

Information Sharing Portal for Indus Sub-systems

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Abstract— Indus complex is a synchrotron particle accelerator facility as particle accelerator in Raja Ramanna Centre for Advanced Technology (RRCAT), Indore: Indus-1 and Indus-2. Indus-1 and Indus-2 comprises of several subsystem like Magnet Power Supply (MPS) system, Vacuum system etc. There exists an automated Indus data acquisition system which stores the periodic data from these subsystems to SQL database. This raw data stored in the database is usually served to end user from web in tabular form. Extracting meaningful information from raw data is difficult and limits user to perform significant analysis on raw data. This work aims to provide solution to this real problem by providing the common portal where data analysis reports can be deployed to serve end users and to reduce the data retrieving load of the centralized database server. The reports are scheduled to be delivered in excel format at non-peak hours which improves the performance of database system. To develop initial prototype, a common task of tracing and displaying the power supplies data of Magnet Power Supply (MPS) sub-system during “ramping” and “cycling” events was selected. Daily generated graphical and tabular reports are deployed successfully on web portal.

Keywords — Indus-1, Indus-2, Magnet Power Supply (MPS)

I. INTRODUCTION

Indus complex is a national level synchrotron particle accelerator facility. There are two such particle accelerator in Raja Ramanna Centre for Advanced Technology (RRCAT), Indore: Indus-1 and Indus-2. Indus-1 and Indus-2 Synchrotron Radiation Sources (SRS) housed in Indus complex are cyclic particle accelerators that accelerate electrons up to 450 MeV and 2.5 GeV respectively. This multi accelerator complex has various subsystems—Magnet Power Supply (MPS), Vacuum Control System (VCS) etc. which are required to work in a stable manner to ensure the required machine performance.

Indus accelerator has its own dedicated Data Acquisition (DAQ) system that is developed and maintained by Accelerator Control Section (ACS) of RRCAT. This DAQ system not only plays a very significant role in administering and controlling the Indus operational activities remotely but also maintains Indus database that stores time series data of all Indus sub-system devices. This archived data is served to the Indus users on demand and serves a critical role in performing offline data analysis & diagnostics and understanding the machine behaviour.

Indus data logging architecture is divided as a three layer architecture from data management perspective. The bottom

and middle layer of the data acquisition system deals in collecting the device data of each subsystem and organising the data respectively. The top layer comprises of SCADA hardware control system, database system and web server.

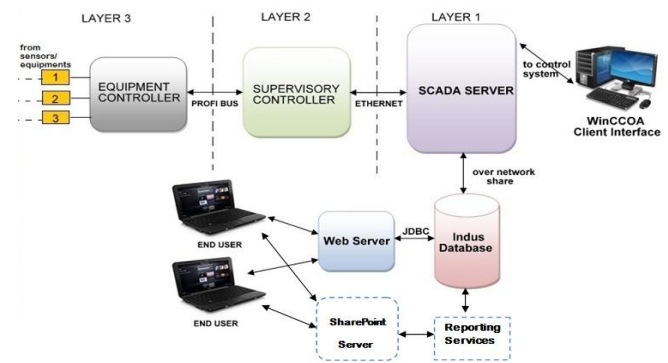


Figure 1: Indus data logging architecture

Limitations in present data retrieving architecture

The raw data stored in the database is usually served to end user from web server in tabular form which requires additional data pruning efforts to find any meaningful information. Besides this, there exists other issues like overloading of database server and network traffic in retrieving large dataset for extracting the desired information from raw data. Also, the end user is required to know data filtering and other data visualization skills.

This work aims to provide solution to this real problem by providing the common portal where data analysis reports can be deployed and appropriately organized to serve end user. It solves database overloading as direct interaction to the database system for large dataset is prevented. The reports will automatically deployed in excel format which decreases the network traffic to the database to some extent and hence improves its performance. Also this work provide interface to share the documents which includes document versioning. Live discussion board is also added to the webpage which will help the user to discuss anything regarding the report they get or can discuss any flaws in the sub system of Indus.

The objective of the work is to develop and deploy informative reports of MPS sub-system of Indus. During Indus operation, magnet power supplies are controlled to contain electron beam in desired orbit during energization of electron beam, this operational activity is termed asRamping. Also magnets installed in Indus accelerator are conditioned before commencement of Indus operation, this operation of conditioning of magnets is termed asCycling. It was required to trace the events of *Ramping* and *Cycling* of magnetsand present the relevant data in graphical for quick diagnosis. Initial step is to trace the daily events of Ramping and Cycling from the raw data accurately,and based on that events, retrieve the required data and perform data processing on retrieved data.

