



**Pragyan 2023**

## Digital Twin Workshop

Hands on session

March 2023

[www.brillio.com](http://www.brillio.com)

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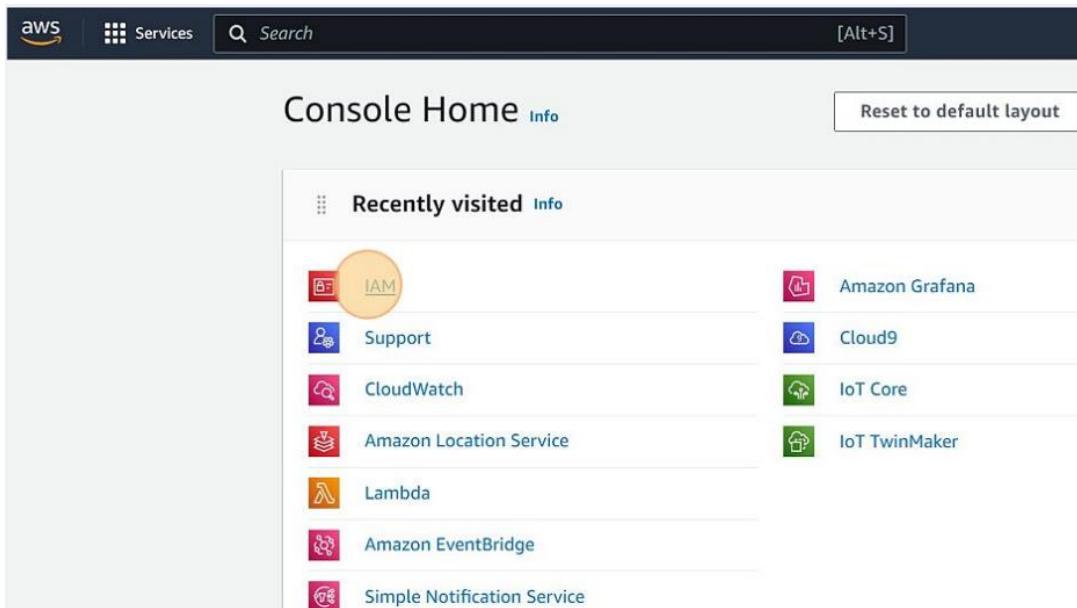
## Hands-on on AWS Digital Twin (IOT TwinMaker)

### 1.1 Prerequisites

- Download hands on pre-requisite files from Github link: <https://github.com/kumarvaibhav7/Workshop-Assets>
- Login [Cloud Computing Services - Amazon Web Services \(AWS\)](#) to with your AWS Root Account.

### 1.2 Creating IAM User

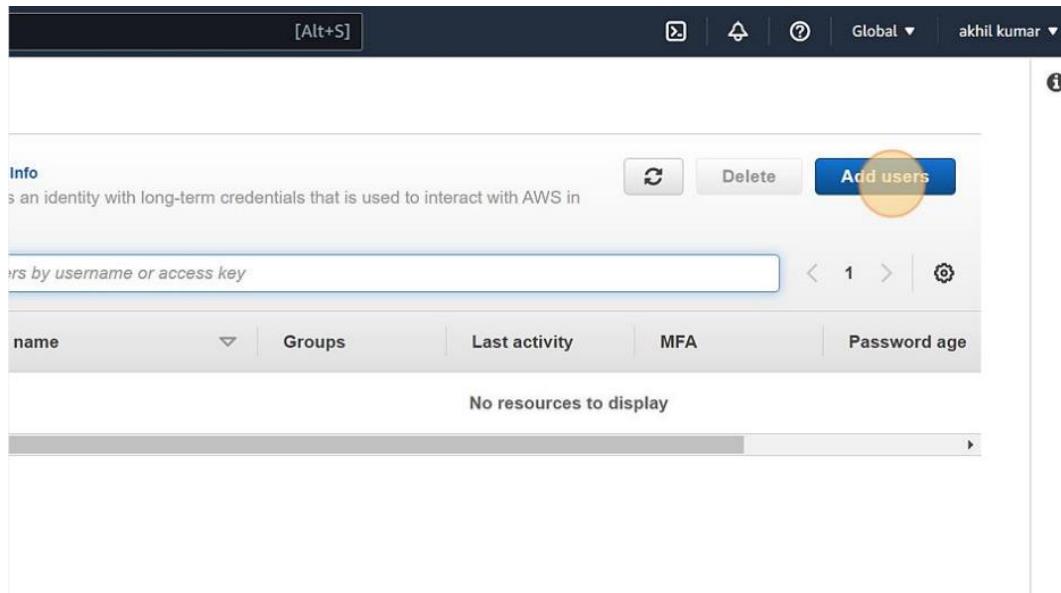
- Click "IAM"



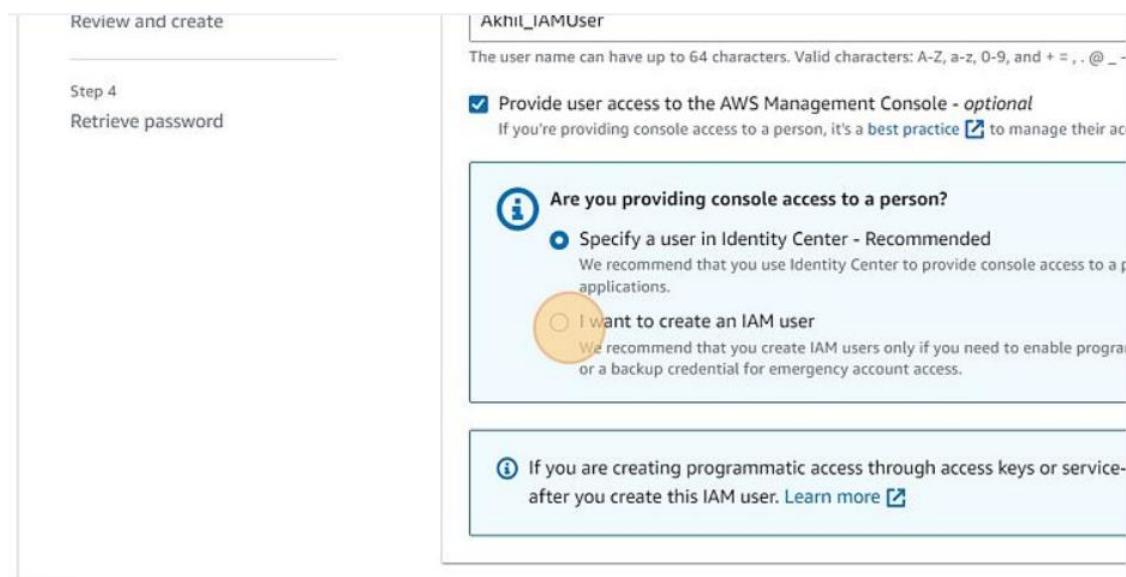
- Click "Users"

The screenshot shows the IAM dashboard. On the left, there's a sidebar with a 'Management (IAM)' heading and several navigation items: 'Dashboard' (selected), 'Access management' (expanded, showing 'User groups', 'Users' (highlighted with a yellow circle), 'Roles', 'Policies', 'Identity providers', and 'Account settings'), 'Access reports' (expanded, showing 'Access analyzer'), and 'Access analyzer'. The main right-hand panel is titled 'IAM dashboard' and contains a 'Security recommendations' section with two items: 'Add MFA for root user' (marked with a red exclamation icon) and 'Root user has no active access keys' (marked with a green checkmark icon). Below this is an 'IAM resources' section with four categories: 'User groups' (0), 'Users' (0), 'Roles' (2), and 'Policies' (0). At the bottom, there's a 'What's new' link.

- Click "Add users"



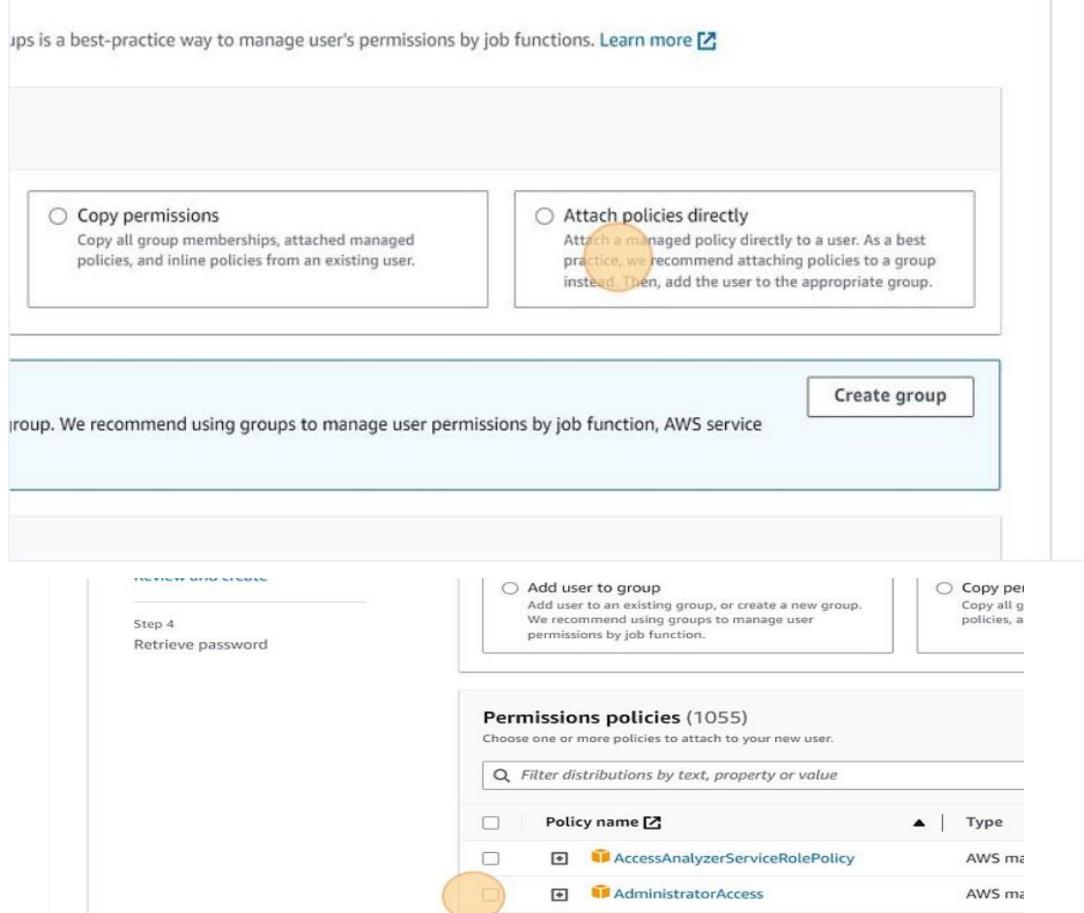
- Enter Username of Your Choice and Click on the checkbox "Provide user access to the AWS Management Console" and after that click on bullet point "I want to create an IAM User"



- Click on the “Custom Password” and give the password of your choice



- Click Next & Click on the Option Attach Policies Directly and attach Administrator Access Policy



- Click on “Next” and review the policy attached and click on “Review and Create”
- Review and create

Review your choices. After you create the user, you can view and download the autogenerated password, if enabled.

**User details**

User name Akhil_IAMUser	Console password type None	Require password reset No
----------------------------	-------------------------------	------------------------------

**Permissions summary**

Name	Type	Used as
AdministratorAccess	AWS managed - job function	Permissions policy

**Tags - optional**  
Tags are key-value pairs you can add to AWS resources to help identify, organize, or search for resources. Choose any tags you want to associate with this user.

No tags associated with the resource.

Add new tag  
You can add up to 50 more tags.

Cancel Previous **Create user**

- Once the user is created note the console sign-on url and download the csv file

### 1.2.1 Sign in with IAM User

- You can login with the console url you copied previously and enter the username and password

## Sign in as IAM user

Account ID (12 digits) or account alias

115770692037

IAM user name

Akhil\_IAMUser

Password

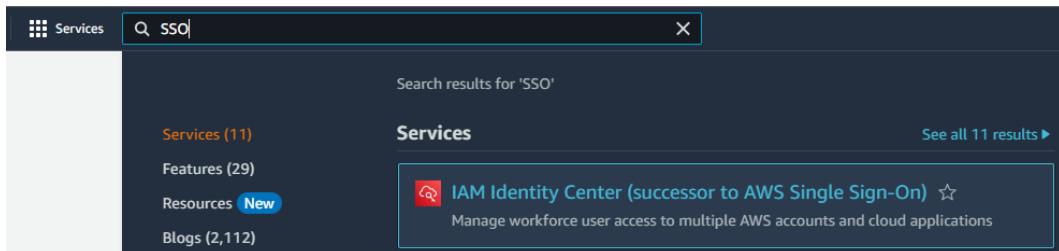
.....

