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# **Corporate Information Model Catalog for Self Service Using (Online Analytical Processing) OLAP Methodology**

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## **Abstract**

Corporate Information Models(CIM) are Online Analytical Processing (OLAP) Cubes is a data structure that enables simple and rapid analysis of data by the multiple dimensions that define a business challenge. A multidimensional cube for reporting composed of multiple Dimension e.g. Customers, Product Lines and business units. By storing data using OLAP cubes, data is pre-calculated and ready-to-use in the form of pre-defined analytic reports, eliminating long-running data queries and enabling self-service for business intelligence users.

**Keywords:** Application packages; Design Concept; Turnkey Solution; Intranet Portal.

## **1. Introduction**

Online Analytical Processing (OLAP) allows users to analyze database information from multiple database systems at one time. “The multidimensionality occurs in the online analytical processing (OLAP) engines” [1]. An OLAP Cube is a data structure that allows fast analysis of data according to the multiple Dimensions that define a business problem. OLAP in a data warehouse enables companies to organize information in multiple dimensions, which makes it easy for businesses to understand and use data. Since OLAP contains multidimensional data usually obtained from different and unrelated sources, it requires a special method of storing that data.

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OLAP tools enable users to analyze different dimensions of multidimensional data using self-service. In our research and implementation scope, we have used OLAP method to provide corporate level multidimensional data to the business users. Corporate Information Models (CIMs) provide trusted and qualified data from multiple sources for everyone to build their own business intelligence reports and dashboards. Corporate Information Models are Online Analytical Processing (OLAP) Cubes – a data structure that enables simple and rapid analysis of data by the multiple dimensions that define a business problem. A multidimensional cube for reporting composed of multiple Dimension e.g. Customers, Product Lines, business units and Date. By storing data using OLAP cubes, data is pre-calculated and ready-to-use, eliminating long-running data queries and enabling self-service business intelligence. A portal has been developed to provide and display the CIM detail. The CIM catalog links to over 60 CIMs categorized by the seven main categories called Value streams.

## **2. Background and concept**

Self-Service Analytics is a form of business intelligence (BI) in which line-of-business professionals are enabled and encouraged to perform queries and generate reports on their own, with nominal IT support. Self-Service Analytics gives users the ability to develop rapid reports, empowering users to analyze their data. End users can analyze their data by dynamically modifying, drilling through, or adding calculation functions to a report. This flexibility decreases IT resource drain freeing up valuable development resources. Self-Service Analytics gives users the ability to easily build reports with the exact information that users need without tying up developer resources. This gives business users the ability to take control of their own analytics needs and helps them to extract maximum value from both their data and their application while simultaneously extending the overall agility of their organizational BI. Data is the Core of Self-Service Analytics. Without reliable and robust data any fine-looking report is misleading and eventually unserviceable to the business. With the current rise of big data “Organizations are recognizing the value of data as a critical business asset to identify trends, patterns and preferences to drive improved customer experiences and competitive advantage. The problem is, users too often can’t find the data they need to perform desired analytics. Data tends to be buried in different systems or siloed in departments across the organization” [2] . “The need service data analytics is inevitable-Self as it supports the business in making the right decisions” [3].

### **2.1. Related work**

Many research have focused on finding the requirement and the appropriate solution for self-service Business Intelligence (SSBI). “Based on data from a literature review, ten challenges divided into two main categories have been identified. In the coding analysis process, two main categories were identified: “Access and use of data” and “Self-reliant users”. Challenges that are caused by issues related to data access and usage were grouped into six sub-categories, while challenges related to users becoming more self-reliant formed four sub-categories” [4]. One of the key component of this research is to provide a BI tools which is easy to use, Control of data integrity, security and distribution, Prepare data for visual analytics, Give the right tools to the right user and educate users on how to select, interpret and analyze data to make decisions. “One common mistake most organizations make is purchasing a single self-service Business Intelligence (SSBI) tool and allowing everyone access to it “[5]. When accessing the data used for advanced analytics and decision-making. Traditional BI is

not a single software or technology that can solve all problems easily. Instead, according to the definition in [6, page 2]: “BI combines products, technology, and methods to organize key information that management needs to improve profit and performance. More broadly, we think of BI as business information and business analyses within the context of key business processes that lead to decisions and actions and that result in improved business performance.”[6]

### **3. Application Overview**

The objective of the offered application is to enable business users to overcome the challenges of the traditional BI software by reacting to the new analytics requirements of the business quickly and effectively. There are some key features for the application that make it unique and useful, as mentioned below.

- **CIM Catalog**

CIM Catalog is a central repository for all the self-service OLAP models in the organization. It contained over 60 models with their description, facts and dimension detail. OLAP models detail synchronize with Azure Analytics Services using Azure Pipelines with daily refresh schedule. Catalog provides insight about every column definition approved by Data Owners, source system detail, connection and access related information. Every model has a hierarchy and map with main category called value Streams.

- **Social**

Business users and analytics team members can easily communicate issues or feedback using focused discussions per analytics on CIM catalog such as Feedback, Reviews, and Support and feature requests.

- **Integrated with the ecosystem**

CIM portal set up as Single-Sign-On with viewer integration. It uses Domain Name System (DNS) and CNAME (Canonical Name record) that is easy to remember and searchable from central internal hub. It also provides authentication on the mobile integrated with Microsoft Intune which is a cloud-based service that focuses on mobile device management (MDM) for the organization.

- **Structure the Catalog using Tags**

To make all analytics on CIM catalog discoverable, it provides a taxonomy to the catalogs using tags. This allows business users to explore what is available in the organization.

Drill down to any combination

Users can easily drill down to the exact combination of what they want to explore. They can also mix and match with other filters that are available, such as a filter to only select a particular data source.

- **Supporting Content**

Add supporting content to each CIM model, like: source data, a user guide, utilization metrics or a video walkthrough. This makes it substantially easier for new users to know their way around the CIM model, especially if it requires more context to understand the analytic assets.

- **Mobile View**

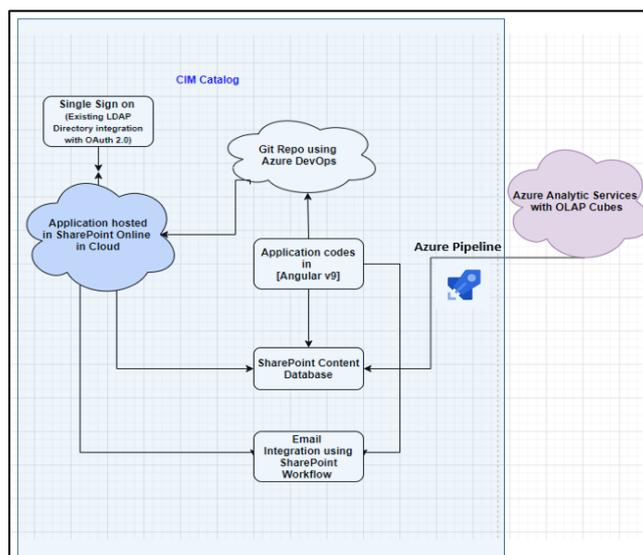
Application supports mobile view using RWD. Responsive web design (RWD) is a web development approach that creates dynamic changes to the appearance of a website, depending on the screen size and orientation of the device being used to view it.

- **Integrated Viewer**

It provides a view of all CIM model right from within Central Catalog. With central catalog users can request for access on the OLAP models, read the columns definitions, find the data owners and download pre-built Power BI report to explore and customize their own analytics.

### 3.1. Application Architecture

CIM Catalog has been designed and developed in the Microsoft Azure Cloud using SharePoint Online as described in high level architecture diagram Figure 1. Microsoft Azure is a cloud computing service created by Microsoft that can be used for deploying and managing applications as well as services through a global network of Microsoft-managed data centers. In our research, corporate data source modeling being developed using Microsoft Azure Analysis Services which is linked with CIM catalog using Microsoft Azure Pipeline. **Azure Analysis Services** is a fully managed platform as a service (PaaS) that provides enterprise-grade data models in the Microsoft Azure cloud. **Azure Data Factory** is Azure's cloud ETL (Extract, Transform, Load) service for scale-out server-less data integration and data transformation.



