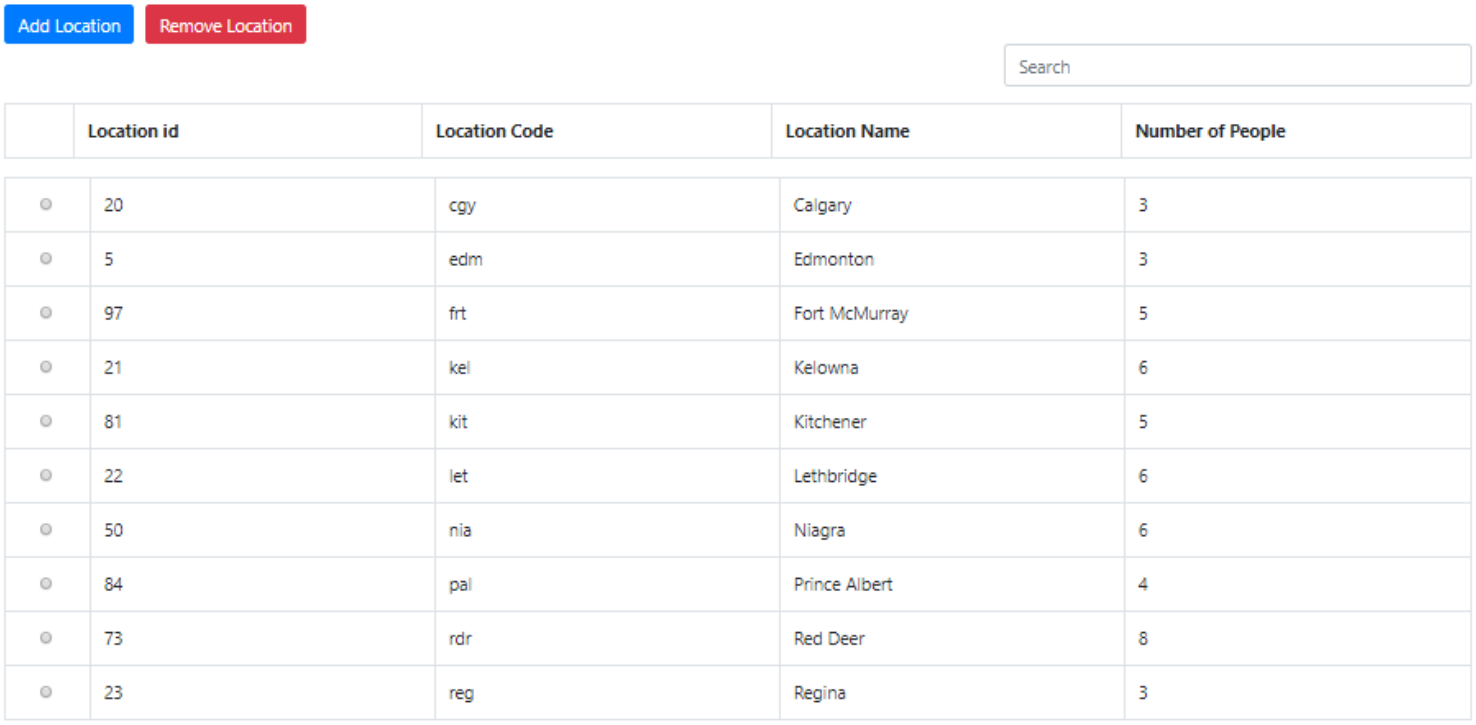


Figure 6.8 Admin View – Skill Page

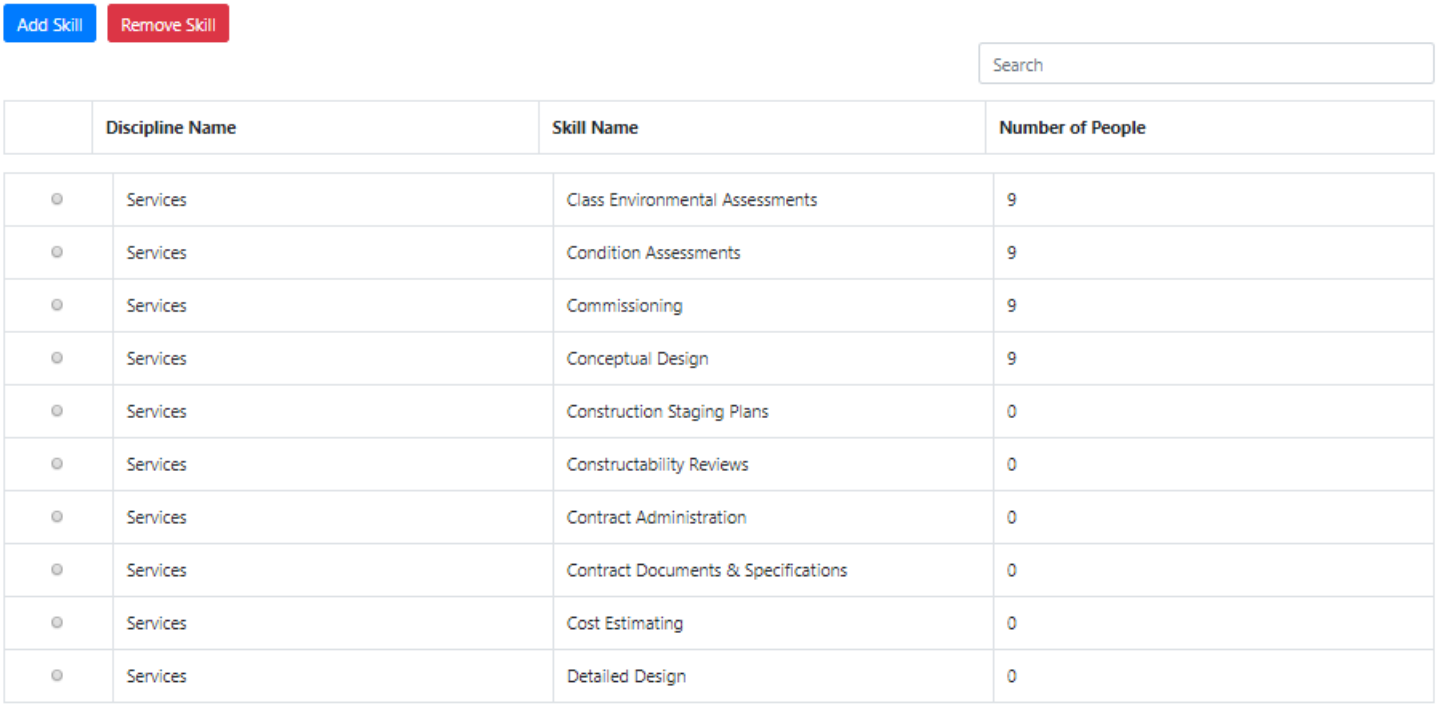


Figure 6.9 Admin View – Discipline Page

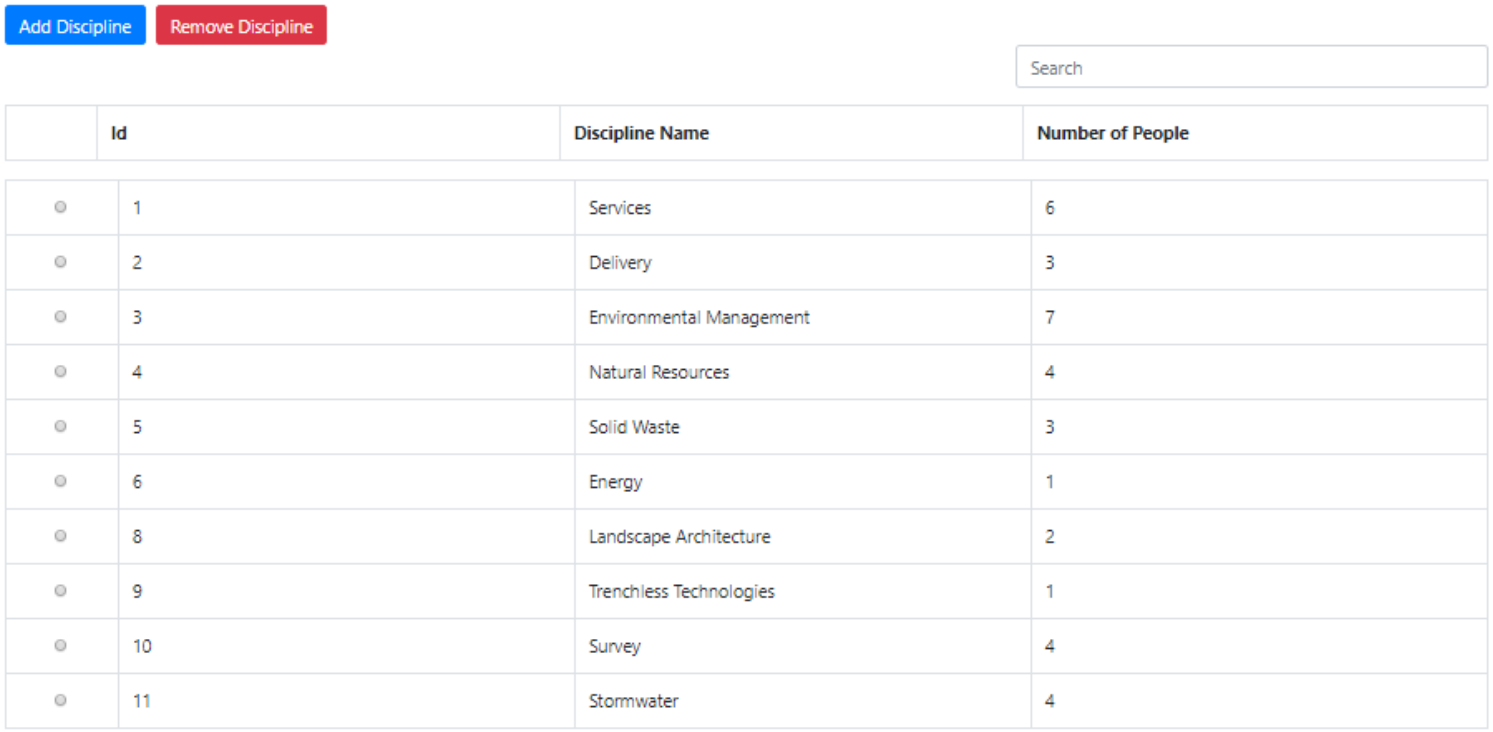