Remember this account

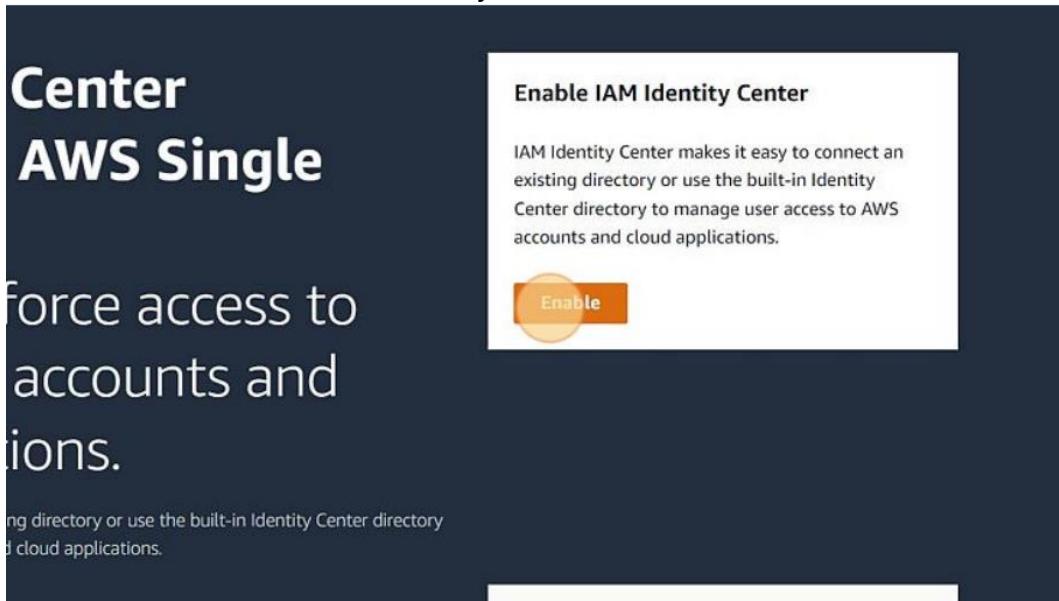
**Sign in**

### 1.2.2 Creation SSO User

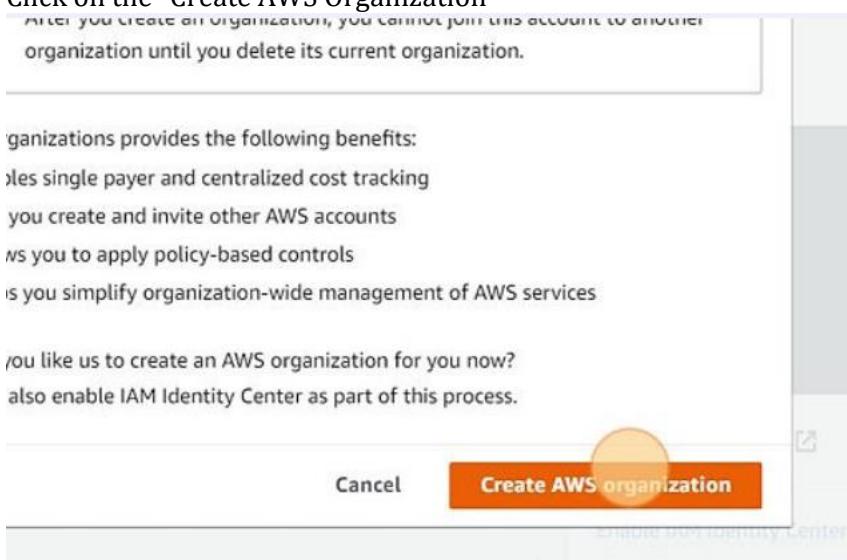
- Click on the search bar and search for SSO and click on “IAM Identity Center”



- Click on “Enable” to enable the identity center



- Click on the “Create AWS Organization”



- Click "Users"

The screenshot shows the AWS IAM Identity Center dashboard. On the left, there's a sidebar with options: Dashboard (highlighted), Users (circled in orange), Groups, and Settings. Below these are two expandable sections: Multi-account permissions (AWS accounts, Permission sets) and Application assignments (Applications). At the top right, a blue banner reads: "AWS IAM Identity Center is the updated console for the features of AWS Single Sign-On (AWS SSO). The features that comprised AWS Single Sign-On (AWS SSO) are available through this service. IAM Identity Center makes it easier to manage users' access across AWS accounts and integrated applications. Learn more". The main content area shows the title "Dashboard" and a sub-section "Recommended setup steps" with "Step 1: Choose your identity source".

- Click "Add user"

The screenshot shows the "Users" list page in the AWS IAM Identity Center. The top navigation bar includes account information (N. Virginia, Akhil\_IAMUser@1157-7069-2037) and a search bar. Below the header, there are buttons for "Delete users" and "Add user" (which is circled in orange). The main table has columns for Status, MFA devices, and Created by. A message at the top states: "No users found". At the bottom of the table area is a large "Add user" button.

- Fill in all the necessary details for creating the SSO User

### Primary information

Username  
This username will be required for this user to sign in to the AWS access portal. The username can't be changed later.

Maximum length of 128 characters. Can only contain alphanumeric characters or any of the following: +,-,.,@,\_

Password  
Choose how you want this user to receive their password. [Learn more](#)  
 Send an email to this user with password setup instructions.  
 Generate a one-time password that you can share with this user.

Email address

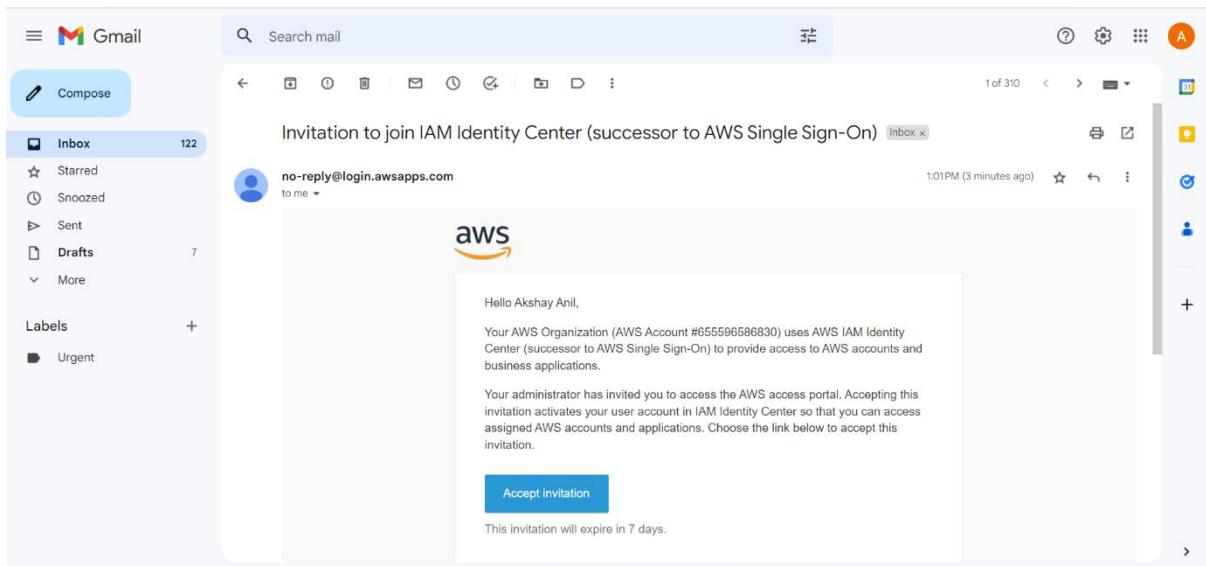
Confirm email address

First name

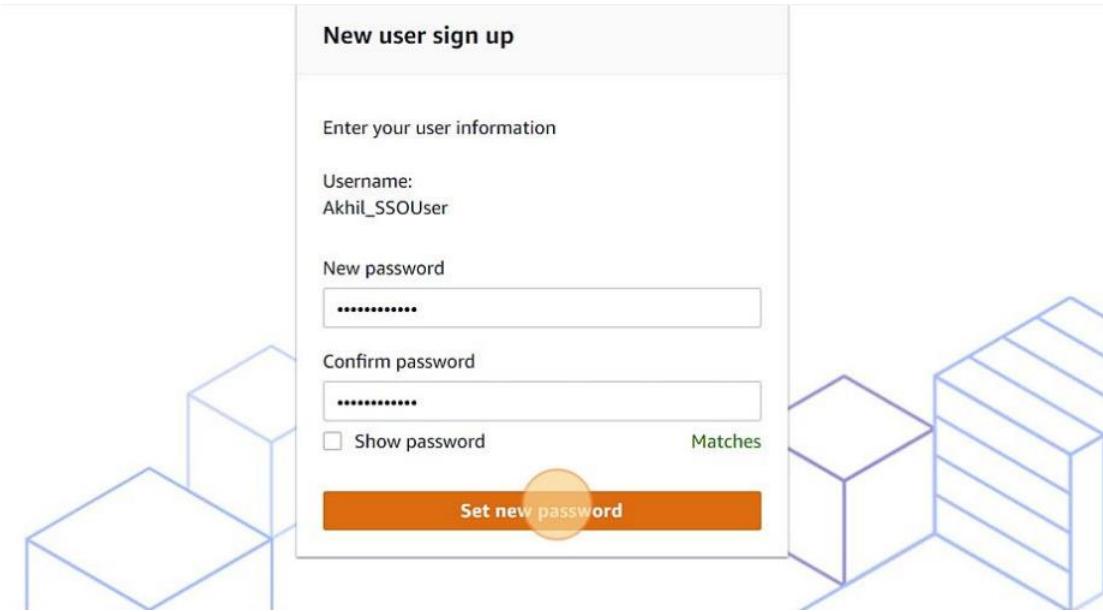
Last name

Display name  
This is typically the full name of the workforce user (first and last name), is searchable, and appears in the users list.

- Click Next and Create the user and check your email to accept the invitation



- After clicking on the accept invitation you have to set the password for the SSO User



### 1.3 Creating Digital Twin Instance

- Search for IOT Twin maker And open the service - AWS IOT Twin Maker and Click on "Create Workspace"



- Enter workspace name as "AirWorkspace"
- While Selecting S3 Bucket – Select “Create a S3 Bucket”
- For Execution Role “Auto Generate a new role”

### Workspace Information

**Name**  
AirWorkspace  
Name must be alphanumeric, unique and fewer than 128 characters. It must start with a letter and contain no spaces.

**Description - optional**  
Enter description.  
Description must be fewer than 512 characters.

**S3 bucket**  
Select an S3 bucket from the list below.

CORS configuration must be set for the S3 bucket, otherwise it will be added automatically.

**Execution Role**  
Select an IAM role with iottwinmaker trust permissions. IoT TwinMaker will use this to call other AWS services on your behalf. [Learn more](#)

**Tags**  
A tag is a label that you assign to an AWS resource. Each tag consists of a key and an optional value. You can use tags to search and filter your resources or track your AWS costs.  
No tags associated with the resource.  
  
You can add up to 50 more tags.

- Click “Next” and ensure that “Aws Managed Grafana” is selected in dashboard management

### Dashboard management - external

Interact with your digital twin on a Grafana dashboard using the IoT TwinMaker application plugin. The plugin provides custom panels, dashboard templates, and a data source to connect to your digital twin data.

**Dashboard management**

Select how you would like to manage your Grafana dashboards.

Amazon Managed Grafana  Self-managed Grafana

Amazon Managed Grafana manages Grafana servers for you so that you can visualize your data without having to build, package, or deploy any hardware or any other Grafana infrastructure. Follow the documentation to create an Amazon Managed Grafana workspace and configure settings.

[Go to Amazon Managed Grafana Documentation](#)

- Under grafana authentication account choose the IAM User and click “Next”

Status: **A** Active | Grafana version: 8.2

**Roles**  
AWSServiceRoleforOrganizations  
AWSServiceRoleforSSO  
AWSServiceRoleforSupport  
AWSServiceRoleforTrustedAdvisor

**Users**  
Akhil\_IAMUser

AWS datasource plugins in Grafana use an IAM authentication provider to make AWS service calls on your dashboard. To control data access and scope permissions to a TwinMaker workspace you will use this authentication provider to assume a scoped down dashboard role for your workspace.

### 1.3.1 Create Dashboard Policy

- Click copy code and then Click on “Create Policy In IAM”

```

{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "s3:GetObject"
            ],
            "Resource": [
                "arn:aws:s3:::twinmaker-workspace-airworspace-758280676580-iad",
                "arn:aws:s3:::twinmaker-workspace-airworspace-758280676580-iad/*"
            ]
        }
    ]
}
  
```

- IAM Console would pop-up and select JSON and paste the code you have copied previously

```

1  {
2      "Version": "2012-10-17",
3      "Statement": [
4          {
5              "Effect": "Allow",
6              "Action": [
7                  "s3:GetObject"
8              ],
9              "Resource": [
10                 "arn:aws:s3:::twinmaker-workspace-airworspace-758280676580-iad",
11                 "arn:aws:s3:::twinmaker-workspace-airworspace-758280676580-iad/*"
12             ]
13         },
14         {
15             "Effect": "Allow",
16             "Action": [
17                 "iottwinmaker:Get*",
18                 "iottwinmaker>List*"
19             ],
20             "Resource": [
21                 "arn:aws:iottwinmaker:us-east-1:758280676580:workspace/AirWorspace",
22                 "arn:aws:iottwinmaker:us-east-1:758280676580:workspace/AirWorspace/*"
23             ]
24         },
25         {
26             "Effect": "Allow",
27             "Action": "iottwinmaker>ListWorkspaces",
28             "Resource": "*"
29         }
30     ]
31 }
  
```

Security: 0 Errors: 0 Warnings: 0 Suggestions: 0

- Click on “Next Tags” and again click on “Next Review”

- Provide the name which is available in Twinmaker console

Create an IAM policy called **AirWorkspaceDashboardPolicy** by copying the permission policy template below. This policy gives ReadOnly access to your workspace's S3 bucket and TwinMaker resources.