**Figure 1:** High-level Architecture diagram – CIM Catalog

### 3.2. Key technology and components

Key technology and components of Digital store are as follows:

- **Web Framework**

In our research we have considered and compare Angular, Angular JS and React for the selection of web framework to develop the application. There are several other web framework available such as Vue, Ember, Meteor, Polymer, Backbone, Aurelia and Mithril. In our research, we have not included the comparison of all other frameworks. Angular is a web framework and a platform for building mobile and desktop web applications using HTML and Typescript. Angular is written in Typescript (Typescript is an open-source programming language developed and maintained by Microsoft). Angular is used in many public-facing application like Google and YouTube. It is a completely free framework helps to use HTML as a template language, creates RICH Internet Application and offers its developers a client-side application. We have used Version 9 in our application development, Angular 9 was released on February 6, 2020. This latest version moves all applications to use the Ivy compiler and runtime by default. Ivy is the code name for Angular’s next-generation compilation and rendering pipeline. Also it has been updated to work with Typescript 3.6 and 3.7.

- **Angular VS. Angular JS**

If we compare the performance on Angular with AngularJS then we have better reasons to use Angular. Angular is at least five times faster than AngularJS due to a much better algorithm for data binding and a component-based architecture. The components of an Angular application are quite independent and self-sufficient, which makes them reusable and test friendly. Angular used Typescript and Angular JS uses JavaScript. The main advantage of Typescript over JavaScript is that Typescript is a superset of JavaScript. So Typescript designed for the development of a large program that Trans compile to JavaScript. But Typescript may be used to develop a JavaScript application for both client-side and server-side.

- **Angular VS. React**

There is a detail comparison which has been done between Angular and React as described in Table 1.

**Table1:** Comparison between Angular and React Framework

Features	Angular	React
<b>Brief Overview</b>	Full-fledged open-sourced JS Framework managed by Google and the Angular developer community Launched in Sep 2016	JS Library for UI development Managed By Facebook and open-source community of developers Launched in May 2013

<b>Universality</b>	<p>Both Web and Mobile</p> <p>For mobile development, it needs to be incorporated with Cordova. Moreover, for mobile development, there is an additional framework – React Native. Single and multiple-page apps</p>	<p>Both Web and Mobile</p> <p>In mobile development, however, a great share of work is done by Ionic. Furthermore, similarly to React, Angular has an additional mobile development framework. The counterpart of React Native is Native Script. Single and multiple-page apps</p>
<b>Self-Sufficiency</b>	<p>Angular is a full-fledged framework for software development. Hence no additional libraries needed</p>	<p>React is a framework for UI development</p> <p>Extra libraries needed</p>
<b>Learning Curve</b>	<p>Angular itself is a huge library. Angular is more complex to understand, there is a lot of unnecessary syntax, and component management is intricate. Some complicated features are embedded into the framework core, which means that the developer cannot avoid learning and using them.</p> <p>Long and difficult</p>	<p>React is minimalistic. However, it takes quite some time to learn how to set up a project because there is no predefined project structure. You also need to learn the Redux library, which is used in more than half of React applications for state management.</p> <p>Fast and Simple with JS technical background</p>
<b>Community</b>	<p>Large</p> <p>Google provides the long-term support of the framework and constantly improves it. However, the updates are so fast that the documentation often falls behind.</p>	<p>Large</p> <p>React framework is one of the most popular JS frameworks worldwide, and the community supporting and developing it is huge.</p>

	Angular is used by such companies as McDonald's, AT&T, HBO, Apple, Forbes, Adobe, Nike, and Microsoft as well.	
<b>Performance</b>	Competitive  Optimized with change detection	Competitive Optimized with Virtual DOM (Document Object Model )
<b>Language</b>	JS, TypeScript	JS ES6+, JSX script
<b>App Structure</b>	Fixed and Complex Component-based Model, Controller, and view	Flexible component-based view only
<b>UI Components</b>	Built-in Material Design toolset	External Material-UI library and Dependencies
<b>Directives</b>	The greatest advantage of Angular rests in the fact that, unlike React, it supports dependency injection. Therefore, Angular allows having different lifecycles for different stores. Incomprehensible without knowledge of Angular	React does not fully support dependency injection as it does not fully comply with the idea of functional programming and data immutability. Instead, it has a global state for all components. Easily understood with knowledge of JavaScript
<b>Dependency Injection</b>	Supported	Not Supported
<b>State Management</b>	Effective improved with NgRx or RxJS	Effective Improved with Redux or MobX
<b>Data Binding</b>	Bidirectional Data is mutable	Unidirectional Data is immutable
<b>Change Rendering</b>	Real DOM, Change detection	Virtual DOM
<b>Tools</b>	Aptana, Sublime Text, Visual studio, Angular CLI, Angular Universal, Jasmine, protector, Karma	Sublime Text, Visual Studio, Atom, Create React App(CLI), Next.js framework, Enzyme, Jest, React-unit

To conclude our comparison, Angular is a full-fledged mobile and web development framework. React is a framework only for UI development, which can be turned into a full-fledged solution with the help of additional libraries. In the end, React vs Angular is all a matter of personal preference, a matter of skills and habits. We have

used Angular v9 for the application development.

- **Microsoft SharePoint online**

SharePoint is a cloud-based service offered from Microsoft that helps organizations share and manage content, knowledge, and applications to empower teamwork, quickly find information and seamlessly collaborate across the organization. In our research and deployment we have privileged enterprise infrastructure setup of SharePoint online in cloud to host the application that provides single sign on authentication using O365 with directory services, out of the box workflow development for email send and receive and host the database using SharePoint online Document library and SharePoint lists.

- **Modern Authentication**

Modern Authentication is the term Microsoft uses to refer to their implementation of the OAuth 2.0 authorization framework for client/server authentication. By default, modern authentication is enabled for SharePoint online.

- **SharePoint content database**

A content database is a database file that stores content for one or more site collections for SharePoint web application. The content can be pages, files, documents, images and much more. In our case, we have used SharePoint document library, lists and images to save the Catalog information.

- **SharePoint Online Workflow**

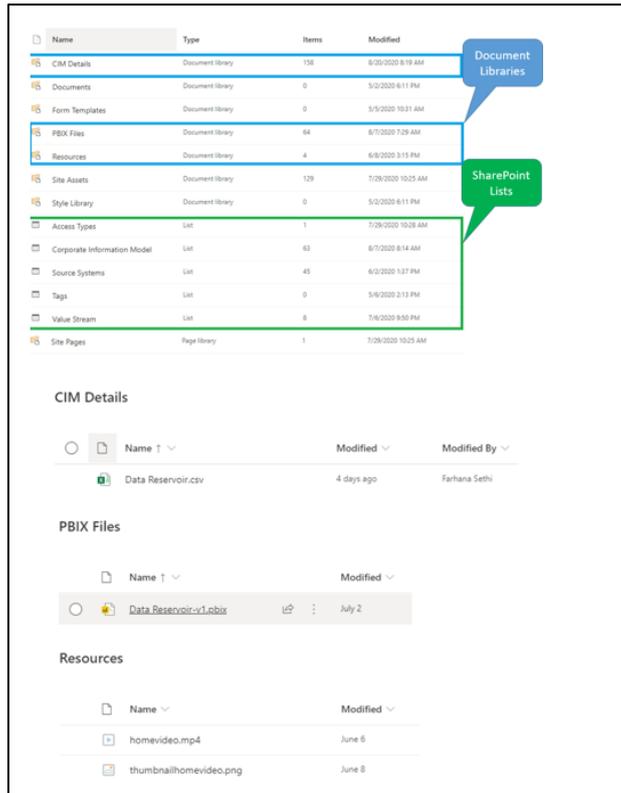
Workflows help people to collaborate on documents and to manage project tasks by implementing business processes on documents and items in a SharePoint site. There are five commonly used Workflows that can be set up within SharePoint: 1) Approval Workflows, 2) Status Workflows, 3) Notification Workflows, 4) Automation Workflows, and 5) Custom Workflows. In our research and deployment we have set up custom workflow to send emails for Feedback and support form.