Figure 6.10 Admin View - Create User Page

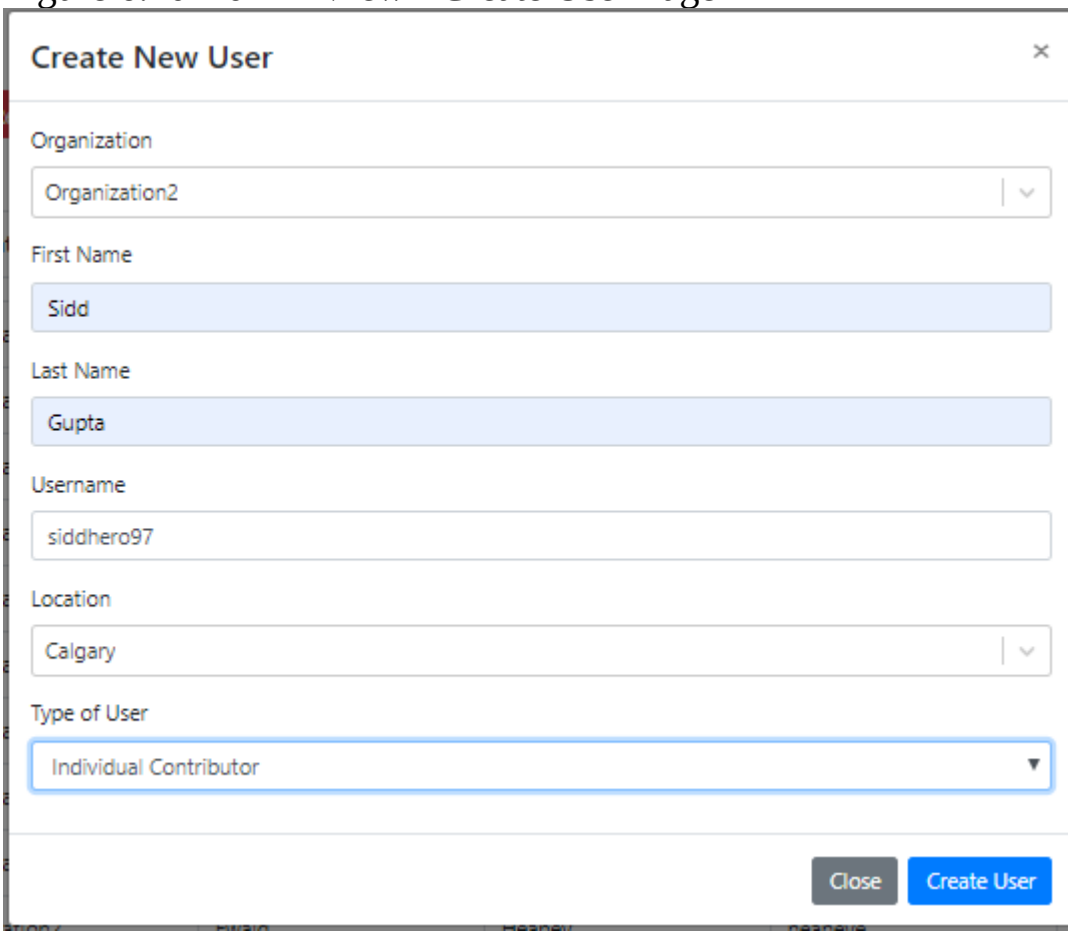


Figure 6.11 Admin View – Create Organization Page

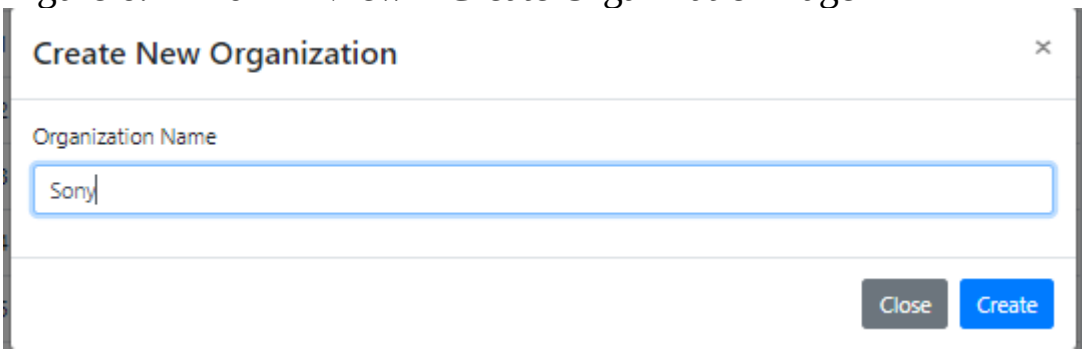


Figure 6.12 Admin View – Create Location Page