- Verify the Name and click “Create Policy”

Create policy

1 2 3

Review policy

Name\*

Use alphanumeric and '+-, @-' characters. Maximum 128 characters.

Description

Maximum 1000 characters. Use alphanumeric and '+-, @-' characters.

Summary

This policy defines some actions, resources, or conditions that do not provide permissions. To grant access, policies must have an action that has an applicable resource or condition. For details, choose Show remaining. [Learn more](#)

Filter

Service	Access level	Resource	Request condition
---------	--------------	----------	-------------------

Allow (2 of 369 services) Show remaining 367

IoT TwinMaker	Full: List Limited: Read	Multiple	None
S3	Limited: Read	BucketName   string like   twinmaker-workspace-airworkspace-758200676580-1ad, ObjectPath   string like   All	None

Tags

Key	Value
-----	-------

No tags associated with the resource.

\* Required

Cancel

Previous

Create policy

### 1.3.2 Create Dashboard Role

- Click on the “Create dashboard role in IAM”

Create dashboard role

Create an IAM role with **AirWorkspaceDashboardRole** as its name. Attach **AirWorkspaceDashboardPolicy** to the **AirWorkspaceDashboardRole**.

- Create a role Under “IOT Twin Maker Service” and click “Next”.

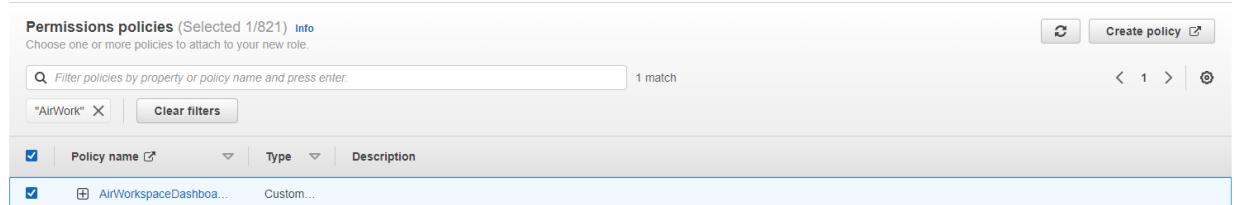
Use cases for other AWS services:

IoT TwinMaker

Allows IoT TwinMaker to call other AWS services on your behalf.

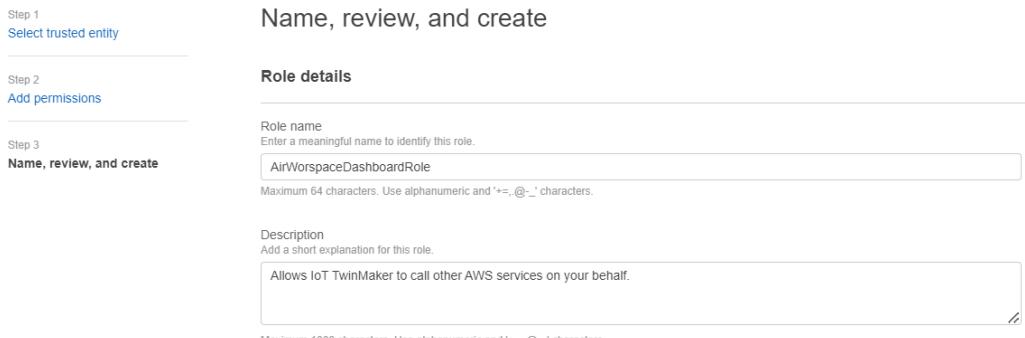
- Search for the dashboard policy (AirWorkspaceDashboardPolicy) and attach it and click “Next”.

## Add permissions



- Give the role name as defined in the console as “AirWorkspaceDashboardRole” and click “Create Role”

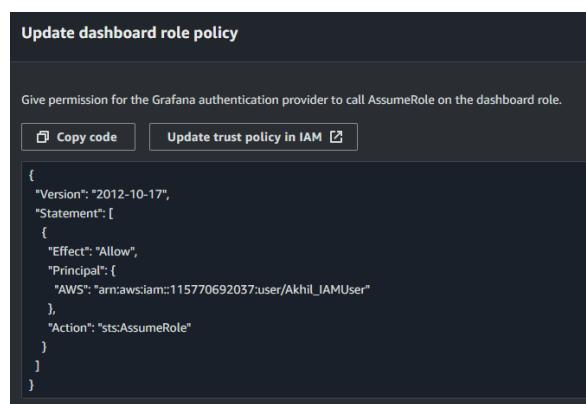
IAM > Roles > Create role



- Click on refresh and select the role you just created.



- Click on copy code and then click on “Update trust policy in IAM”



- The new tab which is opened will give you the option to edit the trust relationship of your dashboard role .

IAM > Roles > AirWorkspaceDashboardRole > Edit trust policy

#### Edit trust policy

```

1 - {
2   "Version": "2012-10-17",
3   "Statement": [
4     {
5       "Sid": "",
6       "Effect": "Allow",
7       "Principal": {
8         "Service": "iottwinmaker.amazonaws.com"
9       },
10      "Action": "sts:AssumeRole"
11    }
12  ]
13 }

```

**Edit statement**

Select a statement  
Select an existing statement in the policy or add a new statement.

**Add new statement**

- Clear the prewritten code and update the code with the one you copied and click on update policy

IAM > Roles > AirWorkspaceDashboardRole > Edit trust policy

#### Edit trust policy

```

1 - {
2   "Version": "2012-10-17",
3   "Statement": [
4     {
5       "Effect": "Allow",
6       "Principal": {
7         "AWS": "arn:aws:iam::115770692037:user/Akhil_IAMUser"
8       },
9       "Action": "sts:AssumeRole"
10    }
11  ]
12 }

```

**Edit statement**

Select a statement  
Select an existing statement in the policy or add a new statement.

**Add new statement**

### 1.3.3 Review & Create Workspace

- Verify all the three steps and click on "Create Workspace"

**Review and create**

**Step 1: Workspace details**

**Workspace details**

Name	S3 Bucket
AirWorkspace	Create an S3 bucket
Description	Execution Role
	Auto-generate a new role

**Step 2: Dashboard management — external**

**Dashboard management**

Dashboard management method	Authentication provider
Amazon Managed Grafana	Akhil_IAMUser

**Step 3: Dashboard role — external**

**Dashboard role**

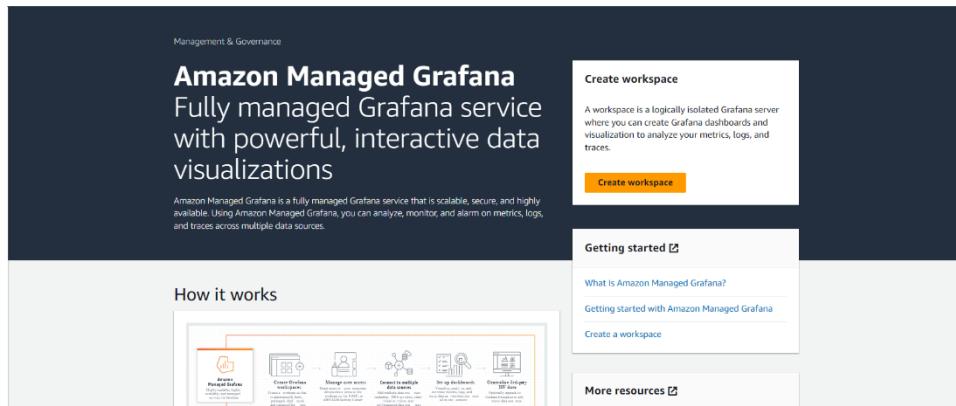
Dashboard role
AirWorkspaceDashboardRole

**Buttons:** Cancel, Previous, Create Workspace

## 1.4 Configuring Visualization

### 1.4.1 Creating Workspace

- Search for “Amazon Grafana” and click on “Create Workspace”



- Enter Workspace name as “AirWorkspaceGrafana” and click “Next”

#### Specify workspace details

A workspace is a logically isolated Grafana server. Once you have created a workspace, you can integrate it with data sources, then query and visualize metrics from those data sources. As part of creating a workspace, you will enable AWS IAM Identity Center (successor to AWS SSO) if you haven't done so already.

<b>Workspace details</b>
Workspace name Give a unique name to your workspace. <input type="text" value="AirWorkspaceGrafana"/>
Valid special characters include "-", ".", "_", "~". Cannot contain non-ASCII characters or spaces. Max length of 255 characters.
Workspace description - <i>optional</i> <input type="text"/>
► Tags - <i>optional</i> <input type="text"/>
<a href="#">Cancel</a> <a href="#">Next</a>

- Select Authentication Access as “Aws IAM Identity Center” and wait for it to get enabled and click “Next”

<b>Authentication access</b> <a href="#">Info</a>
Choose at least one authentication method.
<input checked="" type="checkbox"/> AWS IAM Identity Center (successor to AWS SSO) <span style="color: green;">Enabled</span>
You can enable IAM Identity Center by creating a user. This new user does not automatically have access to the Grafana console. You will still need to assign this user later, once this workspace is created.
<input type="checkbox"/> Security Assertion Markup Language (SAML)
You will need to complete additional steps to finish SAML configuration once this workspace is created.

- Under data sources and notification channels select “Amazon CloudWatch” and click “Next”

▼ Data sources and notification channels - *optional*

Data sources

Selecting an AWS data source below creates an IAM role that enables Amazon Grafana access to those resources in your current account. It does not set up the selected service as a data source. Note that some resources must be tagged GrafanaDataSource to be accessible.

<input type="checkbox"/>	Data source name
<input type="checkbox"/>	AWS IoT SiteWise
<input type="checkbox"/>	AWS X-Ray
<input checked="" type="checkbox"/>	Amazon CloudWatch
<input type="checkbox"/>	Amazon OpenSearch Service
<input type="checkbox"/>	Amazon Managed Service for Prometheus
<input type="checkbox"/>	Amazon TimeStream
<input type="checkbox"/>	Amazon Redshift
<input type="checkbox"/>	Amazon Athena

- Verify the workspace details and authentication access and click on “Create Workspace”

**Review and create**

Step 1: Specify workspace details [Edit](#)

Name and description	
Workspace name	Workspace description
AirWorkspaceGrafana	-

Step 2: Configure settings [Edit](#)

Authentication access	
AWS IAM Identity Center (successor to AWS SSO)	Security Assertion Markup Language (SAML)
<input checked="" type="radio"/> Enabled	<input type="radio"/> Disabled

Step 3: Automatic permission settings [Edit](#)

IAM permission access settings	
Account access specified	
Current account	
▶ Data sources and notification channels	

[Cancel](#) [Previous](#) [Create workspace](#)

- Click on “Assign new user or group” under Authentication

AWS IAM Identity Center (successor to AWS SSO)  
You can enable AWS IAM Identity Center by creating a user or connect IAM Identity Center to an external identity provider (IdP) to enable users to log in to the workspace with their existing credentials. Note that when you enable IAM Identity Center by creating a new user, you will need to assign this user access to the workspace before they can log in to the workspace.

Pending user input

Assign new user or group

⚠ Assign new users to the Grafana workspace so users can access the workspace URL.

- Select the SSO user which we created in 1.2.2 and click on “Assign users and groups”

Users (1) Groups (0)

Users (1)

Display name Email

Akhil Kumar akhilkumar@gmail.com

Selected users and groups (1)

Cancel Assign users and groups

- Select the user and click on actions and select the option of “Make Admin”

AWS IAM Identity Center (successor to AWS SSO)

Assigned users Assigned user groups

Users (1 of 1) Info

The following users have already been assigned access to Grafana.

Find users

Full name User type

Akhil Kumar Viewer

Action ▾

Assign user Unassign user Make admin Make editor Make viewer

Users (1) Info

The following users have already been assigned access to Grafana.

Find users

Full name User type

Akhil Kumar Admin

Action ▾

#### 1.4.2 Connecting Grafana and IOT-Twinmaker

- Go to Twin maker and copy the execution role and open it in IAM console and open the trust relationship in it.

Workspace information

Name: AirWorkspace

Description: -

ARN: arn:aws:iottwinmaker:us-east-1:115770692037:workspace/AirWorkspace

Date created: March 24, 2023 at 02:50:58 (UTC+5:30)

Last modified: March 24, 2023 at 02:50:58 (UTC+5:30)

Edit Delete

53 resource twinmaker-workspace-airworkspace-115770692037-iad

Execution Role twinmaker-workspace-airworkspace-115770692037-iad

IAM > Roles > twinmaker-workspace-airworkspace-115770692037-iad

**twinmaker-workspace-airworkspace-115770692037-iad**

Allows IoT TwinMaker to call AWS services on your behalf.