- **Visual studio Code**

We have used Visual studio Code for code development. Visual Studio Code is a lightweight but powerful free-source code editor made by Microsoft for Windows, Linux and macOS that runs on your desktop. It has built-in source code control including Git support. The Visual Studio (VS) Code product itself ships under a standard Microsoft product license, as it has a small percentage of Microsoft-specific customizations. It's free despite the commercial license. We have all the good reasons to use VS Code for our research and tool deployment.

### **3.3. Data Structure**

There are 5 main list and 3 document libraries has been used to embrace the catalog information as described in Figure 2



**Figure 2:** SharePoint content database

Every SharePoint list has columns to keep the information for the catalog as described in Table 2.

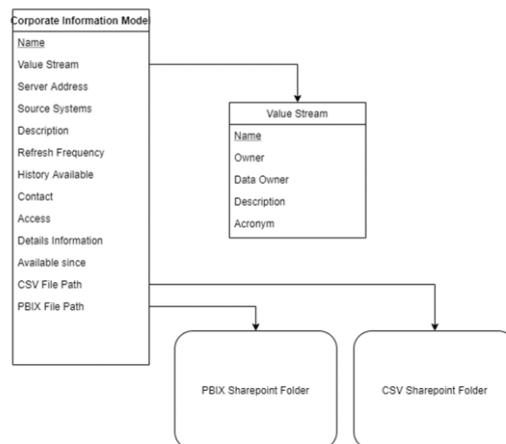
**Table 2:** SharePoint content database Column level detail

List Name	Corporate Information Model
Column	Description
Corporate Information Model Name	Corporate Information Model Name
Value Stream	Value Stream (Main Category of the CIM)
Server Address	OLAP Connection Address
Source Systems	Source Systems Name
Description	Description
Refresh Frequency	Refresh Frequency
History Available	Data retention information
Contact	CIM Contact (Data Owner)
Access	Access
Details Information	CIM Details Information
Available since	CIM Launch date

Tags	Tags
CSV File Path	CSV File Path for the CIM model data dictionary
PBIX File Path	PBIX File Path
Status	Status of the CIM Model (Production or under development)
<b>List Name</b>	<b>Source Systems</b>
Title	Enterprise data source system name
<b>List Name</b>	<b>Tags</b>
Tag Name	Tags name/ Taxonomy to the catalogs
TagColor	Display color for the tags
<b>List Name</b>	<b>Value Streams</b>
Value Stream Name	Main category mapping name
Value Stream Owner	Category Owner
Value Stream Data Owner	Category Data Owner
Value Stream Description	Category description
Value Stream Acronym	Category Acronym
<b>List Name</b>	<b>Access Types</b>
Access Name	Access application name
Access Link	Access application link
Help Link	

### 3.4. Mapping Techniques

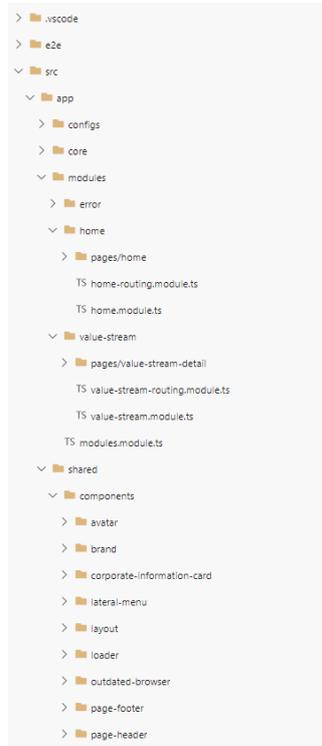
A Smart mapping technique has been used to map OLAP catalog directory with CIM catalog and categories as described in Figure 3.



**Figure 3:** Column mapping for Data association

### 3.5. Folder Structure

The key guidelines for creating folder structure for an Angular Project is to organize the app such that you can locate code quickly and have a near-term view of implementation and a long-term vision. We have built the structure which focuses on a multiple-module architecture which in turn are divided into pages and a shared set of components with a large focus on scaling as described in Figure 4.



**Figure 4:** High level Overview of Folder Structure

### 3.6. Code architecture

We have adopted the MVCS code architecture for the application development. The Model-View-Controller (MVC) is an architectural pattern that separates an application into three main logical components: the model, the view, and the controller. MVC is one of the most frequently used industry-standard web development framework to create scalable and extensible projects

- **Models** - To manage the data of an application. The models will be anemic (they will lack functionalities) since they will be referred to the services.
- **Views/Templates** - The page/GUI where the user interacts with the app.
- **Controllers** - Links between services and views.
- **Services** - Manages the SharePoint request data.
- **Angular Components**

Components are the most basic building block of an UI in an Angular application. An Angular application is a

tree of Angular components. Every page has multiple components and one component can belong to many pages. Below is an example of components breakdown and association with the Storefront landing Page as described in Figure 5.

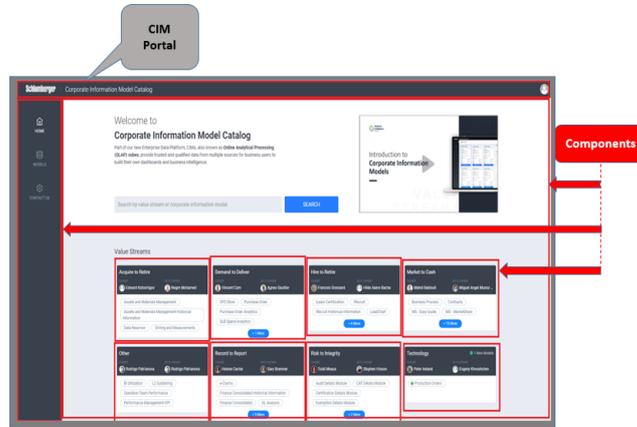


Figure 5: Components Association with the Web page

There are no more or less important components, all are important, but there are more complex or more used components.

### 3.7. Key Components

There are over 20 components being used to develop the application with all the required features in the scope. Top 3 key components has been identified and mentioned below in Figure 6, 7 and 8.