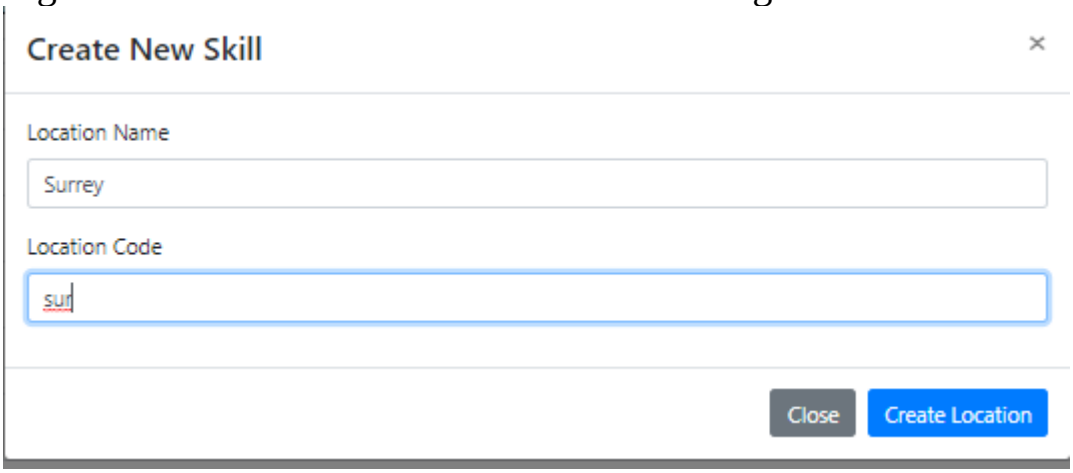


Figure 6.13 Admin View – Create New Skill and Discipline

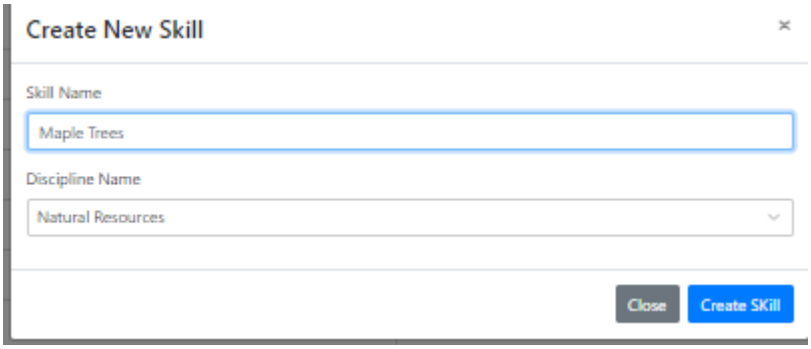


Figure 6.14 Project View-Default Page

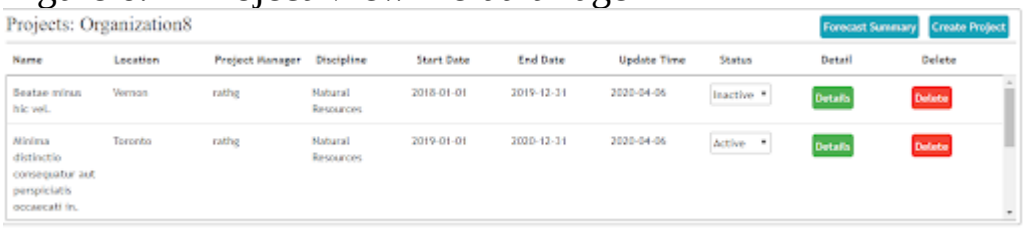