**Summary** Edit

Creation date March 24, 2023, 02:50 (UTC+05:30)	ARN arn:aws:iam::115770692037:role/service-role/twinmaker-workspace-airworkspace-115770692037-iad
Last activity <span>2 hours ago</span>	Maximum session duration 1 hour

Permissions | **Trust relationships** | Tags | Access Advisor | Revoke sessions

**Trusted entities** Edit trust policy

```

1- [
2-   "Version": "2012-10-17",
3-   "Statement": [
4-     {
5-       "Effect": "Allow",
6-       "Principal": [
7-         {
8-           "Service": "iottwinmaker.amazonaws.com"
9-         }
10-       ],
11-       "Action": "sts:AssumeRole"
12-     }
13-   ]
14- ]

```

- Click on Edit Trust Policy and update it with the one provided below. Replace the brackets with your account id and IAM username

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "Service": "iottwinmaker.amazonaws.com"
      },
      "Action": "sts:AssumeRole"
    },
    {
      "Effect": "Allow",
      "Principal": {
        "AWS": "arn:aws:iam::{Account ID}:user/{IAM Username}"
      },
      "Action": "sts:AssumeRole"
    }
  ]
}
```

### Trusted entities

Entities that can assume this role under specified conditions.

```

1 [{"Version": "2012-10-17",
2   "Statement": [
3     {
4       "Effect": "Allow",
5       "Principal": {
6         "Service": "iottwimaker.amazonaws.com"
7       },
8       "Action": "sts:AssumeRole"
9     },
10    {
11      "Effect": "Allow",
12      "Principal": {
13        "AWS": "arn:aws:iam::115770692037:user/Akhil_IAMUser"
14      },
15      "Action": "sts:AssumeRole"
16    }
17  ]
18}
19 ]
```

- Now open the dashboard role you created in 1.3.2 while creating the twinmaker workspace.

[IAM](#) > [Roles](#) > [AirWorkspaceDashboardRole](#)

### AirWorkspaceDashboardRole

Allows IoT TwinMaker to call other AWS services on your behalf.

[Delete](#) [Edit](#)

Summary	
Creation date March 24, 2023, 02:34 (UTC+05:30)	ARN <a href="#">arn:aws:iam::115770692037:role/AirWorkspaceDashboardRole</a>
Last activity None	Maximum session duration 1 hour
<a href="#">Link to switch roles in console</a> <a href="https://signin.aws.amazon.com/switchrole?roleName=AirWorkspaceDashboardRole&amp;account=115770692037">https://signin.aws.amazon.com/switchrole?roleName=AirWorkspaceDashboardRole&amp;account=115770692037</a>	

[Permissions](#) [Trust relationships](#) [Tags](#) [Access Advisor](#) [Revoke sessions](#)

**Permissions policies (1) [Info](#)**  
You can attach up to 10 managed policies.

[Filter policies by property or policy name and press enter.](#)

Policy name	Type	Description
<a href="#">AirWorkspaceDashboardPolicy</a>	Customer managed	

- Go to Grafana dashboard and copy the ARN provided

[AirWorkSpaceGrafana](#)

[Delete](#)

Summary	
Description -	Date created 2023-03-24
Grafana workspace URL <a href="#">g-bb11ada427.grafana-workspace.us-east-1.amazonaws.com</a>	Authentication access IAM Identity Center
Status <a href="#">Active</a>	IAM role <a href="#">arn:aws:iam::115770692037:role/service-role/AmazonGrafanaServiceRole-ahbBCAmPY</a>
	Enterprise license <a href="#">Upgrade to Grafana Enterprise</a>
	Grafana version 8.4

- Go to Dashboard Role and edit the trust relationship and replace the bracket with arn of grafana

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "AWS": "arn:aws:iam::115770692037:user/Akhil_IAMUser"
      },
      "Action": "sts:AssumeRole"
    },
    {
      "Effect": "Allow",
      "Principal": {
        "AWS": "{PASTE IT HERE}"
      },
      "Action": "sts:AssumeRole"
    }
  ]
}
```

IAM > Roles > AirWorkspaceDashboardRole > Edit trust policy

### Edit trust policy

```

1
2   "Version": "2012-10-17",
3   "Statement": [
4     {
5       "Effect": "Allow",
6       "Principal": {
7         "AWS": "arn:aws:iam::115770692037:user/Akhil_IAMUser"
8       },
9       "Action": "sts:AssumeRole"
10      },
11      {
12        "Effect": "Allow",
13        "Principal": {
14          "AWS": "arn:aws:iam::115770692037:role/service-role
15            /AmazonGrafanaServiceRole-ahbBCAmPY"
16        },
17        "Action": "sts:AssumeRole"
18      }
19 ]

```

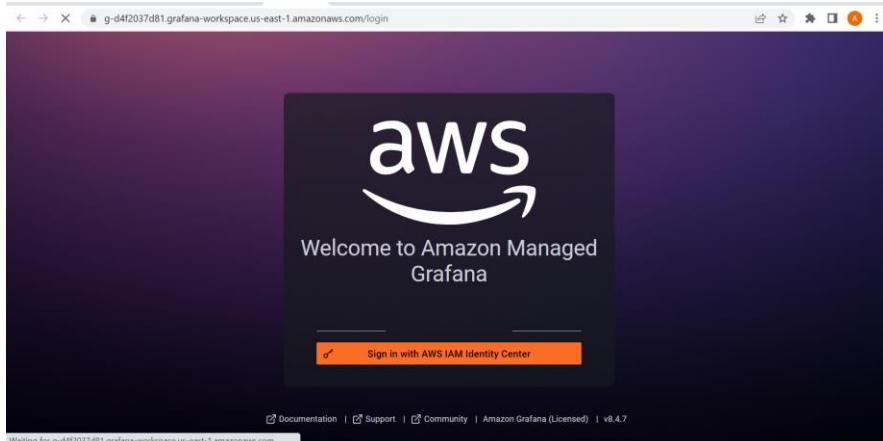
- Click “Update Policy”

- Open the grafana dashboard using grafana workspace url

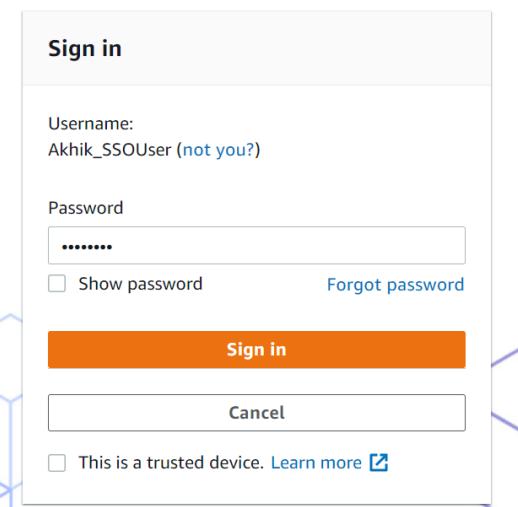
Grafana workspace URL

[g-bb11ada427.grafana-workspace.us-east-1.amazonaws.com](https://g-bb11ada427.grafana-workspace.us-east-1.amazonaws.com) 

- Open the url and click on “Sign in with AWS IAM Identity Center”



- Enter the Credentials and sign in



Sign in

Username:  
Akhik\_SSOUser (not you?)

Password  
.....

Show password      [Forgot password](#)

**Sign in**

[Cancel](#)

This is a trusted device. [Learn more](#) 

- Click “Sign In”

- Select the 6<sup>th</sup> icon (Gear Icon) and select data sources

The screenshot shows the Grafana interface with the following details:

- Header:** Welcome to Amazon Managed Grafana, Need help? Documentation, Tutorials, Community.
- Left Sidebar:** Basic, Configuration (selected), Data sources, Users, Teams, Plugins.
- Middle Panel:** TUTORIAL, DATA SOURCE AND DASHBOARDS, Grafana fundamentals, Set up and understand Grafana if you have no prior experience. This tutorial guides you through the entire process and covers the "Data source" and "Dashboards" steps to the right.
- Right Panels:** DATA SOURCES, Add your first data source, DASHBOARDS, Create your first dashboard.
- Bottom:** Learn how in the docs, Latest from the blog, Mar 22.

- Click on Add Data Source

The screenshot shows the Configuration page with the following details:

- Header:** Configuration, Organization: Main Org.
- Top Navigation:** Data sources (selected), Users, Teams, Plugins, Preferences, API keys, Recorded queries.
- Middle Section:** No data sources defined, Add data source button.

- Search for IOT Twinmaker and Select the option

The screenshot shows the 'Add data source' search results with the following details:

- Search Bar:** Q IOT, Clear, Cancel.
- Results:**
  - AWS IoT SiteWise: A managed service to collect, store, organize and monitor data from industrial equipment. Signed.
  - AWS IoT TwinMaker: Connect to digital twin data from AWS IoT TwinMaker. Signed.

- Go to iam console and search for your dashboard role

AirWorkspaceDashboardRole

Allows IoT TwinMaker to call other AWS services on your behalf.

**Summary**

Creation date	March 24, 2023, 02:34 (UTC+05:30)	ARN Copied
Last activity	None	Maximum session duration 1 hour

[Link to switch roles in console](https://signin.aws.amazon.com/switchrole?roleName=AirWorkspaceDashboardRole&account=115770692037)

<https://signin.aws.amazon.com/switchrole?roleName=AirWorkspaceDashboardRole&account=115770692037>

- Paste the arn copied in “Assume Role Arn” and give workspace name as “AirWorkspace”

Name: AWS IoT TwinMaker

**Connection Details**

Authentication Provider	Workspace IAM Role
Assume Role ARN	arn:aws:iam::115770692037:role/AirWorkspaceDashboardRole
External ID	External ID
Endpoint	https:// <service>.{region}.amazonaws.com</service>
Default Region	us-east-1

**TwinMaker settings**

Workspace: AirWorkspace (not found)

Define write permissions for Alarm Configuration Panel

- Click on “Save & Test” & your connection is successfully added as a data source

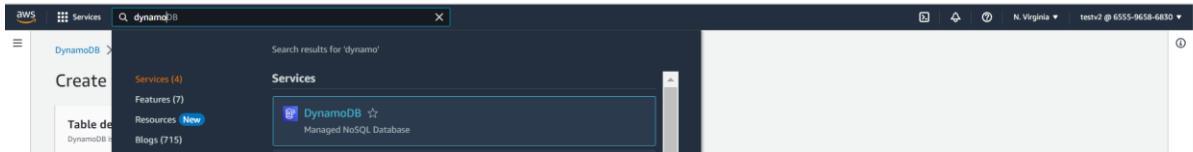
**TwinMaker datasource successfully configured (AirWorkspace)**

Back Explore Delete Save & test

## 1.5 Creating NoSql Database

### 1.5.1 Creating Schema

- Go To DynamoDB Console



- Create a DynamoDB table named TwinMakerTable that contains the key thingName of type String as partition key and the key timestamp of type Number as Sort key.

Note: names are case-sensitive as the same names are used to create schemas

Table details	
Table name	TwinMakerTable
Partition key	thingName
Sort key - optional	timestamp
Table settings	
<input checked="" type="radio"/> Default settings The fastest way to create your table. You can modify these settings now or after your table has been created.	
<input type="radio"/> Customize settings Use these advanced features to make DynamoDB work better for your needs.	

- Leave the rest of fields as it as – Click in Create

Name	Status	Partition key	Sort key	Indexes	Deletion protection	Read capacity mode	Write capacity mode	Total size	Table class
TwinMakerTable	Active	thingName (\$)	timestamp (N)	0	Off	Provisioned with auto scaling (5)	Provisioned with auto scaling (5)	0 bytes	Standard

## 1.5.2 Creating table items

- Create 5 items in the table, corresponding to 5 measurements of a sensor named airTwin
- Click in explore table items

The screenshot shows the AWS DynamoDB console. In the left sidebar, under 'Tables', there is a single entry for 'TwinMakerTable'. On the main page, the 'Indexes' tab is active, showing 'Global secondary indexes (0)'. There is a 'Create index' button at the bottom right of this section.

- Click on Create item

The screenshot shows the AWS DynamoDB console. Under 'Items', it says 'Completed. Read capacity units consumed 0.5'. Below this, there is a table titled 'Items returned (0)' which is currently empty. At the bottom right, there is a 'Create item' button.