There are in total 138 power supplies in Indus MPS sub-system. All the power supply data at the time of ramping and cycling event are represented in the graphical as well as tabular formatand reports are deployedto web portal in excel format.

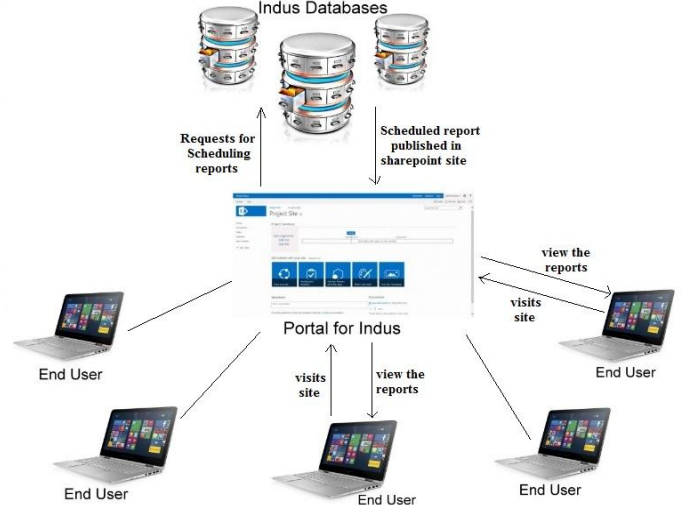


Figure 2 Automatic Report delivery to the user in proposed system

This work aims to deliver a user friendly environment for the user where they will get the readymade deployed report in excel format which will ease them to analysis. In this case, user will not have to interact directly with the database for large dataset queriesas desired reports are scheduled and deployed at web-portal in non-peak hours when there will be minimum traffic on the network. User will get the extracted information of ramping and cycling event along with corresponding graphical and tabular reports which will also solve the above mentioned limitation to some extent. There is additional discussion board for the user to discuss the topic at their ends. Figure 1.3 shows the pictorial representation of what the work aims to deliver.