Figure 6.15 – Project View : Forecast Page

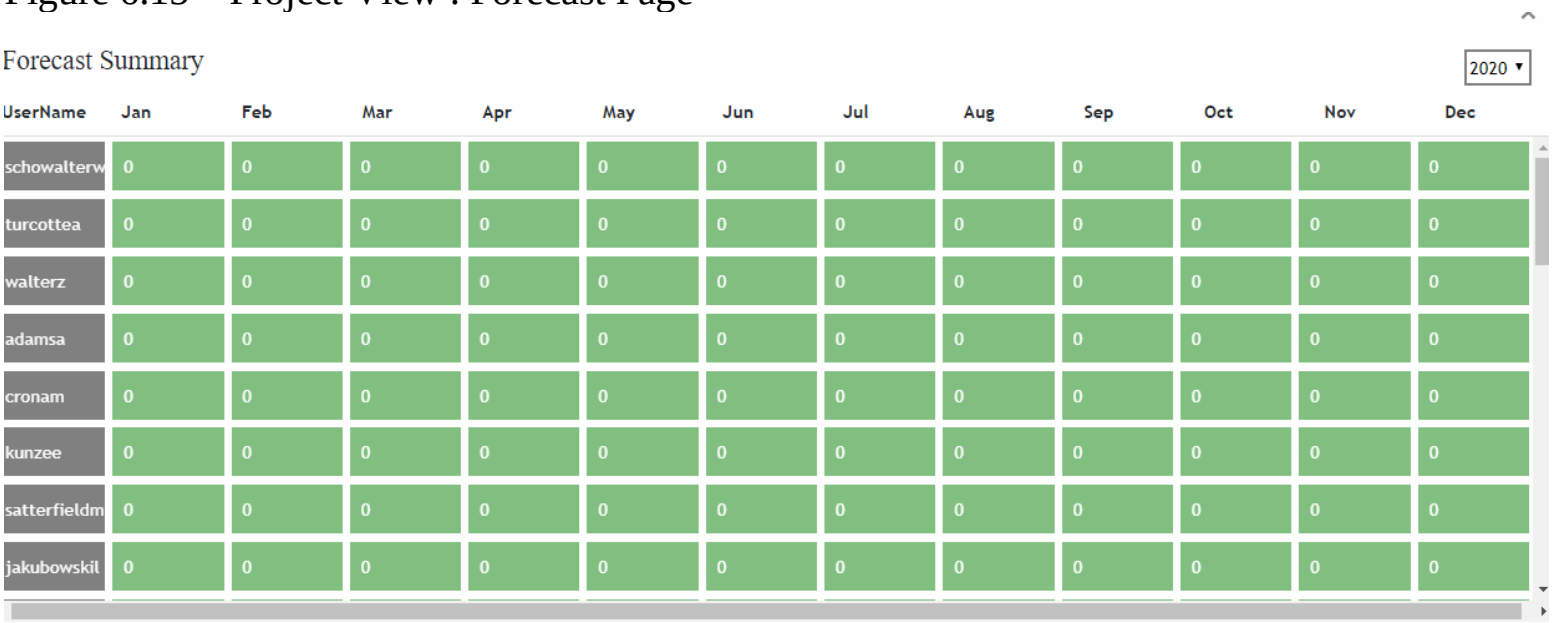


Figure 6.16 – Project View : Create Project Page

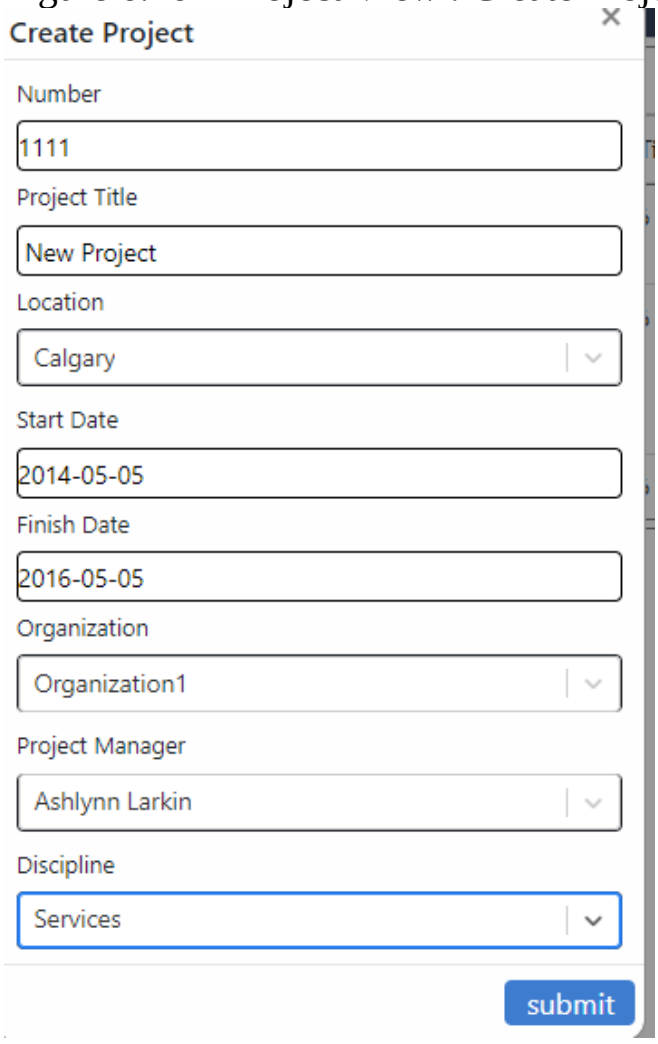
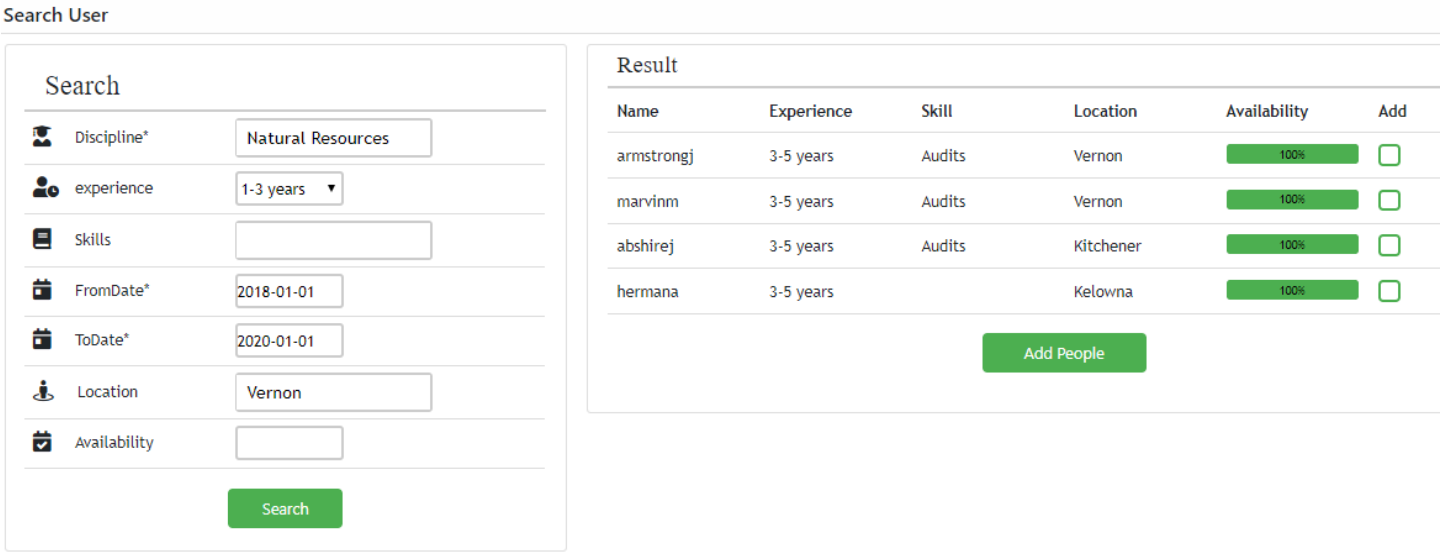