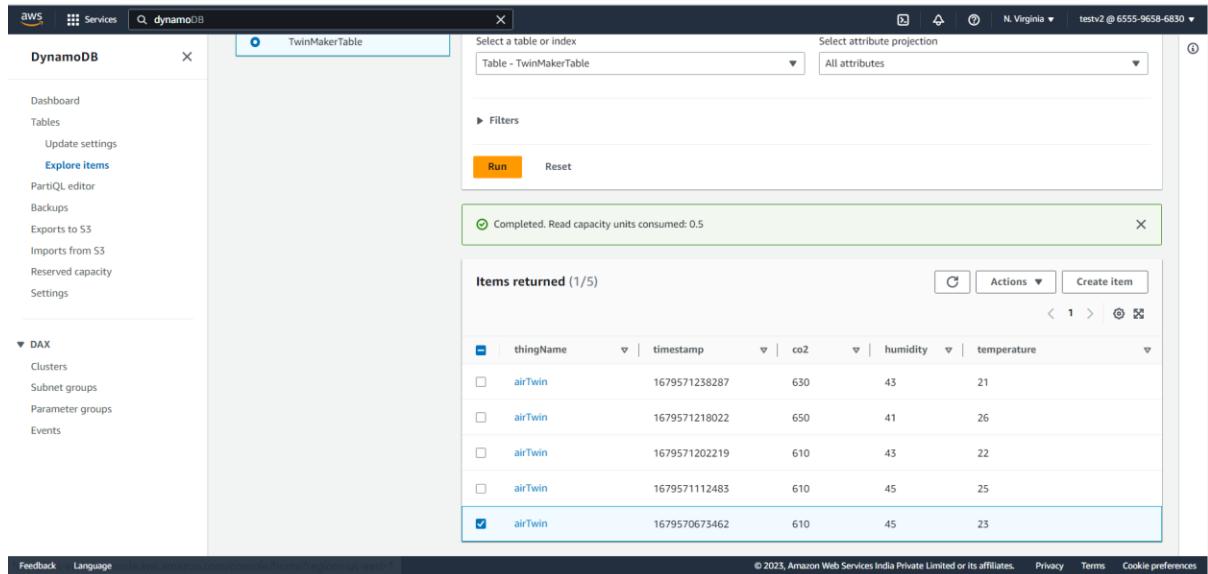
- Copy timestamp from the site mentioned below

The screenshot shows the 'Create item' dialog for the 'TwinMakerTable' table. The 'Attributes' section contains five entries:

Attribute name	Value	Type
thingName - Partition key	airTwin	String
timestamp - Sort key	1679570673462	Number
co2	610	Number
humidity	45	Number
temperature	23	String

At the bottom right of the dialog are 'Cancel' and 'Create item' buttons.

- Enter 5 random values for the properties: temperature, humidity and co2. You can get timestamp [Current Millis - Milliseconds since Unix Epoch](#)

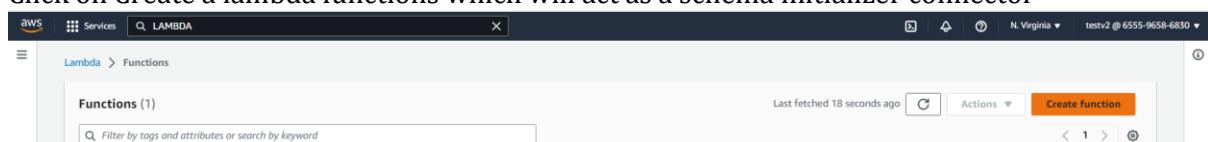


## 1.6 Creating Connectors

- We will creating two lambda functions which will be acting as connectors for twinmaker to read data from database such as DynamoDB.
- We will be creating two lambda functions one for identifying the schema and one for data reader

### 1.6.1 Creating Schema Initializer

- Go to lambda console
- Click on Create a lambda functions which will act as a schema initializer connector

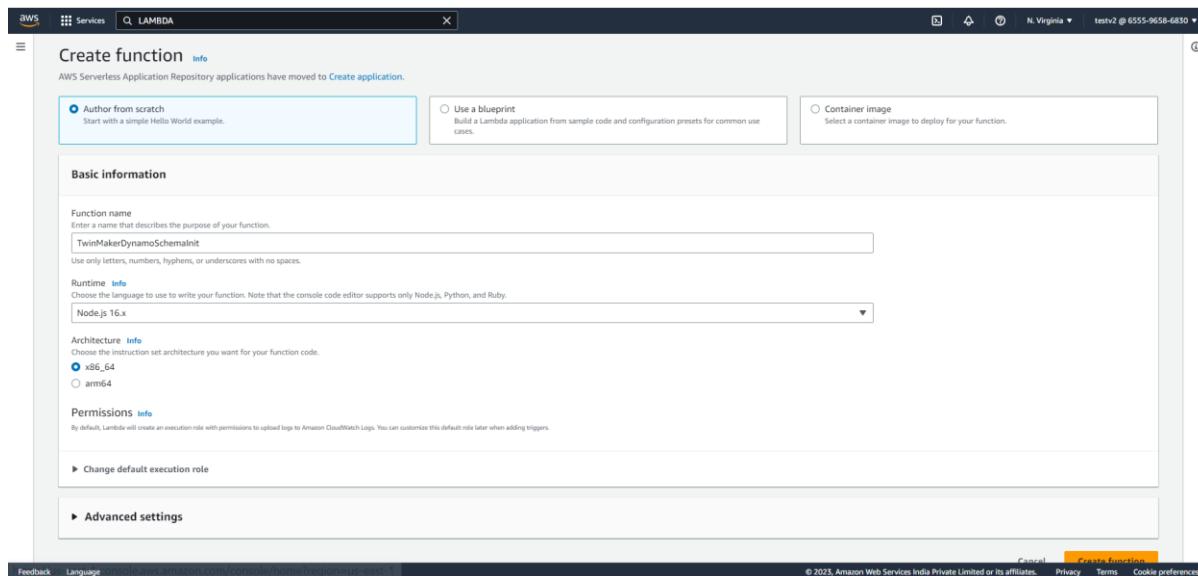


- Under Basic Information

For Function Name:- TwinMakerDynamoSchemaInit

For Runtime:- Node.js 16x

- Choose Create Function



- Under Function code, in the inline code editor, copy/paste the following code and click "Deploy"

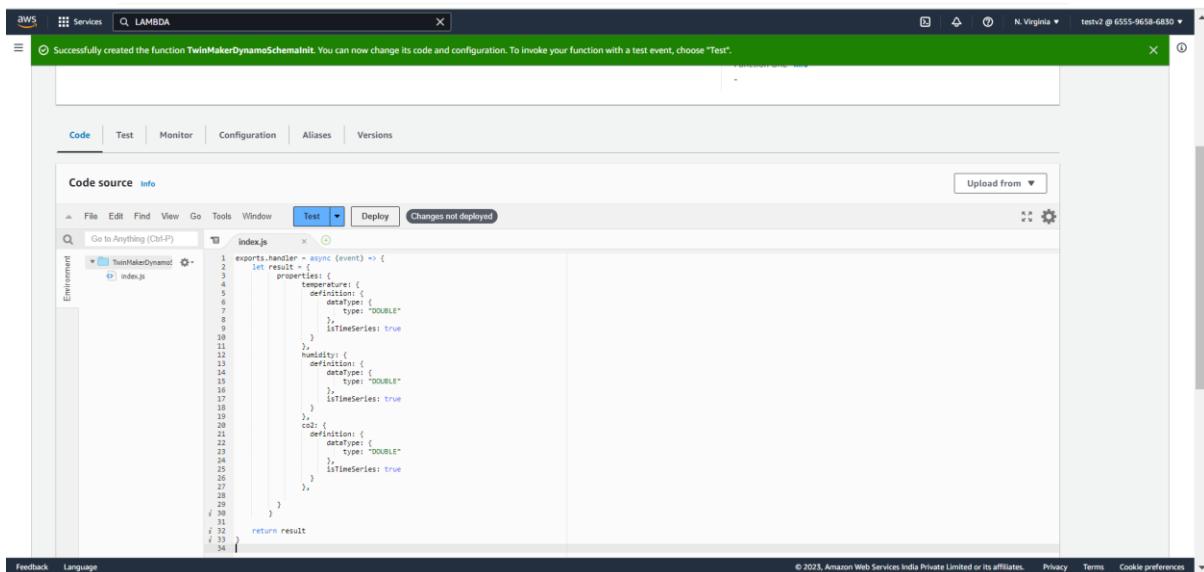
```
exports.handler = async (event) => {
  let result = {
    properties: {
      temperature: {
        definition: {
          dataType: {
            type: "DOUBLE"
          },
          isTimeSeries: true
        }
      },
      humidity: {
        definition: {
          dataType: {
            type: "DOUBLE"
          },
          isTimeSeries: true
        }
      },
      co2: {
        definition: {
          dataType: {
            type: "DOUBLE"
          },
          isTimeSeries: true
        }
      },
    }
  };
  return result;
}
```

```

        }
    }

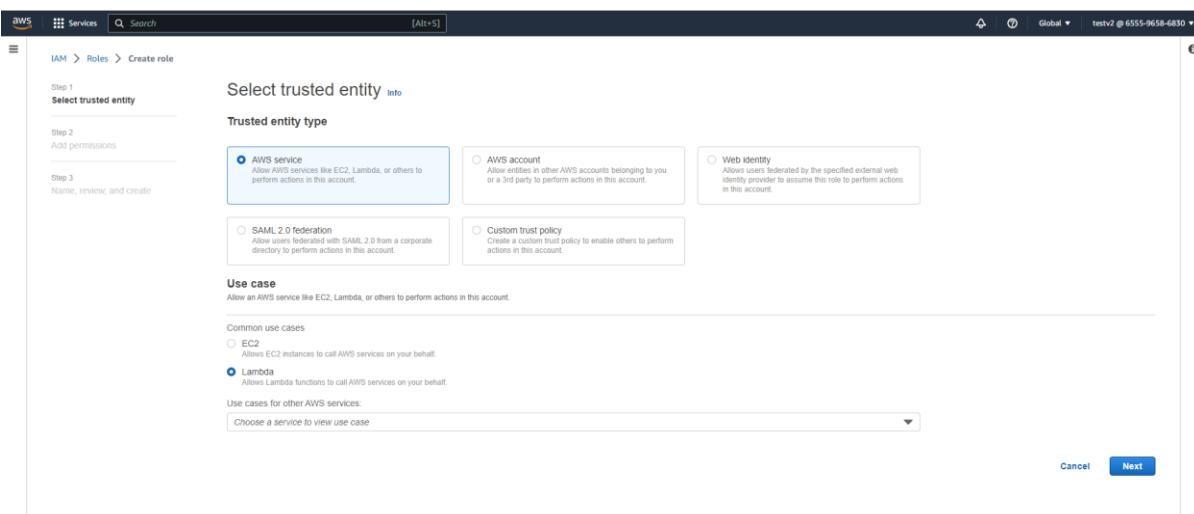
    return result
}

```



## 1.6.2 Creating Data Reader

- Create a second lambda function which will act as a data reader
- Before Creating a Data Reader we have to grant the function the access to the table.
- Create a IAM Role
- Choose Lambda as a Use Case



- Choose AdministratorAccess as policy

The screenshot shows the 'Add permissions' step of the IAM role creation wizard. In the 'Permissions policies' section, the 'AdministratorAccess' policy is selected. The policy details are shown as follows:

```

    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "sts:AssumeRole",
            "Principal": "*"
        }
    ]
}
  
```

- Give RoleName as dynamodatareader

The screenshot shows the 'Name, review, and create' step of the IAM role creation wizard. The 'Role details' section includes the role name 'dynamodatareader' and a description 'Allows Lambda functions to call AWS services on your behalf'. The 'Step 1: Select trusted entities' section displays the JSON policy code for the 'AdministratorAccess' policy.