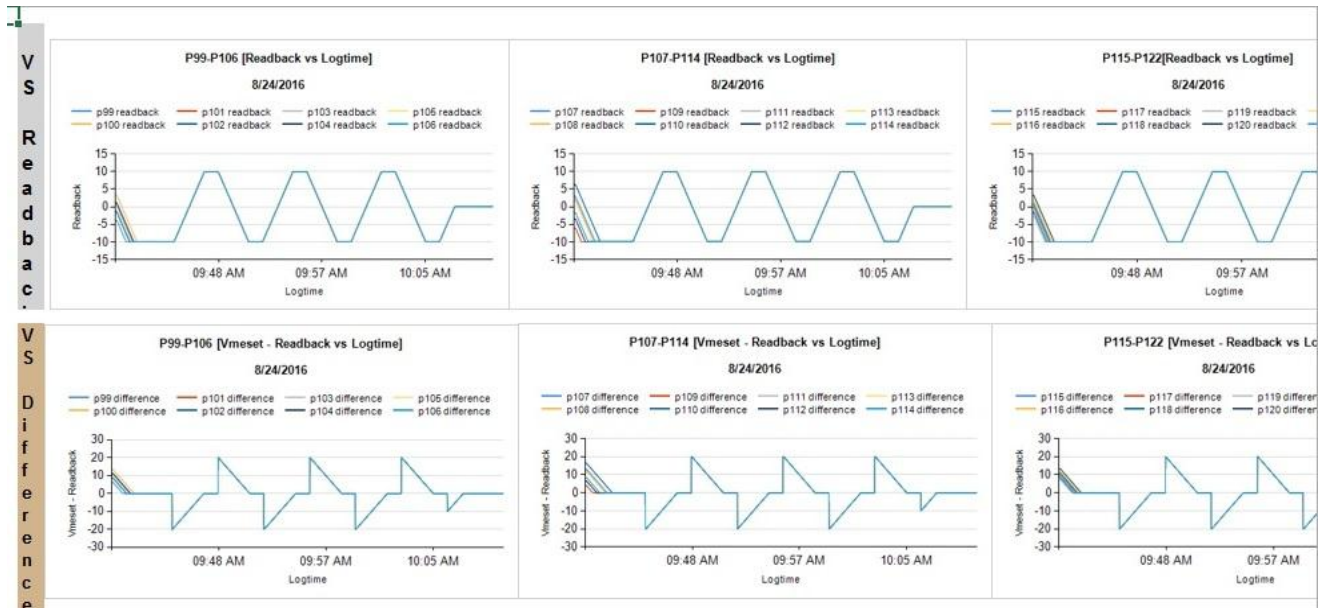


Figure 3: Graphical representation of published report

Tools required for this work are: MS SQL Server, MS SQL Server Reporting Services, and MS SharePoint Server. Details of these tools are covered in the next chapter.

II. SYSTEM SPECIFICATION

This chapter covers the system specification for the work. System specification includes the hardware and software requirement for the work.

Hardware requirement

The hardware configuration of the system which is used to develop this work is:

Server Machine: HP ProLiant DL380 Gen9 Server

Operating System: Windows Server 2012

Processor: Intel(R) Xenon(R) CPU E5-2620

RAM: 32 GB

Software requirement

The software tools which are used in development of this work are:

1. Microsoft SQL Server 2012: MS SQL Server Management Studio

2. Microsoft SQL Server Reporting Services 2012: Data tool- Visual Studio
3. Microsoft SharePoint Server 2013: Enterprise Edition

III. EXPERIMENTAL SETUP