Figure 6.17: Project View – Add User Page



7. API Design

Internal API:

Date	Type	Route	Input	Output

04/02	GET	/skills	N/A	Return all skills
				{
				"id": 2,
				"disciplineId": 1,
				"disciplineName": "Services",
				"name": "Class Environmental Assessments",
				"numberOfPeople": 3
				}

04/02		/skills/{name}		{
				"id": 2,
				"disciplineId": 1,
				"disciplineName": "Services",
				"name": "Class Environmental Assessments",
				"numberOfPeople": 3
				}

04/01		/locations		Return all locations { "id": 5, "code": "edm", "name": "Edmonton", "numberOfPeople": 3
		/locations/{locationCode}		{ "id": 5, "code": "edm", "name": "Edmonton"

				}

04/01		/disciplines		Return all disciplines
				{
				"id": 1,
				"name": "Services",
				"numberOfPeople": 6
				}

		/disciplines/{name}		{
				"id": 1,
				"name": "Services"
				}

04/01		/projects		Return all projects
				{
				"id": 1,
				"number": "2009-VD9D-15",
				"title": "Ut ea magnam qui voluptates enim et voluptas qui.",
				"location": "Toronto",
				"createdAt": "2020-03-27T04:23:18.2376287",
				"updatedAt": "2020-04-01T14:27:02.8041745",
				"numberOfPeople": 2
				}

03/22		/projects/{projectNumber}		{
				"id": 98,
				"number": "2001-0XV2-37",
				"title": "Dolor facilis atque quaerat enim quam optio perspiciatis aliquam.",
				"location": “vancouver”,
				"createdAt": "2020-03-27T04:23:18.5501522",
				"updatedAt": "2020-03-27T20:00:57.4233333"
				}

03/27		/projects/title/{project}		{
				"id": 98,
				"number": "2001-0XV2-37",
				"title": "Dolor facilis atque quaerat enim quam optio perspiciatis aliquam.",
				"location": “vancouver”,
				"createdAt": "2020-03-27T04:23:18.5501522",
				"updatedAt": "2020-03-27T20:00:57.4233333"
				}

03/27		/check/{project}		{
				"project": "Dolor facilis atque quaerat enim quam optio perspiciatis aliquam.",
				“Location”: “vancouver”
				"fromDate": "2020-01-01T00:00:00",
				"toDate": "2021-01-01T00:00:00",
				“updatedAt”: “some time”
				"status": "Active"
				}

04/06		/search/users{organization}
		
		NOTE:
		Only send the required fields.
		
		Organization: name of the organization such as “organization1”
			{
			"discipline": "water treatment",
			"skill": "advanced oxidation",
			"yoe": "3-5 years",
			"fromDate": "2020-05-01",
			"toDate": "2020-06-01",
			"availability": 0
			}
				Return all qualifying users
				
				[
				{
				"id": 1,
				"username": "larkina",
				"location": "Vancouver",
				"type": "Project Manager",
				"discipline": "Water Treatment",
				"yoe": " 3-5 years ",

```
        "skill": "Advanced
Oxidation",
        "organization":
"Organization1",
        "availability": 1
    },
    {
        "id": 3,
        "username":
"turcotter",
        "location": "Vernon",
        "type": "Resource
Manager",
        "discipline": "Water
Treatment",
        "yoe": " 3-5 years ",
        "skill": "Advanced
Oxidation",
        "organization":
"Organization1",
        "availability": 1
    },
    {
        "id": 6,
        "username":
"faheyj",
        "location":
"Kelowna",
        "type": "Project
Manager",
        "discipline": "Water
Treatment",
        "yoe": " 3-5 years ",
        "skill": "Advanced
Oxidation",
        "organization":
"Organization1",
        "availability": 1
    }
]
```

04/05		/search/projects	{
			"projectNumber": "2009-VD9D-15",
			"location": "toronto",
			"projectStatus": "forecast",
			"PMFirstname": "rosemary",
			"PMLastname": "oreilly",
			"discipline": "transit",
			"organization": "organization9"
			}
				Return all qualifying projects
				
				[
				{
				"id": 1,
				"number": "2009-VD9D-15",
				"title": "Ut ea magnam qui voluptates enim et voluptas qui.",
				"location": null,
				"createdAt": "2020-04-05T19:44:15.2335379",
				"updatedAt": "2020-04-05T19:44:15.2335379",
				"numberOfPeople": 0
				}
				]

		/users	N/A	Return all Users

04/02		/users/{username}		{
				"Id": 1,
				"firstName": "Ashlynn",
				"lastName": "Larkin",
				"username": "larkina",
				"location": "Vancouver",
				"type" : "Individual Contributor",
				“organization”: “Organization1”
				}

		/personal/{username}		{username "username": "larkina", "skill": "Class Environmental Assessments", "discipline": "Services", "yoe": “1-3 years” }, { "username": "larkina", "skill": "Condition Assessments", "discipline": "Services", "yoe": “1-3 years” }, { "username": "larkina", "skill": "Commissioning", "discipline": "Services", "yoe": “1-3 years” }, {

				"username": "larkina", "skill": "Conceptual Design", "discipline": "Services", "yoe": “1-3 years” }, ...
		/userprojects/{username}		{ "project": "Nam est et nihil aut nostrum sequi.", "location": "Regina", "fromDate": "2019-01-01T00:00:00", "toDate": "2020-12-31T00:00:00", "updatedAt": "2020-03-27T04:23:18.2532549", "status": "Active" }, { "project": "Nam est et nihil aut nostrum sequi.", "location": "Regina", "fromDate": "2019-01-01T00:00:00", "toDate": "2020-12-31T00:00:00", "updatedAt": "2020-03-27T04:23:18.2532549", "status": "Active" }, { "project": "Nam est et nihil aut nostrum sequi.", "location": "Regina", "fromDate": "2019-01-01T00:00:00", "toDate": "2020-12-31T00:00:00", "updatedAt": "2020-03-27T04:23:18.2532549", "status": "Active" },….