- **Value Stream Card**

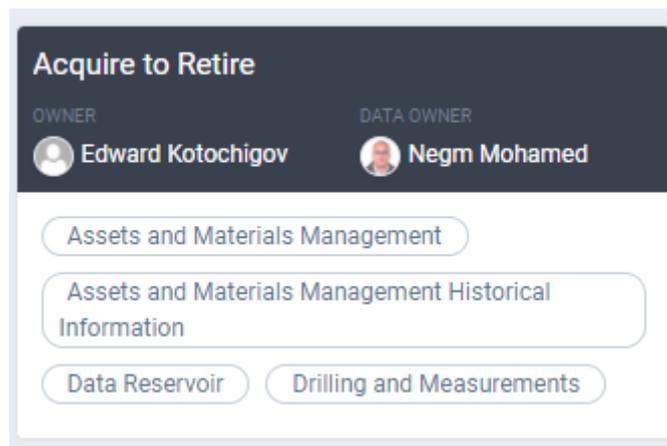
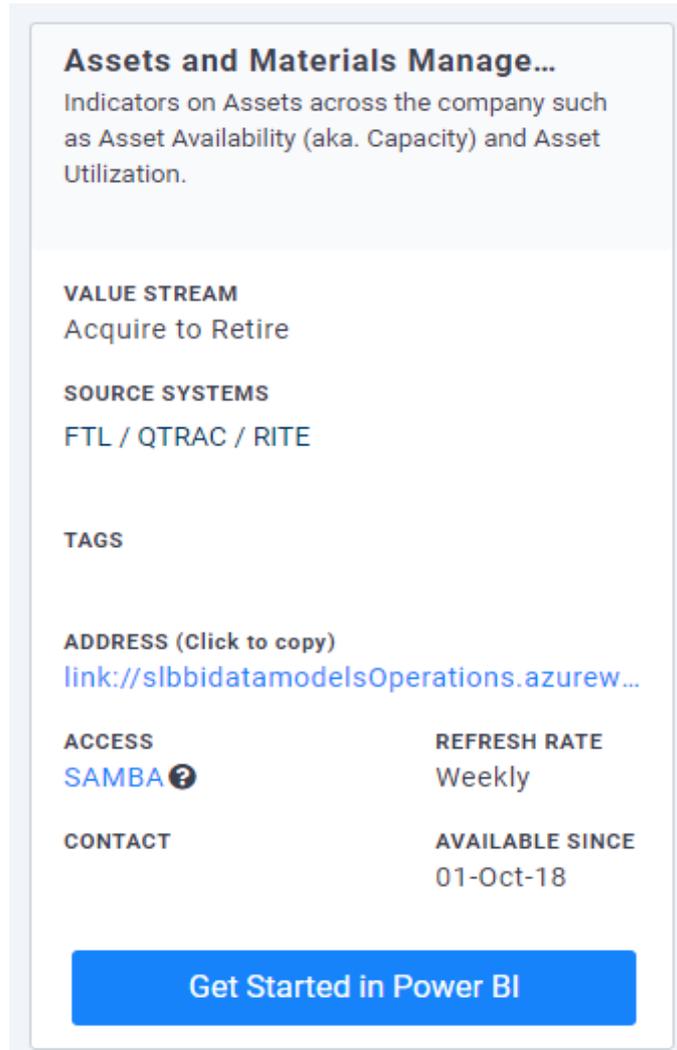


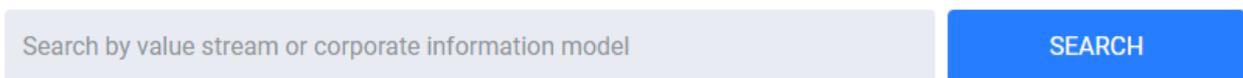
Figure 6: Value Stream Card

- **Corporate Information Card**



**Figure 7:** Corporate Information Card

- **Search Bar**



**Figure 8:** Search Bar

Codes for the top 3 key components has been describe in Appendix 1.

- **Inside the Components**

Every Component has to be written in three languages.

**HTML** - Hypertext Markup Language (HTML) is the standard markup language for documents designed to be displayed in a web browser.

**Scss** - Scss stands for Sassy Cascading Style Sheets and it's an extension of CSS which adds nested rules Variables, mixin, selector, inheritance and a lot more features.

**TS** - TypeScript is an open-source programming language developed and maintained by Microsoft.

- **SharePoint Connection**

SharePoint ship with an updated REST API that can be used to access and control nearly every aspect of a site collection: Lists, Libraries, Permissions, and Users are just some of the objects that have defined endpoints. Integrating Angular, a powerful client-side framework, gives developers and content managers another option for customizing the user experience. The most important library used in the project is to create and manage the connection between the application and the SharePoint structure.

#### 4. Deployment technique

We used Minimum Viable Product (MVP) approach for product development strategy. A minimum viable product (MVP) is a version of a product with just enough features to satisfy early customers and provide feedback for future product development.

Every MVP includes below key elements:

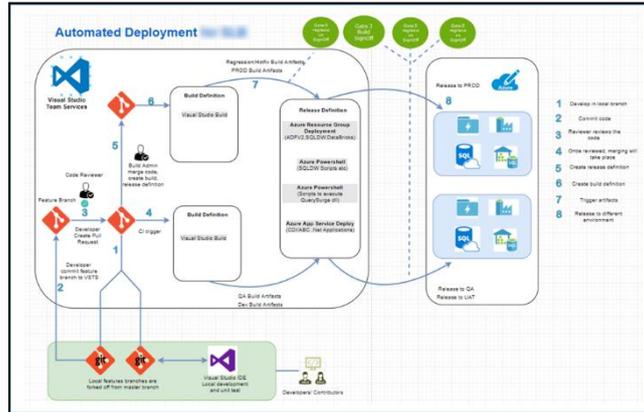
- Functionality - the set of features deliver clear value to the user.
- Design - the design of the MVP was up to the highest industry standard.
- Reliability - production quality standard has been achieved by rigorous testing.
- Usability - the MVP was easy to use and intuitive.

We have used Azure DevOps for code deployment. Azure DevOPS is a Software as a service (SaaS) platform from Microsoft that provides an end-to-end DevOps toolchain for developing and deploying software. Azure DevOps being used for code versioning and release pipeline using Git repository with Visual Studio code tool. Git is a program that tracks changes made to files. Once installed, Git can be initialized on a project to create a Git repository. A Git repository is the .git/ folder inside a project. This repository tracks all changes made to files in the project, building a history over time. A release pipeline is a conceptual process by which we take committed code into production. A release pipeline takes a build artifact, a result of the build process and deploys that to one or more environments. We have used three environment for the product deployment i.e. Development, Quality Assurance and Production as described in Figure 9 below.



**Figure 9:** Release pipeline in Azure DevOps Repository

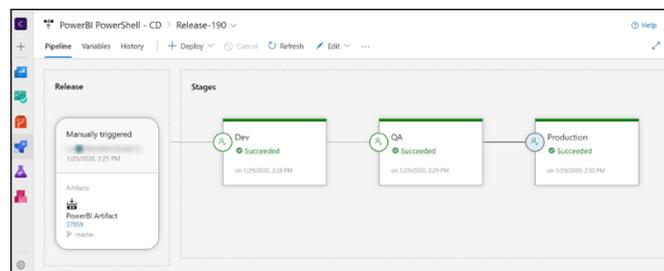
Code Development environment integrates with Azure DevOps Git repository to enable source control management. With source control, developers can collaborate, track and save their changes to a branch and these changes will be merged into the main branch and deployed to the higher-level environments (From development to Quality Assurance/User Acceptance Test environment to Production), where it will also be tested and validated. Once the above mentioned steps are complete the developed codes be published into the development environment as described in Figure 10



**Figure 10:** Automated deployment using Azure DevOps (Git) Repository

#### 4.1. Azure Release Pipeline Approval/Pre Deployment Conditions

Approvals and gates gives further control over the execution and success of the deployment pipeline. Each step in a release pipeline can be built with pre-deployment and post-deployment settings that can embrace waiting for authority users to manually approve or reject deployments, and testing and validating the quality checks with any computerized systems until definite requirements are complete. Also, we can constitute a manual interference to pause the deployment pipeline and prompt developers to carry out manual tasks, then resume or reject the deployment. Once the approvals are in place the Release would be promoted to higher environments and finally deployed in Production. Assigned approvers would receive email notification along with the link to approve. Unless approved deployment will not take place. Once it is approve and release, pipeline shows with success as described in Figure 11



**Figure 11:** successful Azure Release Pipeline

## 5. Output

Application in production has below key displays that will be interesting to show as described in Figure 12, 13, 14 for **CIM Catalog Landing page**, **Inside the CIM** and **Report Selection** respectively.