This work is developed in virtual machine environments running on the Hyper-V tool. Microsoft Hyper-V, codenamed Viridian and formerly known as Windows Server Virtualization, is a native hypervisor; it can create virtual machines on x86-64 systems running Windows.

a. Flow for finding out solution

The steps involved in development of the work: Trace the event of Ramping and Cycling → Create datasets which results in the data of MPS at the time of the two events → Build the report in SSRS → Deploy this report into the SharePoint Server → Schedule this reports → Give Permissions to the user for the site → Adding additional web apps to the site to improve the User Interface of the site and to provide a facility to discuss any query within the portal using Discussion Board → Testing. This flow is presented well in Figure 4.

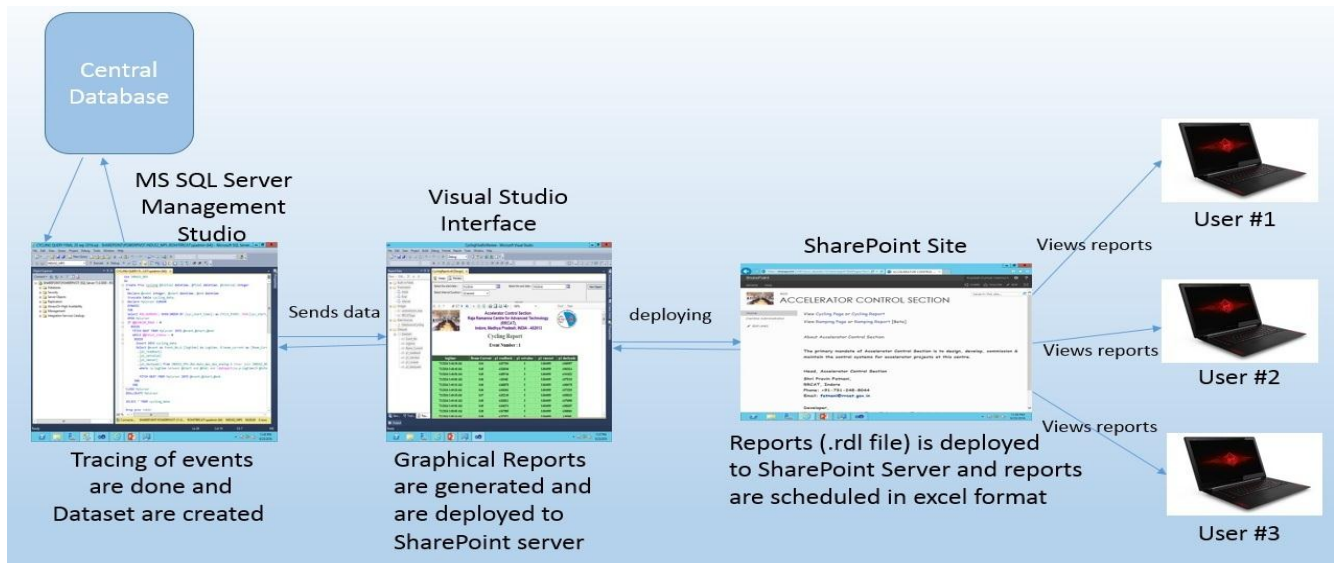


Figure 4: Work flow

b. Tracing Events

Events are traced using T-SQL query which is implemented in MS SQL Server Management Studio tool. *Algorithm TraceEvent ()* is used to trace the event and to fetch the power supplies data.