03/27		/userprojects/{username}/{project}		{
				"project": "Nam est et nihil aut nostrum sequi.",
				"location": "Regina",
				"fromDate": "2019-01-01T00:00:00",
				"toDate": "2020-12-31T00:00:00",
				"updatedAt": "2020-03-27T04:23:18.2532549",
				"status": "Active"
				}

03/21		/{username}/disciplines		{ “Discipline”: “DisciplineName”, “yoe”: “1-3 years” }, {

				“Discipline”: “DisciplineName”, “yoe”: “1-3 years” }, { “Discipline”: “DisciplineName”, “yoe”: “1-3 years” }
3/21		/{username}/skills/{discipline}		{ "id": 2, "disciplineId": 1, "name": "Class Environmental Assessments" }, { "id": 2, "disciplineId": 1, "name": "Class Environmental Assessments" }, { "id": 2, "disciplineId": 1, "name": "Class Environmental Assessments" },
3/22		/skills/d/{discipline}		{ "id": 1, "disciplineId": 2, "name": "Design-Build" }, { "id": 2, "disciplineId": 2, "name": "Design-Bid-Build" }, { "id": 3, "disciplineId": 2, "name": "Design-Build-Finance-Operate" }, ...
03/24		/util/user/{username}		[{ "year": 2020, "jan": 0.511363, "feb": 0.511363, "mar": 0.511363, "apr": 0.511363, "may": 0.852272, "jun": 0.852272, "jul": 0.852272, "aug": 1.704545, "sep": 1.704545, "oct": 1.704545,

				"nov": 0.340909,
				"dec": 0.340909
				},
				{
				"year": 2021,
				"jan": 0.511363,
				"feb": 0.511363,
				"mar": 0.511363,
				"apr": 0.511363,
				"may": 0.852272,
				"jun": 0.852272,
				"jul": 0.852272,
				"aug": 1.704545,
				"sep": 1.704545,
				"oct": 1.704545,
				"nov": 0.340909,
				"dec": 0.340909
				}
				]

03/29		/util/{project}		[{ "resource": "Total", "jan": 800, "feb": 300, "mar": 1900, "apr": 1800, "may": 1300, "jun": 500, "jul": 1900, "aug": 1900, "sep": 700, "oct": 400, "nov": 1400, "dec": 300, "jan2": 0, "feb2": 0, "mar2": 0, "apr2": 0, "may2": 0, "jun2": 0, "jul2": 0, "aug2": 0, "sep2": 0, "oct2": 0, "nov2": 0, "dec2": 0 }, { "resource": "armstrongj", "jan": 0, "feb": 41, "mar": 9, "apr": 37, "may": 63, "jun": 28, "jul": 50, "aug": 58, "sep": 34, "oct": 32, "nov": 58, "dec": 55, "jan2": 15, "feb2": 7, "mar2": 25,

```
        "apr2": 26,
        "may2": 19,
        "jun2": 2,
        "jul2": 18,
        "aug2": 18,
        "sep2": 38,
        "oct2": 1,
        "nov2": 6,
        "dec2": 46
    },
    {
        "resource": "turcotter",
        "jan": 0,
        "feb": 0,
        "mar": 0,
        "apr": 0,
        "may": 0,
        "jun": 0,
        "jul": 0,
        "aug": 0,
        "sep": 0,
        "oct": 0,
        "nov": 0,
        "dec": 0,
        "jan2": 0,
        "feb2": 0,
        "mar2": 0,
        "apr2": 0,
        "may2": 0,
        "jun2": 0,
        "jul2": 0,
        "aug2": 0,
        "sep2": 0,
        "oct2": 0,
        "nov2": 0,
        "dec2": 0
    },
    {
        "resource": "Required
Resource",
        "jan": 800,
        "feb": 259,
        "mar": 1891,
        "apr": 1763,
        "may": 1237,
        "jun": 472,
        "jul": 1850,
        "aug": 1842,
        "sep": 666,
        "oct": 368,
        "nov": 1342,
        "dec": 245,
        "jan2": 0,
        "feb2": 0,
        "mar2": 0,
        "apr2": 0,
        "may2": 0,
        "jun2": 0,
        "jul2": 0,
        "aug2": 0,
        "sep2": 0,
        "oct2": 0,
        "nov2": 0,
        "dec2": 0
    }
```

				]
04/05		/util/{organization}/{year}		[{ "username": "heaneye", "jan": 0, "feb": 0, "mar": 0, "apr": 0, "may": 0, "jun": 0, "jul": 0, "aug": 0, "sep": 0, "oct": 0, "nov": 0, "dec": 0 }, { "username": "marquardts", "jan": 0, "feb": 0, "mar": 0, "apr": 0, "may": 0, "jun": 0, "jul": 0, "aug": 0, "sep": 0, "oct": 0, "nov": 0, "dec": 0 }, { "username": "lefflerc", "jan": 0, "feb": 0, "mar": 0, "apr": 0, "may": 0, "jun": 0, "jul": 0, "aug": 0, "sep": 0, "oct": 0, "nov": 0, "dec": 0 },...
04/01		/forecast/project/{project}		[{ "resource": "turcotter", "jan": 0.275, "feb": 0.047272727, "mar": 0.011111111, "apr": 0.033333335, "may": 0.032, "jun": 0.045, "jul": 0.056, "aug": 0.007142857, "sep": 0.04, "oct": 0.01923077, "nov": 0,

				"dec": 0, "jan2": 0, "feb2": 0, "mar2": 0, "apr2": 0, "may2": 0, "jun2": 0, "jul2": 0, "aug2": 0, "sep2": 0, "oct2": 0, "nov2": 0, "dec2": 0 }]

03/25		/project/{project}		[
				{
				"year": 2020,
				"jan": 300,
				"feb": 300,
				"mar": 300,
				"apr": 300,
				"may": 500,
				"jun": 500,
				"jul": 500,
				"aug": 1000,
				"sep": 1000,
				"oct": 1000,
				"nov": 200,
				"dec": 200
				},
				{
				"year": 2021,
				"jan": 300,
				"feb": 300,
				"mar": 300,
				"apr": 300,
				"may": 500,
				"jun": 500,
				"jul": 500,
				"aug": 1000,
				"sep": 1000,
				"oct": 1000,
				"nov": 200,
				"dec": 200
				}
				]

04/04		/activatedlist/org/{organization} **Name of Organization.**		{ "project": "Aliquam qui placeat sed sapiente qui sequi.", "location": "Saskatoon", "fromDate": "2018-01-01T00:00:00", "toDate": "2019-12-31T00:00:00", "updatedAt": "2020-04-04T22:42:25.3214261", "status": "Forecast",