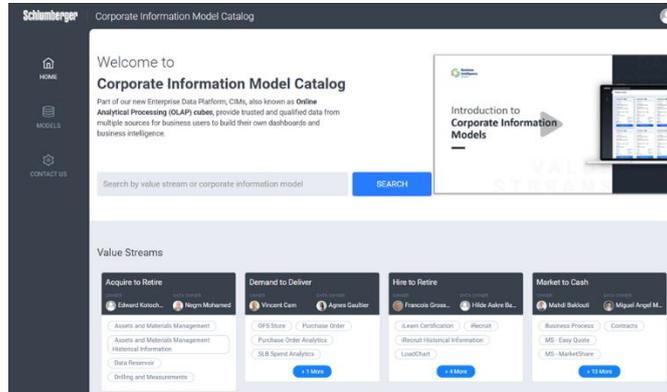


Figure 12: CIM Catalog Landing page

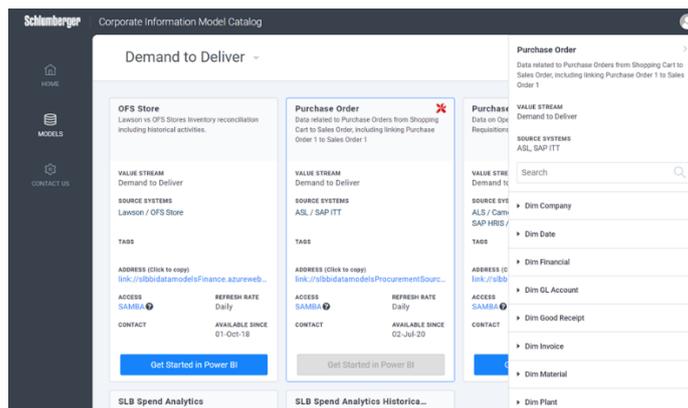


Figure 13: Inside the CIM



Figure 14: Report Selection

## 6. Utilization tracking

Utilization tracking for the Web application is one of the key strategy to get the adoption over the period of time. If you're not tracking enough data, you won't see how trends change over time or why some users behave one way versus another. You won't understand user engagement. Ultimately, you just won't have the knowledge to make smart product or marketing decisions. We have enabled and configured Utilization of the CIM Catalog application due to the precise reasons as follows.

- To find out which storefront bring the most traffic and conversions.
- Determine where the best visitors are located in the worldwide.
- Learn what people are searching for on the application.
- Visualize what people click on the most.
- Uncover the top content. Which pages keep the visitors on the site the longest.
- To identify the worst performing pages.
- Determine where people abandon due to having multiple clicks

We have used and compared SharePoint activity tracker and Google analytics to enable application tracking.

### • Microsoft SharePoint Analytics

We get a view into SharePoint activity using Microsoft SharePoint Analytics by looking at the Files and Users views. It is out of the box services available within Microsoft SharePoint Online in Cloud. This can simply be enabled by the Site admin from the admin center, Go to the Reports > Usage page. From the Select a report drop-down, select SharePoint > Activity. The Pages view shows the number of unique pages visited by users as mentioned in the figure 15.

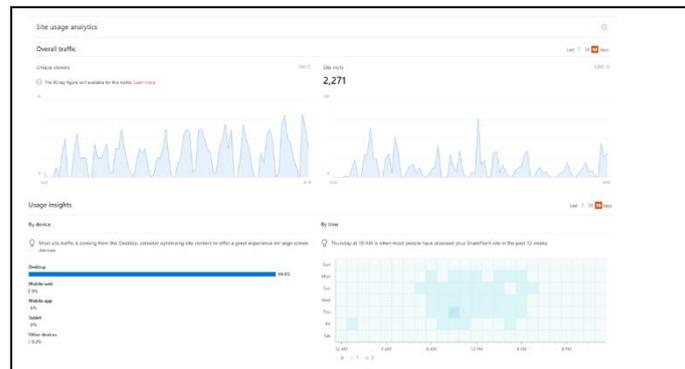


Figure 15: Utilization analysis from SharePoint Online

### • Google Analytics

“Site owners using Google Analytics have the capacity to keep track of views over time, follow site visitors' movements in real time, pinpoint where site visitors leave, view demographics and maps, and understand the

search terms that initially brought visitors to the website”[7].Google Analytics provide detail analysis and is used to track website activity such as session duration, pages per session, bounce rate etc. of individuals using the site, along with the information on the source of the traffic. In order for Google Analytics to function, we were required to put JavaScript tracking code on each page of our application. When a visitor comes to the application, the tracking code runs and sends tracking data to Google’s data collection servers. Hence, we have enabled monitoring for usage analysis over the period of time by adding below line of tracking code in the html as described in Table 3.

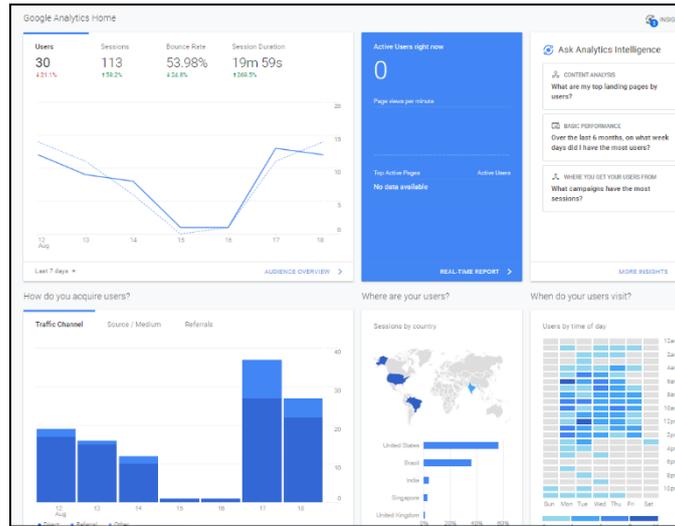
**Table 3:** Tracking code for Google Analytic

```
<!-- Global site tag (gtag.js) - Google Analytics -->  
<script async src="https://www.googletagmanager.com/gtag/js?id=UA-XXXXXXXX-X"></script>  
<script>  
  window.dataLayer = window.dataLayer || [];  
  function gtag(){dataLayer.push(arguments);}  
  gtag('js', new Date());  
  
  gtag('config', 'XXXXXXXX-X');  
</script>
```

In our analysis we decided to use Google analytics as it provides detail and comprehensive active user’s trend over the period of time as described in Figure 16 and Figure 17 below.



**Figure 16:** Active user’s trend in Google Analytics



**Figure 17:** Overall traffic analysis from Google analytics

**7. Security Overview**

CIM Catalog is hosted in Microsoft SharePoint Online environment in Cloud, hence it is inherited the security framework what SharePoint offered. SharePoint has the default security groups which are the SharePoint objects that have “users” (Azure Active Directory Users and Azure Active Directory Groups by default) as members and come with their own settings.

There are 5 main layers of Security available in the CIM Catalog environment:

- **Read:** Can view pages and list items and download documents.
- **Contribute:** Can view, add, update, and delete list items and documents.
- **Edit:** Can add, edit and delete lists; can view, add, update and delete list items and documents.
- **Restricted Edit:** Can add, edit and delete specific rows from the list based on the defined role.
- **Design:** Can view, add, update, delete, approve, and customize.
- **Full Control:** Has full control.

There are three security groups. **Members, Owners and Visitors.** Users required to be added into a security group. Each security group has unique Permission level as described in Figure 18.

Security Groups	Permission Level					
	Read	Contribute	Edit	Restricted Edit	Design	Full Control
Members	✓	✓	✓	✗	✗	✗
Owners	✓	✓	✓	✓	✓	✓
Visitors	✓	✗	✗	✗	✗	✗
site collection Admins	✓	✓	✓	✓	✓	✓
Category owner	✓	✓	✗	✓	✗	✗
Value Stream Owners	✓	✓	✗	✓	✗	✗

**Figure 18:** CIM Catalog Security Overview

## **8. Self-Service for Catalog maintenance**

Self-service is the practice of serving oneself and empowered the clients. We have designed and built the application in a way that it required least support and maintenance from the CIM portal Admins and IT Staff. One of the key benefits of self-service to an organization is that they save on resources. Also Customers have better control and privilege on the Content and hence engagement and adoption will increase eventually. We have considered all those factors in the consideration and designed CIM Catalog application in such a manner where Category Owner, Product Owners and Co-Owners can maintain their assigned catalog and CIMs on their own.