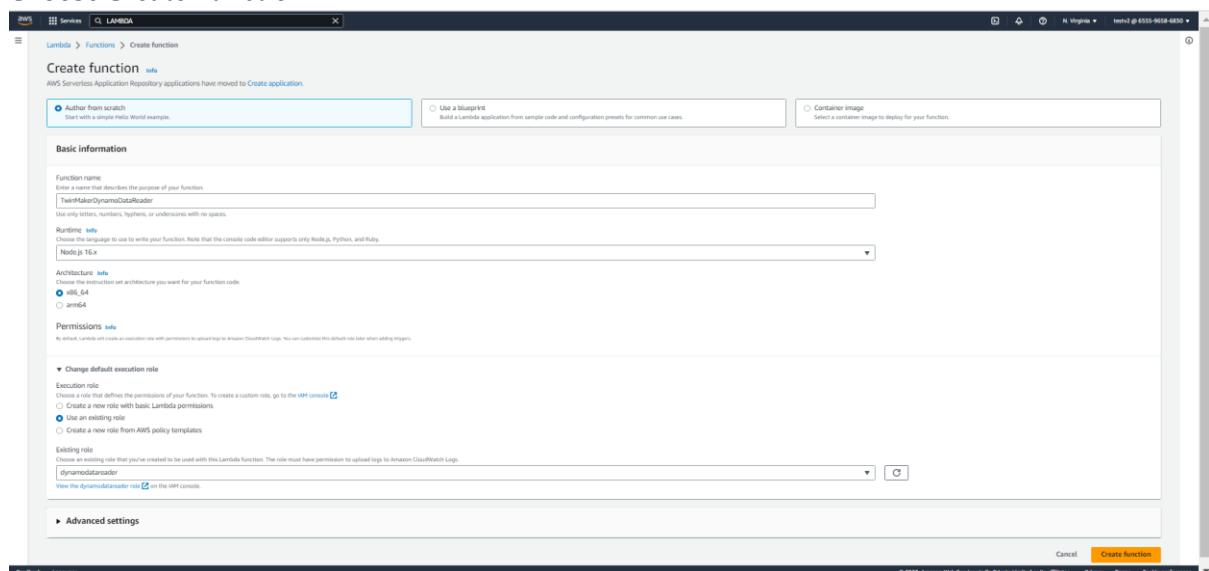
- Under Basic Information

For Function Name: TwinMakerDynamoDataReader

For Runtime:- Node.js 16x

For IAM Role :- dynamodatareader

- Choose Create Function



- Under Function code, in the inline code editor, copy/paste the following code and choose Deploy – this code is actually querying the data in DynamoDB

```

const TABLE = 'TwinMakerTable'
const aws = require('aws-sdk')
const dynamo = new aws.DynamoDB.DocumentClient()

exports.handler = async (event) => {
  try {

    let {workspaceId, entityId, componentName, selectedProperties, startTime,
      endTime} = event

    // QUERY THE DATABASE WITH THE SELECTED PROPERTIES
    const {Items} = await dynamo.query({
      TableName: TABLE,
      ProjectionExpression: `#${selectedProperties}, #tmsp`,
      KeyConditionExpression: `thingName = :hashKey AND #tmsp BETWEEN
        :startTime AND :endTime`,
      ExpressionAttributeNames: {
        '#tmsp': 'timestamp'
      },
      ExpressionAttributeValues: {
        ':hashKey': entityId,
        ':startTime': (new Date(startTime)).getTime(),
        ':endTime': (new Date(endTime)).getTime()
      }
    }).promise()

    let results = { propertyValues: [] }

    Items.forEach(item => {
      results.propertyValues.push(item)
    })
  }
}
  
```

```

let res = []
Items.forEach(item => {

    selectedProperties.forEach(prop => {
        if(!res[prop]){
            res[prop] = {
                entityPropertyReference:{},
                propertyName: prop,
                componentName,
                entityId: event.entityId

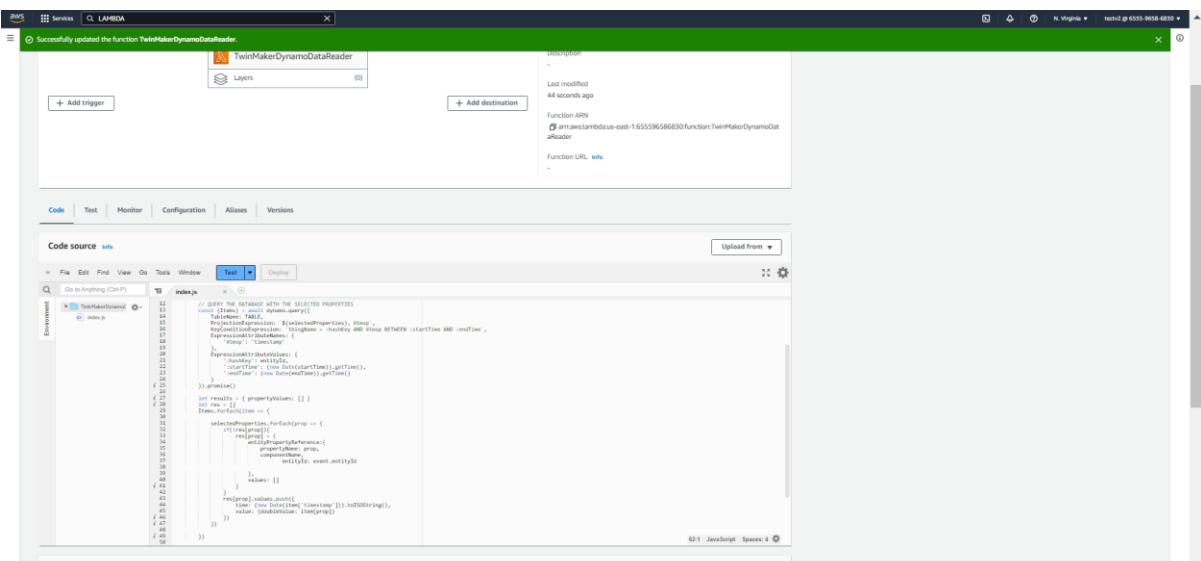
            },
            values: []
        }
    })
    res[prop].values.push({
        time: (new Date(item['timestamp'])).toISOString(),
        value: {doubleValue: item[prop]}
    })
})

for (let key in res){
    results.propertyValues.push(res[key])
}

console.log(results)
return results
} catch (e) {
    console.log(e)
}

}

```



### 1.6.3 Connecting IOT-Twinmaker & Lambda

- Find the execution role of iot-workspace

AWS IoT TwinMaker > Workspaces > test

**test** Info

**Workspace information**

Name	test	ARN	arn:aws:iot:twimaker:us-east-1:655596586830/workspace/test
Description	demo - twinmaker	Date created	March 23, 2023 at 12:55:31 (UTC+5:30)
		Last modified	March 23, 2023 at 12:55:31 (UTC+5:30)

**Entity model sources (0)**

- Go to IAM Console Roles and Search the above Execution Role

IAM > Roles > twinmaker-workspace-test-655596586830-iad

**Summary**

Creation date	March 23, 2023, 12:54 (UTC+05:30)	ARN	arn:aws:iam:655596586830:role/service-role/twinmaker-workspace-test-655596586830-iad
Last activity	3 hours ago	Maximum session duration	1 hour

**Permissions**

**Permissions policies (1) Info**

Policy name	Type	Description
twinmaker-workspace-test-655596586830-iad-AutoPolicy	Customer managed	Auto-generated role by IoT TwinMaker Console

**Permissions boundary - (not set) Info**

- Click on the Role and Add Permission under that attach **AdministratorAccess** Policy and update the role.

IAM > Roles > twinmaker-workspace-test-655596586830-iad

**Summary**

Creation date	March 23, 2023, 12:54 (UTC+05:30)	ARN	arn:aws:iam:655596586830:role/service-role/twinmaker-workspace-test-655596586830-iad
Last activity	3 hours ago	Maximum session duration	1 hour

**Permissions**

**Permissions policies (2) Info**

Policy name	Type	Description
twinmaker-workspace-test-655596586830-iad-AutoPolicy	Customer managed	Auto-generated role by IoT TwinMaker Console
AdministratorAccess	AWS managed - job function	Provides full access to AWS services and resources.

**Permissions boundary - (not set) Info**

## 1.7 Creating Components & Entities

- Go IOT-Twinmaker console
- Create an IOT Twinmaker Component

ID	Name	Definition	Status	Created at
com.amazon.athena.connector	-	Pre-defined	Active	November 11, 2022 a...
com.amazon.iotsitewise.alarm	-	Pre-defined	Active	July 15, 2022 at 22:53...
com.amazon.iotsitewise.connector	-	Pre-defined	Active	November 13, 2021 a...

- In the workspace, choose Component types and then choose Create component type
- Copy the following JSON document in the Request section and replace the ARN of the DataReader and Schema initializer functions respectively with the ones you created before:

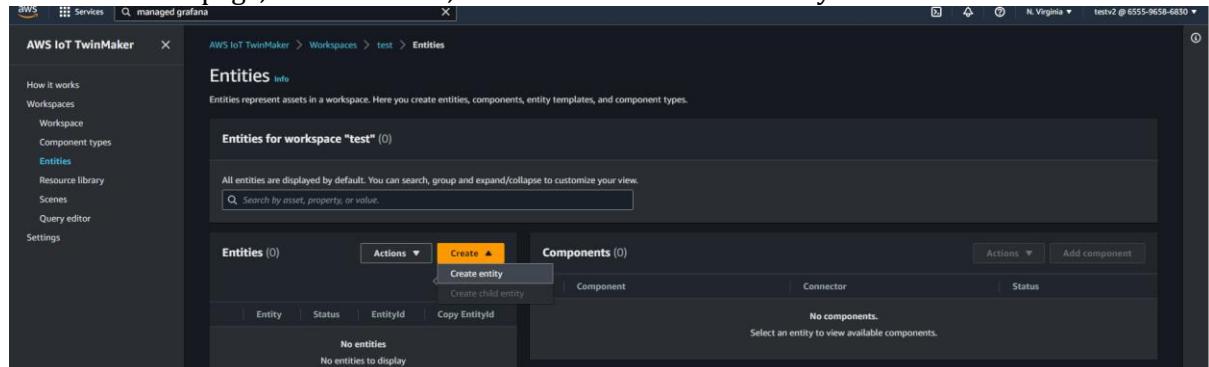
```
{
  "componentTypeId": "com.dynamodb.airQuality",
  "description": "Connector for DynamoDB - Use case Air Quality",
  "propertyDefinitions": {},
  "functions": {
    "dataReader": {
      "implementedBy": {
        "lambda": {
          "arn": "arn:aws:lambda:{AWS_REGION}:{ACCOUNT_ID}:function:TwinMakerDynamoDataReader"
        }
      }
    },
    "schemaInitializer": {
      "implementedBy": {
        "lambda": {
          "arn": "arn:aws:lambda:{AWS_REGION}:{ACCOUNT_ID}:function:TwinMakerDynamoSchemaInit"
        }
      }
    }
  }
}
```

The screenshot shows two open browser tabs. The top tab is titled 'TwinMakerDynamoSchemainit' under the 'Lambda > Functions' section. It displays a function overview with a thumbnail labeled 'TwinMakerDynamoSchema Init', a 'Layers' section showing '(0)', and buttons for '+ Add trigger' and '+ Add destination'. On the right, there are sections for 'Description', 'Last modified 9 minutes ago', 'Function ARN' (with a copied link), and 'Function URL'. The bottom tab is titled 'Request' under the 'AWS IoT TwinMaker' header. It shows a JSON file upload interface with a 'Choose file' button and a large text area containing a JSON configuration. The JSON code defines a component type with various properties like 'componentTypeId', 'description', 'propertyDefinitions', 'functions', 'dataReader', 'schemaInitializer', and 'lambda'. Below the JSON editor is a 'Tags' section. The bottom of the screen includes standard AWS navigation links: Feedback, Language, © 2023, Amazon Web Services India Private Limited or its affiliates., Privacy, Terms, and Cookie preferences.

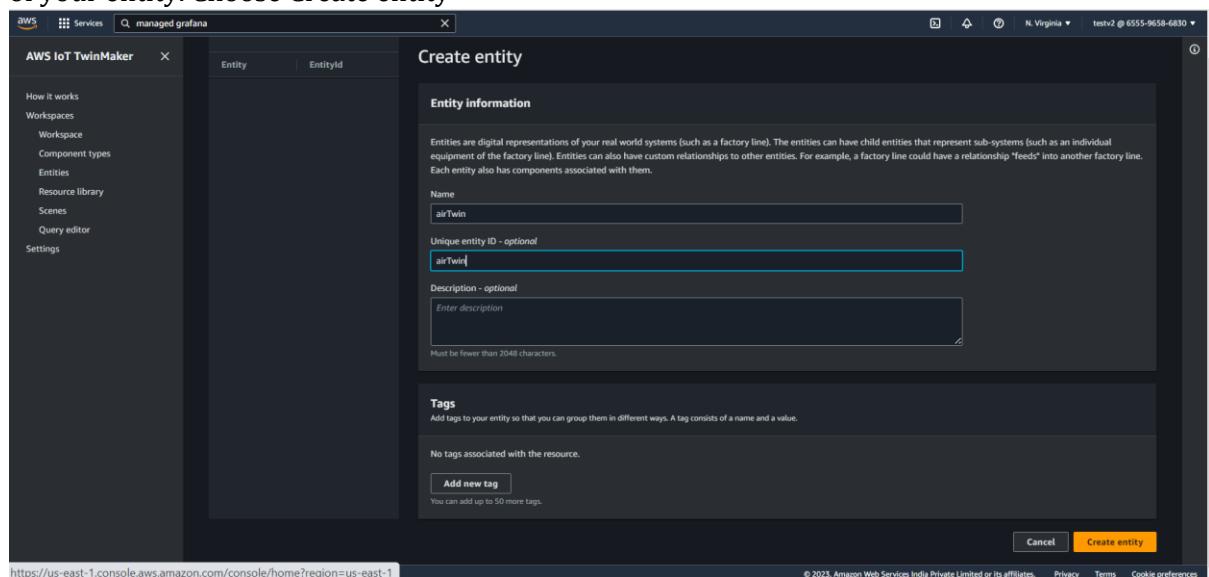
- Click on Create Component type
- On the Workspaces page, choose your workspace, and then in the left pane choose Entities.

The screenshot shows the 'Entities' page within the 'AWS IoT TwinMaker' interface. The left sidebar is set to 'Entities'. The main area is titled 'Entities for workspace "test" (0)'. It contains a search bar and a table with columns for Entity, Status, EntityId, and Copy EntityId. A message indicates 'No entities to display'. To the right, there is a 'Components (0)' section with a message 'No components. Select an entity to view available components.' and a 'Create component' button.