				"projectManager": "armstrongj", "discipline": "Services" }, { "project": "Aliquam ratione quis sed enim et enim rerum.", "location": "Kitchener", "fromDate": "2019-01-01T00:00:00", "toDate": "2020-12-31T00:00:00", "updatedAt": "2020-04-04T22:42:25.3526584", "status": "Forecast", "projectManager": "mertza", "discipline": "Services" }, { "project": "Architecto sint perferendis amet vel quidem distinctio totam dolor soluta.", "location": "Fort McMurray", "fromDate": "2020-01-01T00:00:00", "toDate": "2021-12-31T00:00:00", "updatedAt": "2020-04-04T22:42:25.3370325", "status": "Inactive", "projectManager": "armstrongj", "discipline": "Services" }, ...
03/30		/deactivatedlist		{ "id": 98, "number": "2001-0XV2-37", "title": "Dolor facilis atque quaerat enim quam optio perspiciatis aliquam.", "location": “vancouver”, "createdAt": "2020-03-27T04:23:18.5501522", "updatedAt": "2020-03-27T20:00:57.4233333" }, { "id": 99, "number": "2001-0XV3-47", "title": "Dolor facilis atque quaerat enim quam optio perspiciatis aliquam maliquam.", "location": “vancouver”, "createdAt": "2020-03-27T04:23:18.5501522", "updatedAt": "2020-03-27T20:00:57.4233333" }, ...

03/30		/years/{project}		[
				{
				"year": 2020
				},
				{
				"year": 2021
				}
				]

04/05		/managers/{organization}		[
				{
				"username": "heaneye",
				"type": "Resource Manager"
				},
				{
				"username": "marquardts",
				"type": "Resource Manager"
				},
				{
				"username": "raynorh",
				"type": "Resource Manager"
				},
				{
				"username": "conno",
				"type": "Project Manager"
				},
				{
				"username": "johnstont",
				"type": "Project Manager"
				},
				{
				"username": "lefflerc",
				"type": "Project Manager"
				}
				]

	PUT	/skills	{
			"id": 2,
			"disciplineId": 1,
			"name": "Class Environmental Assessments"
			}
				{
				"id": 2,
				"disciplineId": 1,
				"name": "Class Environmental Assessments"
				}
				{
				"id": 5,
				"code": "edm",
				"name": "Edmonton"
				}
				{
				"id": 1,
				"name": "Services"
				}

		/locations	{
			"id": 5,
			"code": "edm",
			"name": "Edmonton"
			}	

		/disciplines	{
			"id": 1,
			"name": "Services"
			}	

		/projects	{
			"id": 98,
			"number": "2001-0XV2-37",
			"title": "Dolor facilis atque quaerat enim quam optio perspiciatis aliquam.",
			"location": “vancouver”,
			"createdAt": "2020-03-27T04:23:18.5501522",
			"updatedAt": "2020-03-27T20:00:57.4233333"
			}
				{
				"id": 98,
				"number": "2001-0XV2-37",
				"title": "Dolor facilis atque quaerat enim quam optio perspiciatis aliquam.",
				"location": “vancouver”,
				"createdAt": "2020-03-27T04:23:18.5501522",
				"updatedAt": "2020-03-27T20:00:57.4233333"
				}

		/users	{
			"id": 1,
			"firstName": "Ashlynn",
			"lastName": "Larkin",
			"username": "larkina",
			"location": "Vancouver",
			"type": "Individual Contributor"
			}
				{
				"id": 1,
				"firstName": "Ashlynn",
				"lastName": "Larkin",
				"username": "larkina",
				"location": "Vancouver",
				"type": "Individual Contributor"
				}

03/31		/projectstatus/{project}	{
			"year": 2020,
			"jan": 300,
			"feb": 300,
			"mar": 300
			}
				{
				"project": "Nam est et nihil aut nostrum sequi.",
				"location": "Regina",
				"fromDate": "2019-01-01T00:00:00",
				"toDate": "2020-12-31T00:00:00",
				"updatedAt": "2020-03-27T04:23:18.2532549",
				"status": "Active"
				}

04/01		/userprojects/{username}/{project}	{
			"year": 2020,
			"jan": 300,
			"feb": 300,
			"mar": 300
			}
				{
				"project": "Nam est et nihil aut nostrum sequi.",
				"location": "Regina",
				"fromDate": "2019-01-01T00:00:00",
				"toDate": "2020-12-31T00:00:00",
				"updatedAt": "2020-03-27T04:23:18.2532549",
				"status": "Active"
				}

04/03	POST	/skills	{ "name": "Toooo", "disciplineName": "Services"	{

			}	"id": 343, "disciplineId": 0, "disciplineName": "Services", "name": "Toooo", "numberOfPeople": 0 }

		/locations	{
			"code": "edm",
			"name": "Edmonton"
			}
				{
				"id": 5,
				"code": "edm",
				"name": "Edmonton"
				}

		/disciplines	{
			"name": "Services"
			}
				{
				"id": 1,
				"name": "Services"
				}

04/04		/projects
		
		NOTE:
		Number is a string with Year-Number-Number
			{
			"Number": "2020-VA3D-03",
			"Title": "AD Azure Connect Project.",
			"Location": "Kelowna",
			"FromDate": "2020-03-30",
			"ToDate": "2020-06-13",
			“ProjectManager”: “armstrongj”
			“Discipline”: “Services”,
			“Organization”: “Organization1”}
				{
				"project": "AD Azure Connect Project",
				"location": "Kelowna",
				"fromDate": "2020-03-30T00:00:00",
				"toDate": "2020-06-13T00:00:00",
				"updatedAt": "2020-04-04T22:42:25.3214261",
				"status": "Active",
				"projectManager": "armstrongj",
				"discipline": "Services"
				}

03/30		/activate/{project}		{
				"project": "Dolor facilis atque quaerat enim quam optio perspiciatis aliquam.",
				“Location”: “Kitchener”,
				"fromDate": "2020-01-01T00:00:00",
				"toDate": "2021-01-01T00:00:00",
				“updatedAt”: “some time”
				"status": "Active",
				}

		/personal	{
			"username": "larkina",
			"skill": "Coal",
			"discipline": "Energy",
			"yoe": “1-3 years”
			}
				{
				"username": "larkina",
				"skill": "Coal",
				"discipline": "Energy",
				"yoe": “1-3 years”
				}

03/21		/{username}/disciplines	{ “discipline”:	{ “discipline”:

			“DisciplineName”, “yoe”: “1-3 years” }	“DisciplineName”, “yoe”: “1-3 years” }

03/30		/userprojects/{username}/{project}		{
				"project": "Ut ea magnam qui voluptates enim et voluptas qui.",
				"location": "Toronto",
				"fromDate": "2019-01-01T00:00:00",
				"toDate": "2020-12-31T00:00:00",
				"updatedAt": "2020-03-27T04:23:18.2376287",
				"status": "Active"
				}