Algorithm TraceEvent ()

```
{
    1. Select time duration for event tracing, lets t1 and t2.
}
```

2. Record Total number of events and their respective start and end time are traced for time duration t_1 and t_2 .
3. Fetch Power supplies data from the database at the time of each event start and event end which is traced in the step 1 and 2.
4. Insert power supplies data at time of events into a new table NT.
5. Use NT table for creating datasets to support report generation.

III. PROPOSED DESIGN

Figure 5, Figure 6 and Figure 7 presents the context and it's deeper level of abstractions respectively.

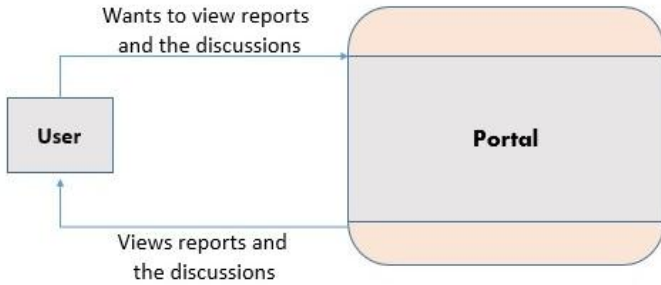


Figure 5: Context Diagram

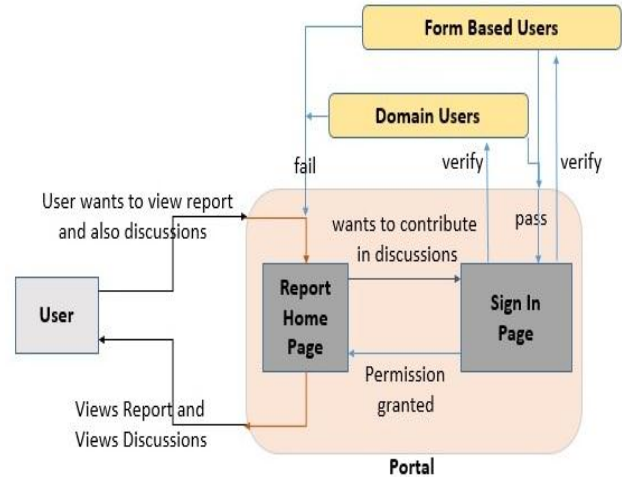


Figure 6: 2 Level DFD

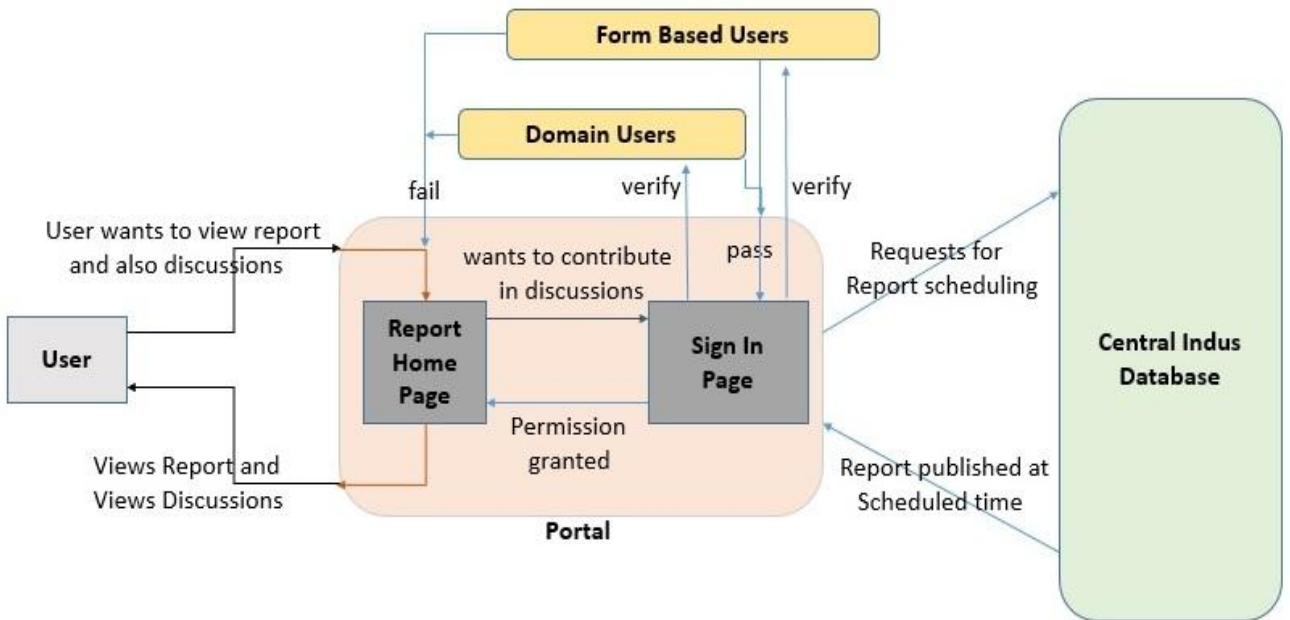


Figure 7: 3 Level DFD

Based upon the framework and flow presented in previous section the proposed User Interfaces have been demonstrated in Figure 8 to Figure 15. From the Home Page of the Portal, to year wise Cycling Reports Folder, monthly Excel format of deployed result and schedule, it presents

web-app of discussion board and document page to manage shared documents and feed back survey app .It also provides RDL files. The screenshots of these user interfaces depicts the typical layout for expected requirements.