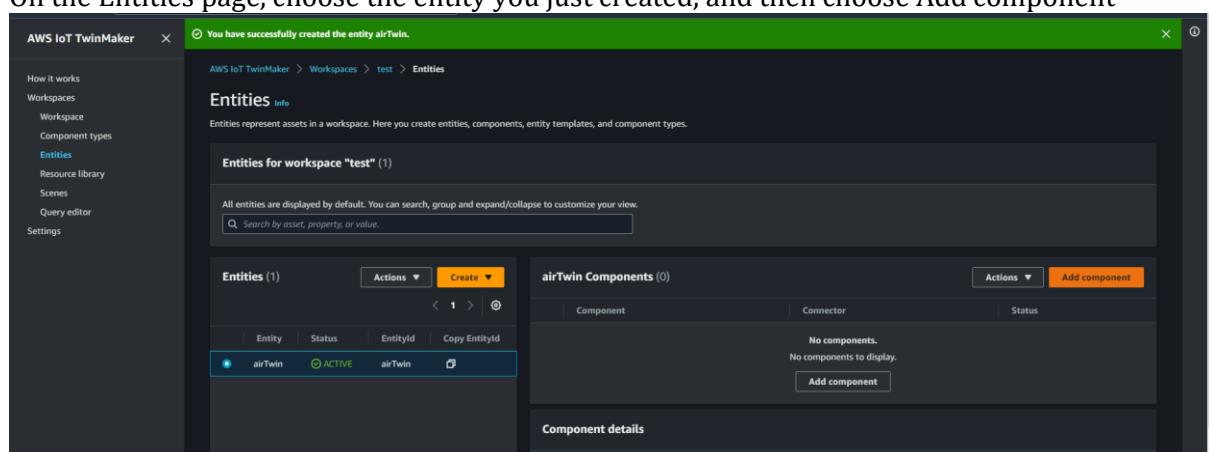
- On the Entities page, choose Create, and then choose Create entity.



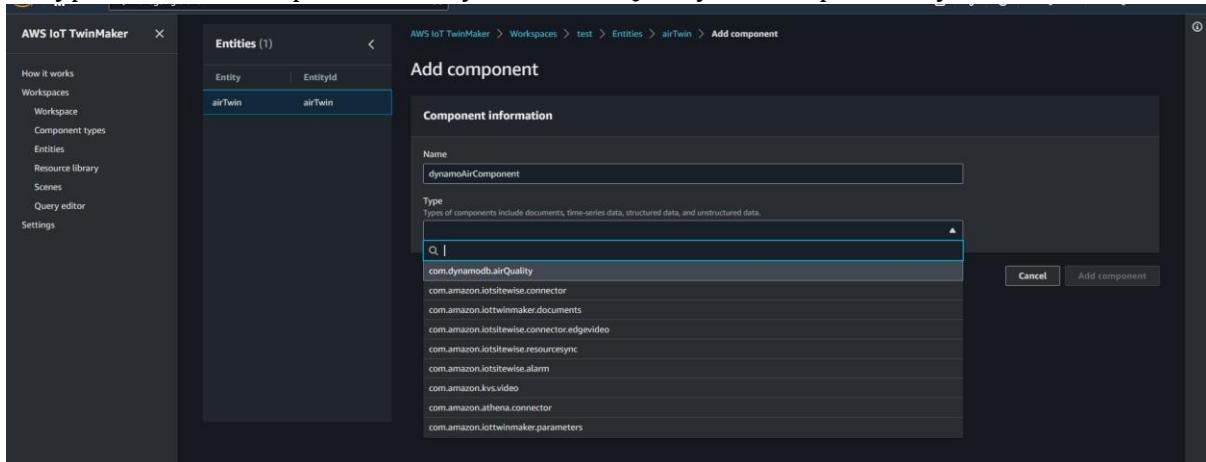
- In the Create an entity window, enter airTwin for the entity name and also for the entity ID of your entity. Choose Create entity



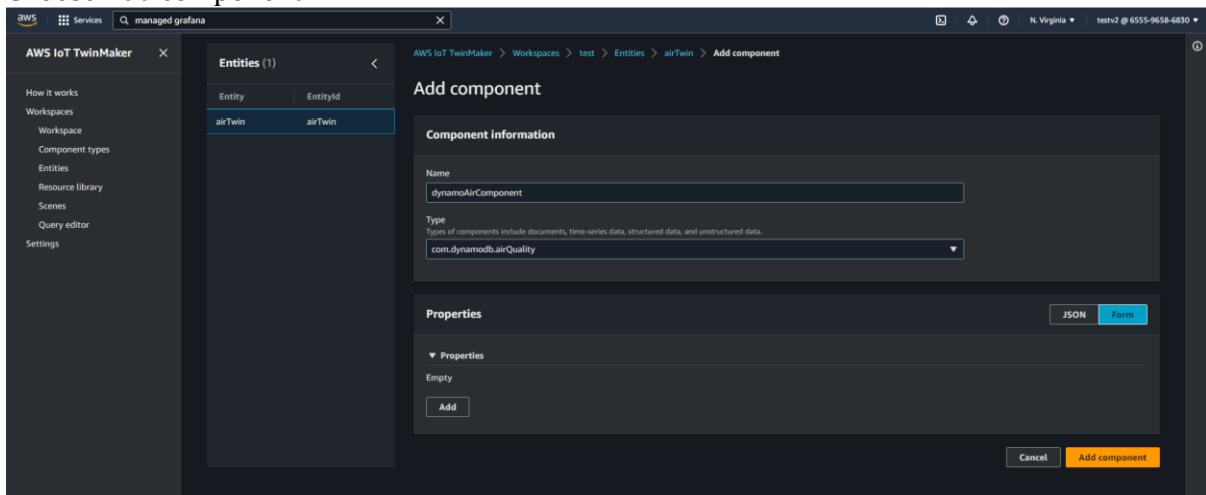
- On the Entities page, choose the entity you just created, and then choose Add component



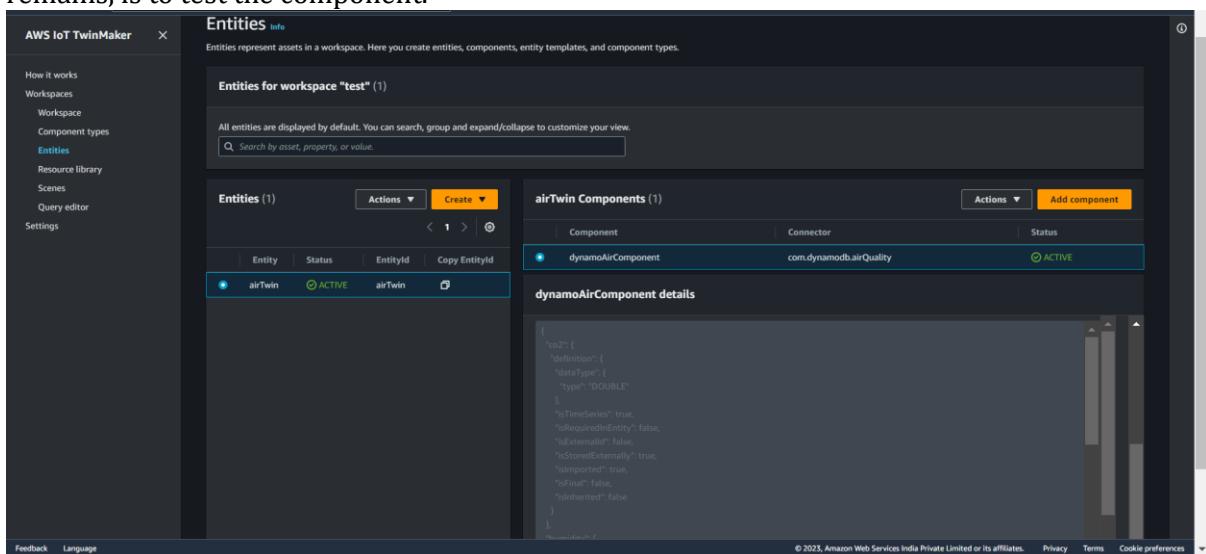
- Enter a name for the component. You can call it dynamoAirComponent
- In Type, select the component com.dynamodb.airQuality created previously



- Choose Add component.



- The component is attached to the entity with the ID airTwin. Now the only step that remains, is to test the component.



- On the Entities page, choose the entity airTwin, and then select the component com.dynamodb.airQuality
- Then choose Actions and View component details.

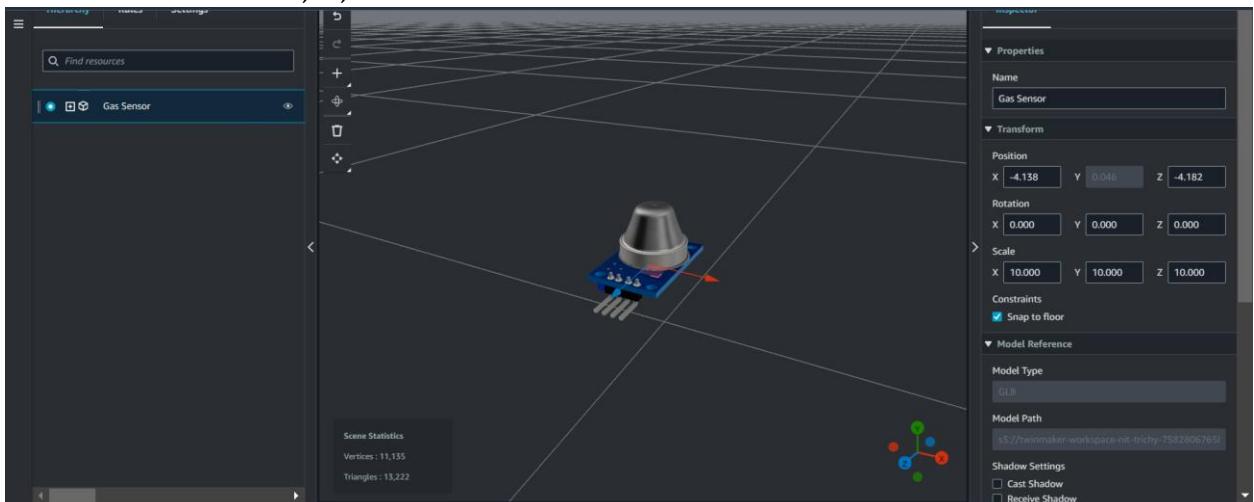
The screenshot shows the AWS IoT TwinMaker Entities page. On the left, there's a sidebar with options like 'How it works', 'Workspaces', 'Component types', 'Entities' (which is selected), 'Resource library', 'Scenes', 'Query editor', and 'Settings'. The main area is titled 'Entities for workspace "test" (1)'. It shows a table with one row for 'airTwin'. To the right of the table, under 'airTwin Components (1)', there's a list with one item: 'dynamoAirComponent' (com.dynamodb.airQuality). Below this, a 'dynamoAirComponent details' panel is expanded, showing properties for 'co2': Property (co2), Display Name (-), Data type (Double), isTimeSeries (True), Storage (External), and Latest value (External). There's also a 'Test' tab where properties like Co2, Humidity, and Temperature can be selected, along with a time range selector set to 'Last 6 hours'.

- In the tab Test, select the properties you want to retrieve and a time range. Make sure that the time range selected includes the timestamp of the measurements.
- Finally, choose Run test to test our component.

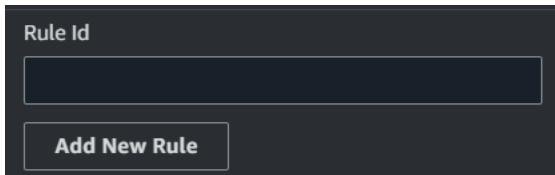
This screenshot shows the 'Test connector' configuration page. It has sections for 'Timeseries properties (max 10 supported)' (Co2, Humidity, Temperature checked), a 'Time range' selector set to 'Last 6 hours', and a 'Status' indicator showing 'SUCCESS'. The 'Time-series result' section displays a JSON array of data points. One point is shown in detail: { "entityPropertyReference": { "componentName": "dynamoAirComponent", "externalIdProperty": {}, "entityId": "airTwin", "propertyName": "co2" }, "values": [ { "value": { "doubleValue": 610 }, "time": "2023-03-22T11:39:19.557Z" }, { "value": { "doubleValue": 600 }, "time": "2023-03-22T11:41:37.463Z" } ] }

## 1.8 Creating 3D Scene

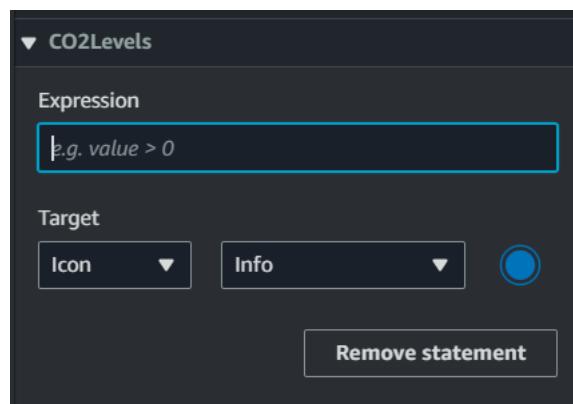
- Go to Resource Library and add a 3d Model. You can download the 3d model from github provided in the pre-requisite.
- Create a 3d Scene with Name AirSensor. Open the Scene and change the environment to Neutral
- Add 3d Model and select the model you just uploaded. Click on the 3d plane to place your 3d Model and Scale it to 10,10,10



- Go to Rules and give rule id as “CO2Levels” and click on “Add New Rule”



- Using Add New Statement change the “Target” as Colour



- Using Add New Statement apply the rules as following set Target as colour and Expression as given

The screenshot shows the configuration of two statements under the 'CO2Levels' rule. The first statement has an expression of 'co2 > 630' and a target color of '#d13212' (orange). The second statement has an expression of 'co2 < 630' and a target color of '#34d112' (green). Both statements include a 'Remove statement' button.