04/01		/userprojects/multi/{project}	[
			{
			"Username": "kunzee"
			},
			{
			"Username": "armstrongj"
			}
			]
				[
				{
				"Username": "kunzee"
				},
				{
				"Username": "armstrongj"
				}
				]

	DELETE	/skills/{name}	NONE	{
				"id": 343,
				"disciplineId": 1,
				"name": "WOWOWO"
				}

		/locations/{locationCode}		{
				"id": 5,
				"code": "edm",
				"name": "Edmonton"
				}

		/disciplines/{name}		{
				"id": 1,
				"name": "Services"
				}

		/projects/{projectNumber}		{ "id": 108, "number": "2014-32-213", "title": "BLABLA", "locationId": 51, "createdAt": "0001-01-01T00:00:00", "updatedAt": "0001-01-01T00:00:00", "startDate": "2020-02-02T00:00:00", "endDate": "2020-10-10T00:00:00", "hours": 1500, “Status”: “Active”

				}

03/27		/deactivate/{project}		{
				"project": "Ut ea magnam qui voluptates enim et voluptas qui.",
				"location": "Toronto",
				"fromDate": "2019-01-01T00:00:00",
				"toDate": "2020-12-31T00:00:00",
				"updatedAt": "2020-03-27T04:23:18.2376287",
				"status": "Active"
				}

03/22		/{username}/{discipline}/{skill}		{
				"username": "larkina",
				"skill": "Class Environmental Assessments",
				"discipline": "Services",
				"yoe": “1-3 years”
				}

03/21		/{username}/disciplines/{discipline}		{ "username": "larkina", "skill": "Class Environmental Assessments", "discipline": "Services", "yoe": “1-3 years” }, { "username": "larkina", "skill": "Condition Assessments", "discipline": "Services", "yoe": “1-3 years” }, { "username": "larkina", "skill": "Commissioning", "discipline": "Services", "yoe": “1-3 years” },...

03/27		/userprojects/{username}/{project}		{
				"project": "Ut ea magnam qui voluptates enim et voluptas qui.",
				"location": "Toronto",
				"fromDate": "2019-01-01T00:00:00",
				"toDate": "2020-12-31T00:00:00",
				"updatedAt": "2020-03-27T04:23:18.2376287",
				"status": "Active"
				}

03/21	PATCH	/personal/{username}/{discipline}/{yoe}		{ "username": "turcotter",

				"skill": "Class Environmental Assessments",
				"discipline": "Services",
				"yoe": “1-3 years”
				},
				{
				"username": "turcotter",
				"skill": "Condition Assessments",
				"discipline": "Services",
				"yoe": “1-3 years”
				},
				{
				"username": "turcotter",
				"skill": "Commissioning",
				"discipline": "Services",
				"yoe": “1-3 years”
				},
				{
				"username": "turcotter",
				"skill": "Conceptual Design",
				"discipline": "Services",
				"yoe": “1-3 years”
				
				}

03/27		/projectstatus/{project}/{year}	{
			“Month”: “may”,
			“Hours”: 20
			}
				{
				"project": "Ut ea magnam qui voluptates enim et voluptas qui.",
				"location": "Toronto",
				"fromDate": "2019-01-01T00:00:00",
				"toDate": "2020-12-31T00:00:00",
				"updatedAt": "2020-03-27T04:23:18.2376287",
				"status": "Active"
				}

03/27		/userprojects/{username}/{project}/{year}	{
			"Month": "jun",
			"Hours": 176
			}
				{
				"project": "Nam est et nihil aut nostrum sequi.",
				"location": "Regina",
				"fromDate": "2019-01-01T00:00:00",
				"toDate": "2020-12-31T00:00:00",
				"updatedAt": "2020-03-27T04:23:18.2532549",
				"status": "Active"
				}

04/01		/projectstatus/status/{project}/{status} **NOTE:** Status is one of: “Active”, “Inactive” “Forecast”		{ "project": "Consectetur architecto repudiandae deserunt eligendi et.", "location": "Fort McMurray", "fromDate": "2020-01-01T00:00:00",

				"toDate": "2021-12-31T00:00:00", "updatedAt": "2020-04-02T01:10:56.1346512", "status": "Active" }

External Open Source API maybe added to the list if it is deemed necessary in the future.

API	Version	Usage
AzureAD	Latest version	For authentication
React	V16.12.0	For the front-end development
Bootstrap	V4.4.1	For the front-end development
Google developer	Latest version	For the front-end testing

8. Environment

Most developers in our group use a Mac. However, the application should be able to work on a Windows 10. We should ensure that we test the application in at least 1 windows machine. We are going to use Babel to transpile our JS code.

9. Algorithm and Data Structure

We need to compute Utilization for 3 different resource; Organization. User and Project. All utilizations are represented by a ratios. The "Average Working Time" in most organizations is 8 hours. Henceforth , the " Cumulative Average Working Time", across 8 days is 176 hours.

- Utilization of an organization is calculated through the following process. Firstly, we sum up of all the hours for all the users of that particular organization. We subtract this amount from the "Cummulative Average Working Time" .
- User Utilization is the calculated through the following process. Firstly, we sum of all hours across all projects and organizations. We subtract this amount from the "Cummulative Average Working Time" . We then divide this result by the "Cummulative Average Working Time".
- Project Utilization is a ratio between the sum of hours assigned to Users of the project and the hours expected to

complete the project.

In all of the above cases, if the ratio is greater than 1 we can claim that the resource is “Over Utilized”. Likewise, if its under 1 we can claim that the resource is “Under-Utilized”.

10. Analysis of Trade-Offs and Risks of the Project

10.1 Back-End Development

Since we have decided using all proposed technology from AE, there are not many notable trade-offs pertaining to the back-end development. However, for data structure to represent the data, we decided to use a very simple architecture. We may improve upon the data structure in this project, however, as the system does not require knotty operations, using efficient data structure may not improve efficiency significantly.

10.2 Testing

For full system tests, we would need to use a setup which runs IE 11 natively. That is to say we would need to run Windows 8 or newer in our development systems. For this, we could run Windows on an Open-Source or free VM (for example, Oracle's VirtualBox), run natively on a PC-system, or we can Dockerize the application. Dockerization is our stretch goal and would require extra time and resources, which we might not be able to achieve. Most of the development would take place in a macOS environment, as majority of our team members have Mac as their development environment: this could result in some unexpected behaviors which we could have neglected or not have encountered during our rigorous testing.

10.3 Front-End Development

As said above, most of our team members would be using macOS as their development environment, so this could result in some unexpected behaviors which we could have neglected or not have encountered during testing or development.