Content is the essence of any digital application. The CIM catalog has to be current, consistent, and correct. There are three main components of CIM Catalog that require to be updated and accurate all the time.

- CIM catalog Models and their detail
- Data definitions
- Connection detail and Power BI report

Every Category Owner, Product Owners and Co-Owners can add/edit or update their assigned CIM models information from the administrator console from the front end of the CIM portal application.

## **9. Conclusions**

In this paper, we demonstrate that how Corporate information model using OLAP approach can serve as self-service strategy to business users from corporate level systems. The proposed method can be implemented to any large organization. The developed scripts has been implemented in real time in the organization. Furthermore, if the identified approach is also suitable for different processes, the scope of the analysis can be extended using a similar approach.

## **10. Recommendation**

We recommend further experimental and theoretical studies for Self Service Business Intelligence (SSBI) that can directly connect to OLAP Cubes and provide a robust solution. “Many researchers argue that most studies in the field of information systems are predominantly empirical and that more literature studies are needed” [8, 9, 10].

## **References**

- [1]. Shaker H. AliEl-Sappagha ;Abdeltawab M. AhmedHendawib;Ali HamedEl Bastawissy. Journal of King Saud University - Computer and Information Sciences. Volume 23, Issue 2, July 2011, Pages 91-104
- [2]. Paul Brunet. The rise of self-service analytics. <http://analytics-magazine.org/rise-self-service-analytics/>. Digital Edition;INFORMS Analytics Society

- [3]. Ali-Eldin, Amr & zaghoul, M & Salem, Mofreh. (2013). Towards a Self-service Data Analytics Framework. *International Journal of Computer Applications*. 80. 41-48. 10.5120/13893-1840.
- [4]. Christian Lennerholt University of Skövde. Implementation Challenges of Self Service Business Intelligence:A Literature Review. *Proceedings of the 51st Hawaii International Conference on System Sciences | 2018*
- [5]. W. Eckerson, "Business-driven BI: Using New Technologies to Foster Self-Service Access to Insights", Tableau Software, 2012.
- [6]. S. Williams and N. Williams, "The profit impact of business intelligence", Morgan Kaufmann, 2010.
- [7]. E. J. Petersen and B. M. Martin, "Misuse, play, and dis-use: Technical and professional communication's role in understanding and supporting website owners' engagement with Google Analytics," 2015 IEEE International Professional Communication Conference (IPCC), Limerick, 2015, pp. 1-5, doi: 10.1109/IPCC.2015.7235786.
- [8]. F. Rowe, "What literature review is not: diversity, boundaries and recommendations", *European Journal of Information Systems*, 2014, pp. 241-255.
- [9]. J. Webster and R. T. Watson, "Analyzing the past to prepare for the future: Writing a literature review", *MIS quarterly*, 2002, pp. xiii-xxiii.
- [10]. I. Benbasat and R. Weber, "Research Commentary: Rethinking "Diversity" in Information Systems Research", *Information Systems Research*, 1996, pp. 389 - 399.

Appendix 1

Table 4

Card name	Corporate Information Card
Code language	TS
<pre> import { HttpClient } from '@angular/common/http'; import { Component, EventEmitter, Input, OnInit, Output } from '@angular/core'; import { take } from 'rxjs/operators'; import { AccessType } from '~/shared/models/access-type.model'; import { CorporateInformationModel } from '~/shared/models/corporate-information-model.model'; import { AccessTypeService } from '~/shared/services/access-type.service';  @Component({   selector: 'app-corporate-information-card',   templateUrl: './corporate-information-card.component.html',   styleUrls: ['./corporate-information-card.component.scss'] }) export class CorporateInformationCardComponent implements OnInit {    @Output()   public cardClicked = new EventEmitter();    @Input()   public corporateInformation: CorporateInformationModel;    @Input()   public parentSelectedIdx = -1;    public accessTypes: Array&lt;AccessType&gt; = [];    // public html = `&lt;span style="min-width: 100px;" class="btn-block btn-danger well-sm"&gt;Never trust not sanitized HTML!!!&lt;/span&gt;`;    constructor(private httpClient: HttpClient,     private accessTypeService: AccessTypeService) { }    // tslint:disable-next-line: no-empty   public ngOnInit(): void {      this.accessTypeService.getAccessTypeById(this.corporateInformation.AccessTypes.map((t)     =&gt; { return t.Id })))       .pipe(take(1))       .subscribe((at) =&gt; {         this.accessTypes = at;       })   }    public navigate() {     this.cardClicked.emit(this.corporateInformation);   }    public get valueStreams(): string {     let valueString = ""; </pre>	

```
this.corporateInformation.ValueStream.forEach((vs, index) => {
  valueString = valueString.concat(vs.Title);

  if (index < this.corporateInformation.ValueStream.length - 1)
    valueString = valueString.concat(', ');
});

return valueString;
}

public get sourceSystems(): string {
  let valueString = "";

  this.corporateInformation.SourceSystems?.forEach((ss, index) => {
    valueString = valueString.concat(ss.Title);

    if (index < this.corporateInformation.SourceSystems.length - 1)
      valueString = valueString.concat(' / ');
  });

  return valueString;
}

public openPBIX() {
  // tslint:disable-next-line: deprecation
  event.stopPropagation();
  this.download();
}

public download() {
  if (!this.corporateInformation.PBIXFilePath) {
    alert('Error \nThe PBIX File Path is empty');

    return;
  }

  window.open('./..' + this.corporateInformation.PBIXFilePath, '_blank');
}

public copyLinkToClipboard() {
  // tslint:disable-next-line: deprecation
  event.stopPropagation();

  const selBox = document.createElement('textarea');
  selBox.style.position = 'fixed';
  selBox.style.left = '0';
  selBox.style.top = '0';
  selBox.style.opacity = '0';
  selBox.value = this.corporateInformation.ServerAddress;
  document.body.appendChild(selBox);
  selBox.focus();
  selBox.select();
  document.execCommand('copy');
  document.body.removeChild(selBox);
}

public get isUnderDevelopment(): boolean {
  return this.corporateInformation.Status?.toLocaleLowerCase() === 'under development';
}
```

}	
<b>Code language</b>	<b>SCSS</b>
<pre>.main { display: flex; flex-direction: column; width: 320px; min-height: 510px; background-color: #ffffff; border: 1px solid #c7d0d8; border-radius: 3.5px; transition: box- shadow 0.3s ease-in-out, border 0.3s ease-in-out; -webkit-box-direction: normal; -webkit- box-orient: vertical; span, label { cursor: pointer; }}a { text-decoration: none; cursor: pointer;}.selected { border: 1px solid rgb(39, 125, 255);}.main:hover { border: 1px solid rgb(39, 125, 255); box-shadow: 0 3px 10px 0 rgba(0, 0, 0, 0.15); -moz-box-shadow: 0 3px 10px 0 rgba(0, 0, 0, 0.15); -webkit-box-shadow: 0 3px 10px 0 rgba(0, 0, 0, 0.15); transition: box-shadow 0.3s ease-in-out, border 0.3s ease-in-out;}.header { height: rem(120px); background-color: rgba(241, 244, 249, 0.44); border-radius: 4px; .new { width: 40px; height: 17px; margin-top: 3px; color: #ffffff; font-size: 10px; font-weight: 700; letter-spacing: 1.21px; background-color: #47b280; border-radius: 8.5px; } span:nth- child(1){ display: block; max-width: 260px; overflow: hidden; color: #39414d; font-weight: 700; text-overflow: ellipsis; letter-spacing: 0.7px; white-space: nowrap; } span:nth-child(2){ display: -webkit-box; overflow: hidden; color: #39414d; font-size: 13px; text-overflow: ellipsis; -webkit-box-orient: vertical; -webkit-line-clamp: 4; }}.body { position: relative; flex: 1 1 auto; padding: 1rem; -ms-flex: 1 1 auto; -webkit-box- flex: 1;}label { margin: 0; color: #39414d; font-size: 11px; font-weight: bold; letter- spacing: 0.55px;}.data { display: block; max-width: 100%; overflow: hidden; color: #39414d; font-size: 14px; text-overflow: ellipsis; letter-spacing: 0.55px; white-space: nowrap;}.avatar { width: rem(20px); height: rem(20px); object-fit: cover;}.contat-name { display: block; max-width: 100%; overflow: hidden; font-size: 14px; text-overflow: ellipsis; white-space: nowrap;}.tag { overflow: hidden; color: #39414d; font-size: 12px; background-color: #e8ecf2; border-radius: 10.5px;}.tags-area { min-height: 22px;}.source- system { display: -webkit-box; overflow: hidden; font-size: 14px; text-overflow: ellipsis; - webkit-box-orient: vertical; -webkit-line-clamp: 2; min-height: 42px;}.card-footer { background-color: #ffffff; border: 0;}.get-started { width: 280px; height: 40px; color: #ffffff; background-color: #1683fb; border-radius: 3px;}.get-started:disabled { color: #666666; background-color: #cccccc; border: 1px solid #999999;}</pre>	
<b>Code language</b>	<b>HTML</b>