Statement	Expression	Target Color
1	co2 > 630	#d13212 (Orange)
2	co2 < 630	#34d112 (Green)

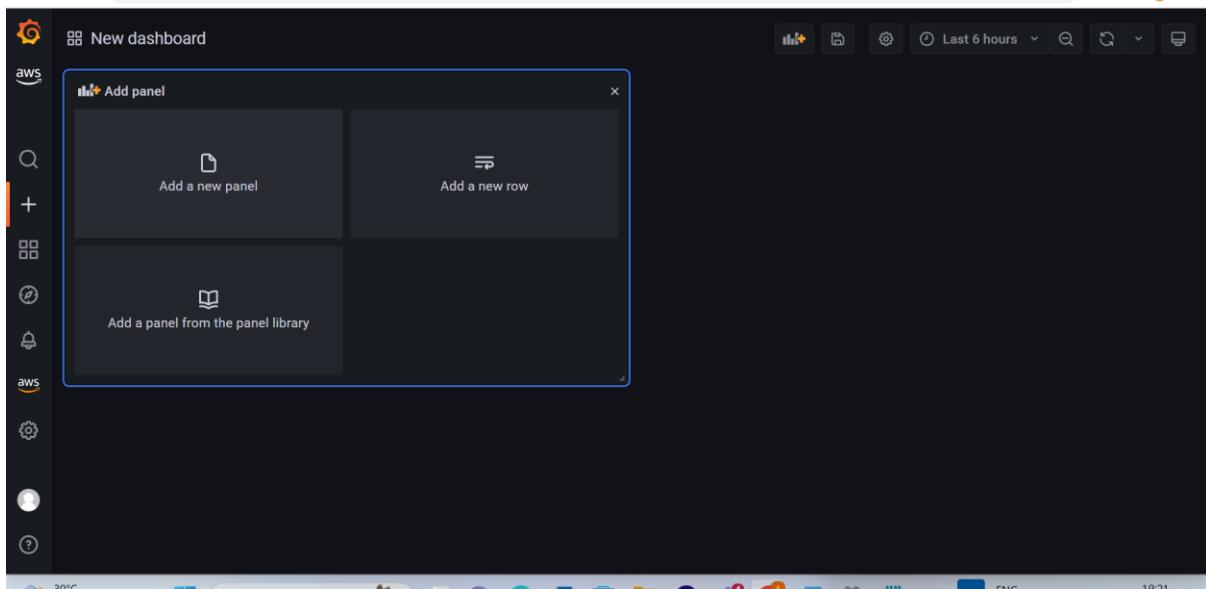
- Select the model you uploaded and using the plus symbol click on Add Model Shader.

The screenshot shows the configuration of a model shader for the 'airTwin' entity. It specifies the component name as 'dynamoAirComponent', property name as 'co2', and rule ID as 'CO2Levels'. A 'Remove' button is also present.

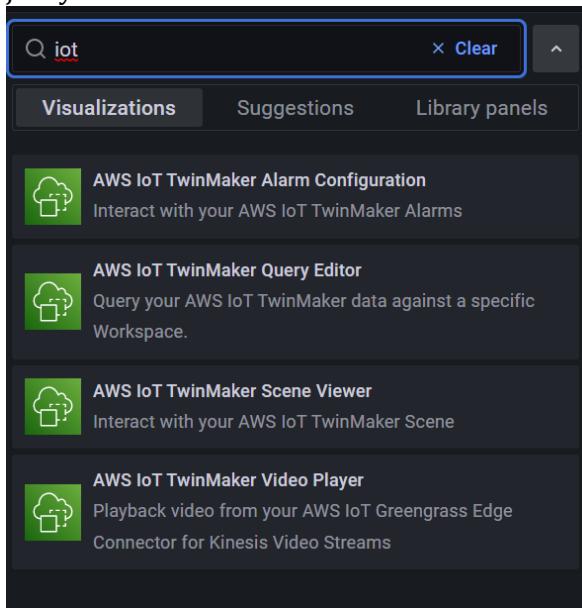
Setting	Value
Entity Id	airTwin
Component Name	dynamoAirComponent
Property Name	co2
Rule Id	CO2Levels

## 1.9 Working Dashboard

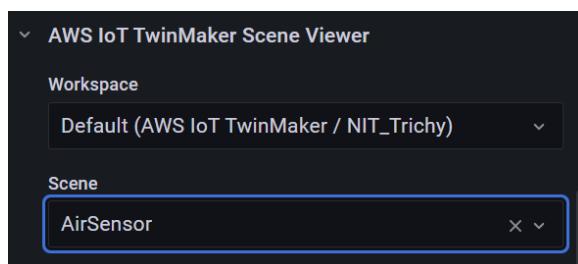
- Go to Grafana Dashboard using the plus symbol on left create a new dashboard



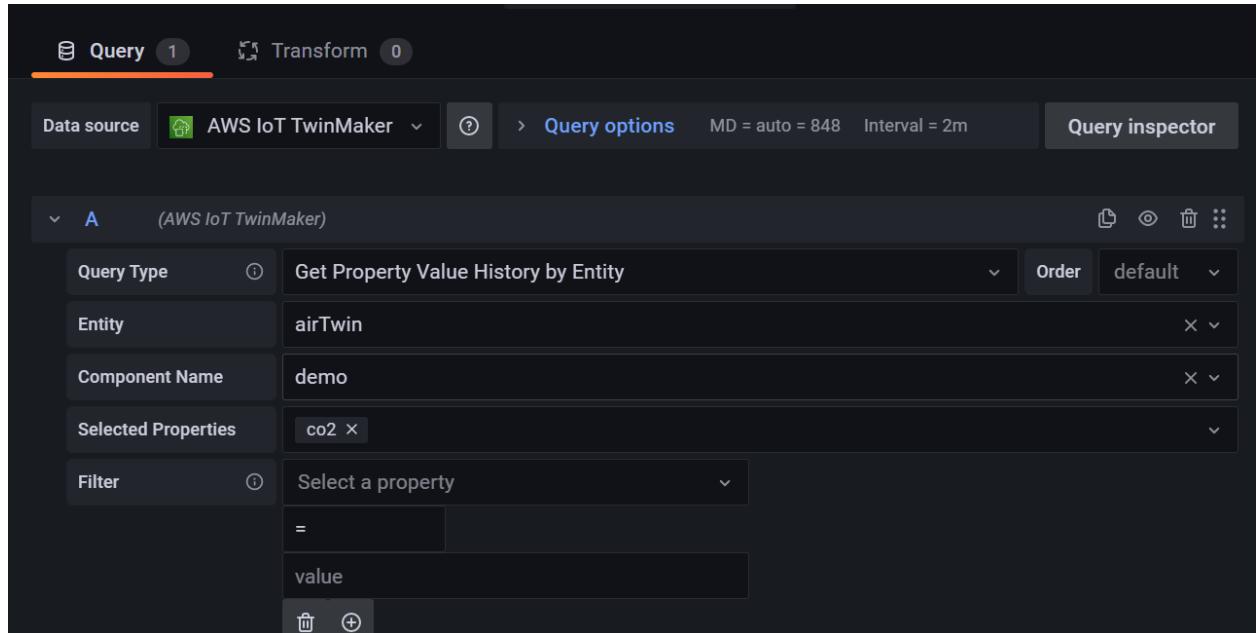
- Add a New Panel use Aws IoT Twin maker Scene Viewer under Scene select the scene which just you created



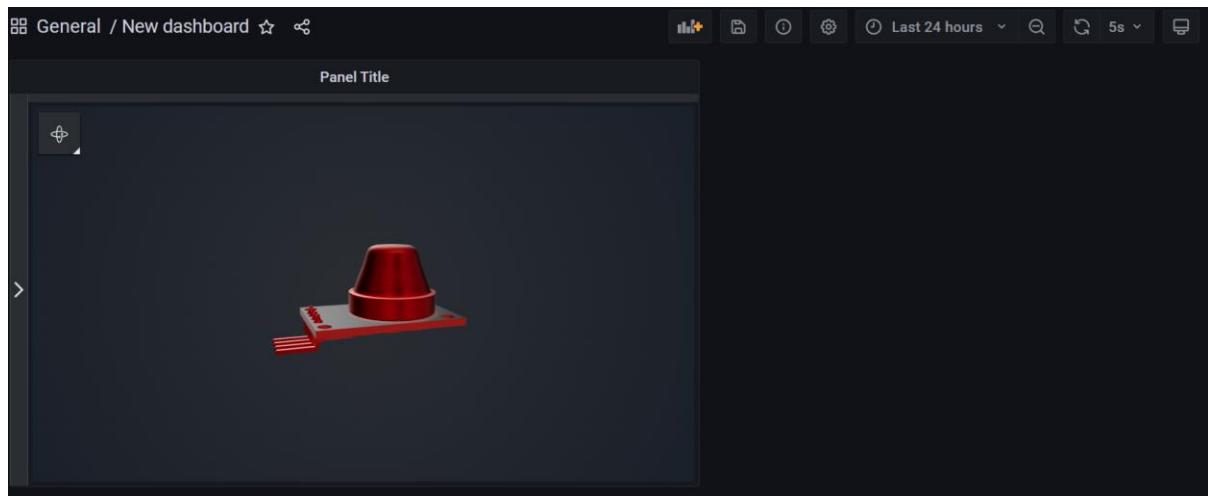
- In the Scene select the scene we created "AirSensor"



- Under the query inspector select “Query Type” as “Get Property Value History by Entity”.
- Select the entity as “AirTwin”, component as “dynamoaircomponent” and selected properties as co2



- Click on apply and save the dashboard

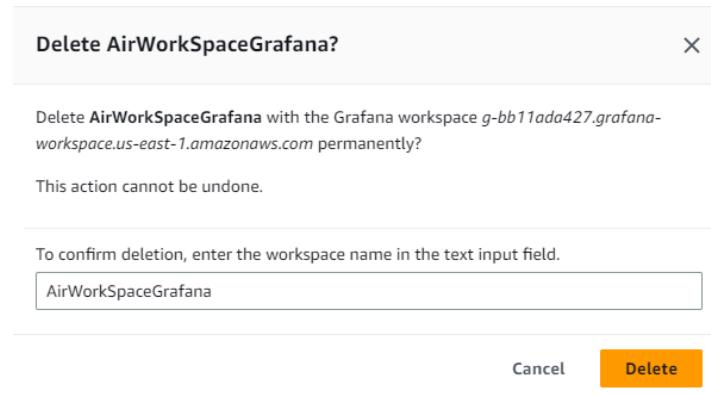


## 1.10 Deleting Resources

- Go To Amazon Grafana and select the workspace and then click on "Delete"

The screenshot shows the 'Workspaces' page in the Amazon Grafana interface. There is one workspace listed:

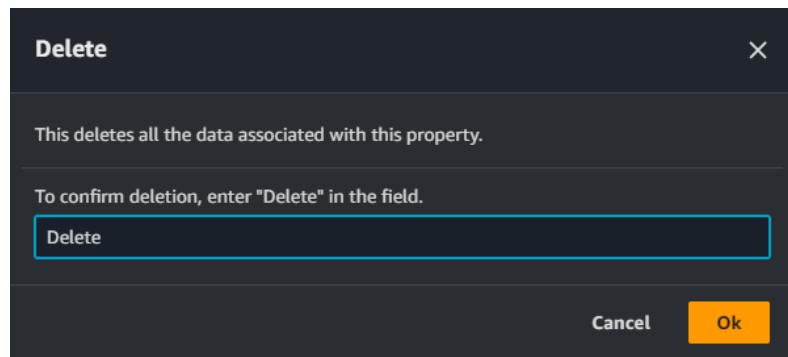
Workspace name	Grafana workspace URL	Status	Authentication	Version	Description	Date created
AirWorkSpaceGrafana	g-bb11ada427.grafana-workspace.us-east-1.amazonaws.com	Active	IAM Identity Center	8.4		Fri Mar 24 2023 05:07:0...



- Go To IOT-Twin maker Console and select the workspace and click on "Delete"

The screenshot shows the 'Workspaces' page in the IOT-Twin maker Console. There is one workspace listed:

Workspaces	Info
AirWorkspace	Workspaces are top-level containers for your digital twin applications. Select a workspace to update it.



- Go to DynamoDB Console and select the table and click on “Delete” and type “confirm” in the popped message