<pre> &lt;a href="javascript:;" (click)="navigate()" class="cursor-pointer"&gt; &lt;div class="main m-2" [ngClass]='{"selected": parentSelectedIdx === corporateInformation.Id}'&gt; &lt;div *ngIf="corporateInformation" class="header d-flex flex-column px-3 pt-2"&gt; &lt;div class="row no-gutters" *ngIf="corporateInformation"&gt; &lt;div class="d-flex col-md-11"&gt; &lt;span class="mr-2" [attr.title]="corporateInformation.Title"&gt;{{ corporateInformation.Title }} &lt;/span&gt; &lt;div class="new d-flex align-items-center justify-content-center" *ngIf="corporateInformation.isNew"&gt;NEW&lt;/div&gt; &lt;/div&gt; &lt;div *ngIf="isUnderDevelopment" class=" d-flex justify-content-end align-items-center col-md-1" "&gt; &lt;i class="fas fa-tools" tooltip="Under Development" containerClass="custom-tooltip" style=" font-size: 18px; color: #e00000;"&gt;&lt;/i&gt; &lt;/div&gt; &lt;/div&gt; &lt;span [attr.title]="corporateInformation.Description"&gt;{{ corporateInformation.Description }}&lt;/span&gt; &lt;/div&gt; &lt;div *ngIf="corporateInformation" class="body"&gt; &lt;div class="d-flex flex- column"&gt; &lt;label&gt;VALUE STREAM&lt;/label&gt; &lt;span [attr.title]="valueStreams" class="data"&gt;{{ valueStreams }}&lt;/span&gt; &lt;/div&gt; &lt;div class="d-flex flex-column mt-3"&gt; &lt;label&gt;SOURCE SYSTEMS&lt;/label&gt; &lt;div class="row no-gutters pt-1 tags-area"&gt; &lt;span [attr.title]="sourceSystems" class="source-system"&gt;{{ sourceSystems }}&lt;/span&gt; &lt;/div&gt; &lt;/div&gt; &lt;div class="d-flex flex-column mt-3"&gt; &lt;label&gt;TAGS&lt;/label&gt; &lt;div class="row no-gutters pt-1 tags-area"&gt; &lt;span *ngFor="let item of corporateInformation.Tags" class="tag mr-2 px-2 d-block"&gt;{{ item.Title }}&lt;/span&gt; &lt;/div&gt; &lt;/div&gt; &lt;div class="d-flex flex-column mt-3"&gt; &lt;label&gt;ADDRESS (Click to copy)&lt;/label&gt; &lt;span #pop="bs-tooltip" triggers="" tooltip="Copied to clipboard" [attr.title]="Click to copy to Clipboard \n' + corporateInformation.ServerAddress" class="data" (click)="copyLinkToClipboard(); pop.show();" (mouseleave)="pop.hide();" style="color: #1683fb"&gt;{{ corporateInformation.ServerAddress }}&lt;/span&gt; &lt;/div&gt; &lt;div class="row"&gt; &lt;div class="col-md-7"&gt; &lt;div class="d-flex flex-column mt-3"&gt; &lt;label&gt;ACCESS&lt;/label&gt; &lt;div class="d-flex"&gt; &lt;div class="d-flex" *ngFor="let at of accessTypes"&gt; &lt;a (click)="\$event.stopPropagation()" style="color: #1683fb" class="data" href={{ at.Url.Url }} target="_blank"&gt;{{ at.Title }} &lt;/a&gt; &lt;a *ngIf="at.HelpLink" href={{ at.HelpLink.Url }}" style="font-size: 14px; color: #39414d; padding-left: 0.1rem;" (click)="\$event.stopPropagation()" tooltip="{{ at.Title }} Help" [delay]=500 target="_blank"&gt; &lt;i class="fas fa-question-circle pr- 2"&gt;&lt;/i&gt;&lt;/a&gt; &lt;/div&gt; &lt;/div&gt; &lt;/div&gt; &lt;/div&gt; &lt;div class="col-md-5"&gt; &lt;div class="d-flex flex-column mt-3"&gt; &lt;label&gt;REFRESH RATE&lt;/label&gt; &lt;span class="data"&gt;{{ corporateInformation.RefreshFrequency.Value }}&lt;/span&gt; &lt;/div&gt; &lt;/div&gt; &lt;/div&gt; &lt;div class="row"&gt; &lt;div class="col-md-7 pr-0"&gt; &lt;div class="d- flex flex-column mt-3"&gt; &lt;label&gt;CONTACT&lt;/label&gt; &lt;div class="user d-flex" *ngIf="corporateInformation.Contact"&gt; &lt;img src="/_layouts/15/userphoto.aspx?size=L&amp;username={{ corporateInformation.Contact.Email  }}" class="avatar img-thumbnail rounded-circle shadow-sm p-0 mr-1" [attr.title]="corporateInformation.Contact.Title" [attr.alt]="corporateInformation.Contact.Email"&gt; &lt;span class="contat-name" [attr.title]="corporateInformation.Contact.Email"&gt; {{ corporateInformation.Contact.Title }} &lt;/span&gt; &lt;/div&gt; &lt;/div&gt; &lt;/div&gt; &lt;/div&gt; &lt;div class="col-md-5"&gt; &lt;div class="d-flex flex-column mt-3"&gt; &lt;label&gt;AVAILABLE SINCE&lt;/label&gt; &lt;span [attr.title]="corporateInformation.AvailableSince" class="data"&gt;{{ corporateInformation.AvailableSince   date: 'dd-MMM-yy' }}&lt;/span&gt; &lt;/div&gt; &lt;/div&gt; &lt;/div&gt; &lt;/div&gt; &lt;div class="card-footer"&gt; &lt;button type="submit" [disabled]="!corporateInformation.PBIXFilePath    isUnderDevelopment" (click)="openPBIX()" class="btn btn-block get-started"&gt;Get Started in Power BI&lt;/button&gt; &lt;/div&gt; &lt;/div&gt;&lt;/a&gt; </pre>
<p><b>Card name</b> Value Stream Card</p>
<p><b>Code language</b> TS</p>

<pre>import { Component, Input, OnInit } from '@angular/core';import { Router } from '@angular/router';import { CorporateInformationModel } from '~/shared/models/corporate- information-model.model';import { ValueStream } from '~/shared/models/value- stream.model';@Component({ selector: 'app-value-strem-card', templateUrl: './value-strem- card.component.html', styleUrls: ['./value-strem-card.component.scss']})export class ValueStremCardComponent implements OnInit { @Input() public valueStream: ValueStream; public MaxCorporateInformationsToShow = 4; constructor( private router: Router ) { // tslint:disable-next-line: no-empty public ngOnInit() { } public cardClicked() { this.router.navigate(['/value-stream', this.valueStream.Id, 'details']) } public corporateInformationClicked(ci: CorporateInformationModel) { this.router.navigate(['/value-stream', this.valueStream.Id, 'details', ci.Id]) } public get countNew(): number { let count = 0; this.valueStream.CorporateInformations.forEach((element) =&gt; { if (element.isNew) count = count + 1; }); return count; }}</pre>	
<b>Code language</b>	<b>SCSS</b>
<pre>a { color: #ffffff; text-decoration: none; cursor: pointer;}.card-value-stream { background- color: #ffffff; border-radius: 4px; border: 1px solid #dfe2e6;}.header { background-color: #39414d; border-top-left-radius: 4px; border-top-right-radius: 4px;}.body { min-height: rem(72px); background-color: #ffffff; border-radius: 4px;}.no-info { font-size: 14px;}.name { display: inline-block; width: 180px; overflow: hidden; font-size: rem(15px); text- overflow: ellipsis; white-space: nowrap;}.new { color: #c7d0d8; font-size: rem(11px); i { margin-top: -3px; color: #47b280; font-size: rem(11px); }}.owner { span { color: #737e8c; font-size: 9px; } .avatar { width: rem(20px); height: rem(20px); object-fit: cover; } .user { span { display: inline-block; width: 100%; overflow: hidden; color: #ffffff; font-size: 12px; text-overflow: ellipsis; white-space: nowrap; } }}.corporate-title { color: #5a7793; font-size: rem(12px); font-weight: 400; height: fit- content; border: 1px solid #c7d0d8; border-radius: 11px; transition: all 0.4s ease-out; i { margin-top: -3px; color: #47b280; font-size: rem(10px); }}.corporate-title:hover { background: #5a7793; color: white; border: 1px solid white;}.show-more { color: #ffffff; font-size: 11px; background-color: #1683fb; border-radius: 11px;}.show-more-div { min- height: 5px;}</pre>	
<b>Code language</b>	<b>HTML</b>

```

<div class="card-value-stream row d-block m-2"
*ngIf="valueStream.CorporateInformations"> <a href="javascript:;"
(click)="cardClicked()"> <div class="header p-2"> <div class="row no-gutters">
<span [attr.title]="valueStream.Title" class="name col-md-7">{{ valueStream.Title }}</span>
<div *ngIf="valueStream.CorporateInformations?.length && countNew > 0" class="col-md-5
new d-flex align-items-center justify-content-end"> <i class="fas fa-circle pr-1"></i>
<span>{{ countNew }} New Models</span> </div> </div> <div class="row no-
gutters pt-2"> <div class="owner col-md-6 new d-flex flex-column pr-2">
<span>OWNER</span> <div class="user pt-1 d-flex">  <span
[attr.title]="valueStream.ValueStreamOwner.Title"> {{
valueStream.ValueStreamOwner.Title }} </span> </div> </div> <div
class="owner col-md-6 new d-flex flex-column pl-2"> <span>DATA OWNER</span>
<div class="user pt-1 d-flex">  <span
[attr.title]="valueStream.ValueStreamDataOwner.Title"> {{
valueStream.ValueStreamDataOwner.Title }} </span> </div> </div>
</div> </div> </a> <div class="body p-2 row no-gutters"> <span class="no-info px-1"
*ngIf="valueStream?.CorporateInformations?.length === 0" style="margin:auto;
display:table;">No models related</span> <div class="cursor-pointer corporate-title m-1
px-2" *ngFor="let ci of valueStream.CorporateInformations |
slice:0:MaxCorporateInformationsToShow" (click)="corporateInformationClicked(ci)">
<i class="fas fa-circle" *ngIf="ci.isNew"></i> <span class="px-1">{{ ci.Title }}</span>
</div> </div> <div class="show-more-div d-flex justify-content-center"> <span
class="cursor-pointer show-more p-1 px-3 mb-2"
*ngIf="valueStream.CorporateInformations?.length > 0 &&
(valueStream.CorporateInformations?.length - 4) > 0 &&
MaxCorporateInformationsToShow == 4" (click)="MaxCorporateInformationsToShow =
1000">+ {{ valueStream.CorporateInformations?.length - 4 }} More</span> </div></div>

```

<b>Card name</b>	<b>Search Bar</b>
<b>Code language</b>	<b>TS</b>

<pre>import { Component, EventEmitter, Input, OnInit, Output } from '@angular/core';import { BehaviorSubject } from 'rxjs';import { Store } from '~/shared/models/store.model';import { FilterService } from '~/shared/services/filter.service';import { HeaderService } from ~/shared/services/header.service';@Component({ selector: 'app-search-bar', templateUrl: '/search-bar.component.html', styleUrls: ['./search-bar.component.scss']})export class SearchBarComponent implements OnInit { @Input() public isListSearch = false; @Output() public onSearch = new EventEmitter&lt;string&gt;(); public searchText = ""; public placeholder = 'Search'; public currentStorefront: Store; private selectedFrontStore: Store; public StoreColor: BehaviorSubject&lt;string&gt;; constructor( private heraderService: HeaderService, private filterService: FilterService, ) { } public doSearch(): void { if (this.searchText) this.isListSearch ? this.onSearch.emit(this.searchText) : this.defaultSearch(); } public ngOnInit() { this.StoreColor = this.heraderService.storeColor\$; this.heraderService.selectedStore\$.subscribe( (selectedStore) =&gt; { if (selectedStore) this.currentStorefront = selectedStore; else this.currentStorefront = null; if (selectedStore &amp;&amp; !this.isListSearch) this.placeholder = 'Search in ' + selectedStore?.Title; else this.placeholder = 'Search'; this.selectedFrontStore = selectedStore; } ) } private defaultSearch() { if (this.selectedFrontStore) this.filterService.ShowAllRelatedToFrontStore(this.selectedFrontStore, this.searchText); else this.filterService.ShowAllGlobal(this.searchText); this.searchText = ""; } public doSearchEmpty() { if (this.isListSearch &amp;&amp; !this.searchText) this.onSearch.emit(this.searchText); } public get getTitle(): string { return this.currentStorefront ? this.currentStorefront.Title : "; } }</pre>	
<b>Code language</b>	<b>SCSS</b>
<pre>.search-bar { color: #ffffff; background-color: transparent; transition: all 0.25s; input { background-color: #ffffff; border-radius: 3px; overflow: hidden; border-color: transparent; } .btn-primary { border-radius: 2px; border: 1px solid #ffffff; background- color: transparent; font-size: rem(14px); } .btn-primary:focus { outline: none; box- shadow: none; }}button:focus,input:focus,input.form-control:focus { outline: none !important; outline-width: 0 !important; box-shadow: none; -moz-box-shadow: none; - webkit-box-shadow: none; border-color: transparent;}span.store-name:empty:before { content: "\200b";}.verified-icon { margin-bottom: 4px;}</pre>	
<b>Code language</b>	<b>HTML</b>
<pre>&lt;div class="search-bar py-2" [ngStyle]="{ backgroundColor: StoreColor   async }"&gt; &lt;div class="container"&gt; &lt;div class="row"&gt; &lt;div class="col-md-10 p-1"&gt; &lt;input type="text" name="main-search" [(ngModel)]="searchText" class="form- control" autocomplete="off" [placeholder]="placeholder" (keydown.enter)="doSearch()" (keyup.backspace)="doSearchEmpty()" (keyup.delete)="doSearchEmpty()"&gt; &lt;/div&gt; &lt;div class="col-md-2 p-1"&gt; &lt;button type="submit" class="btn btn-primary btn-block text-uppercase h-100" (click)="doSearch()"&gt;Search&lt;/button&gt; &lt;/div&gt; &lt;/div&gt;&lt;/div&gt;&lt;/div&gt;</pre>	