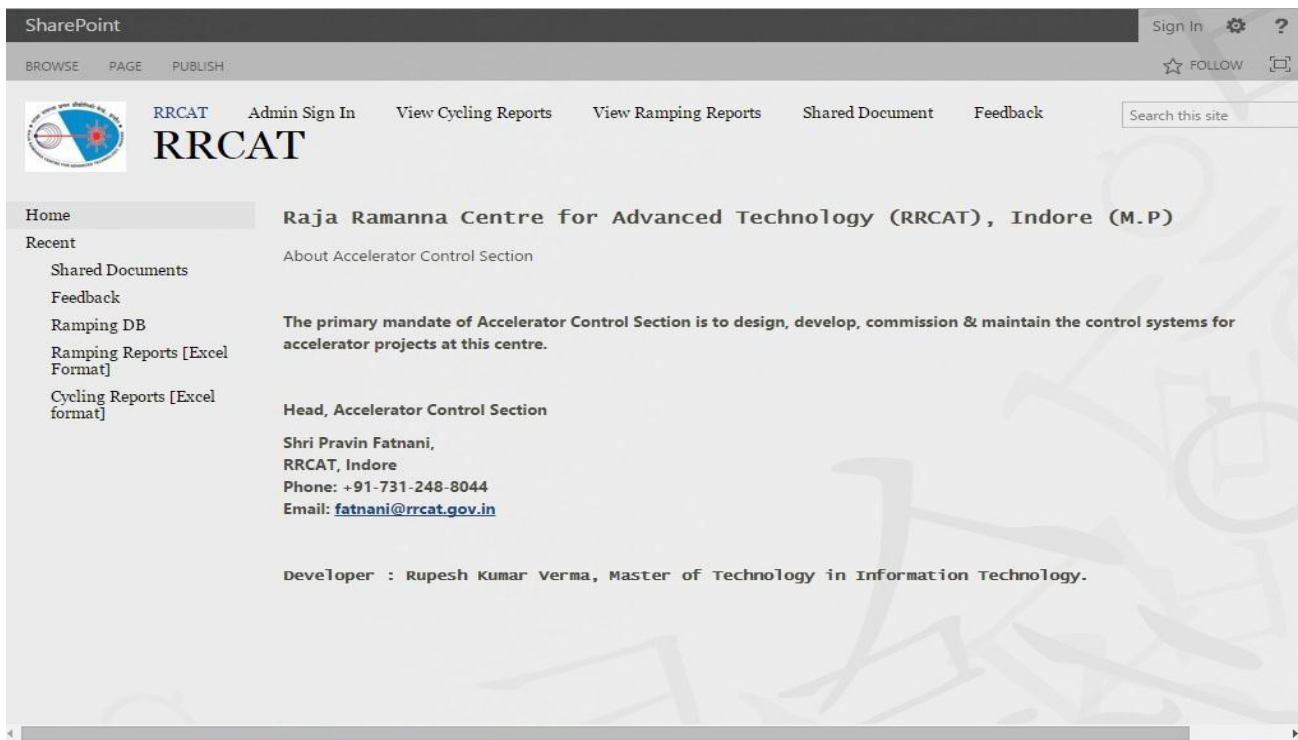


Figure 8: Home Page of the Portal

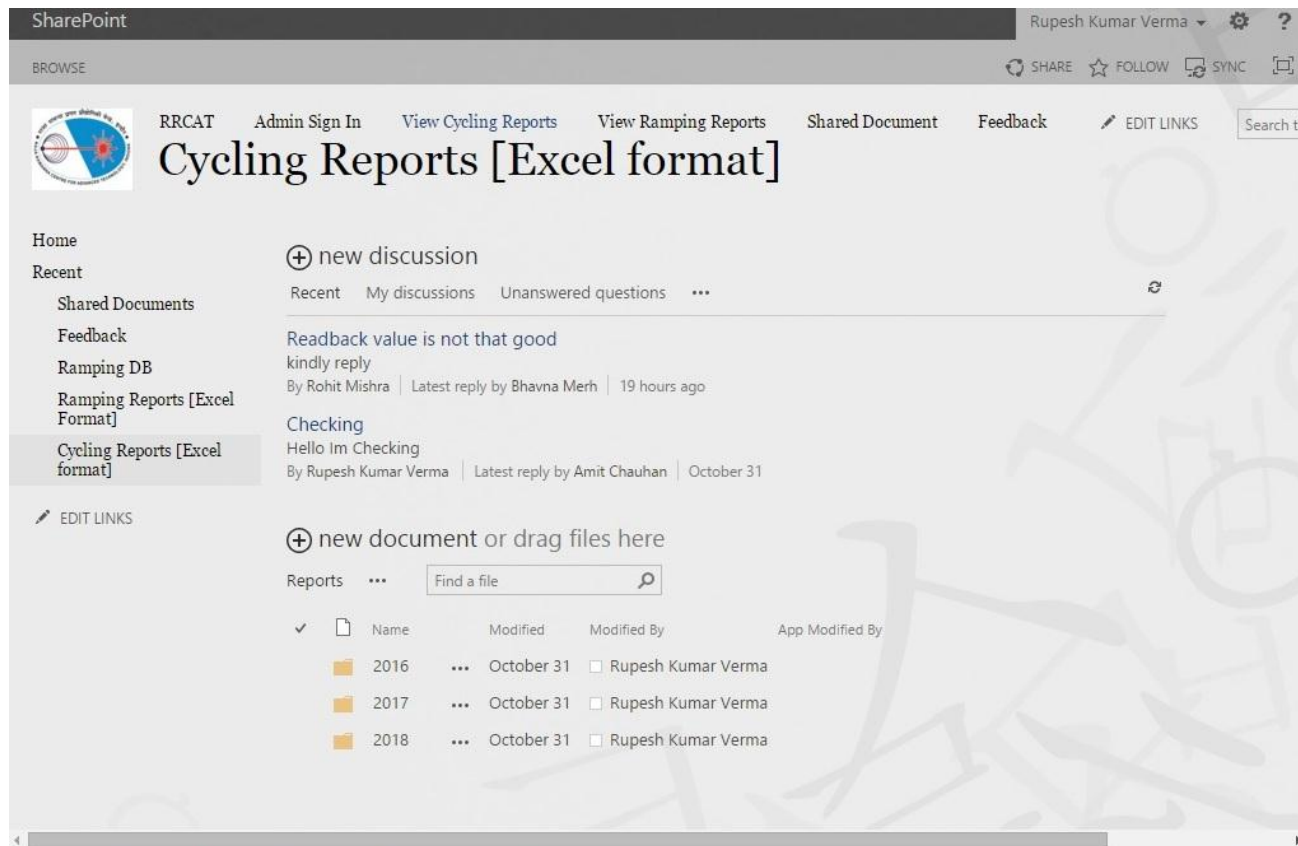


Figure 9: Cycling Reports Folder: Year wise

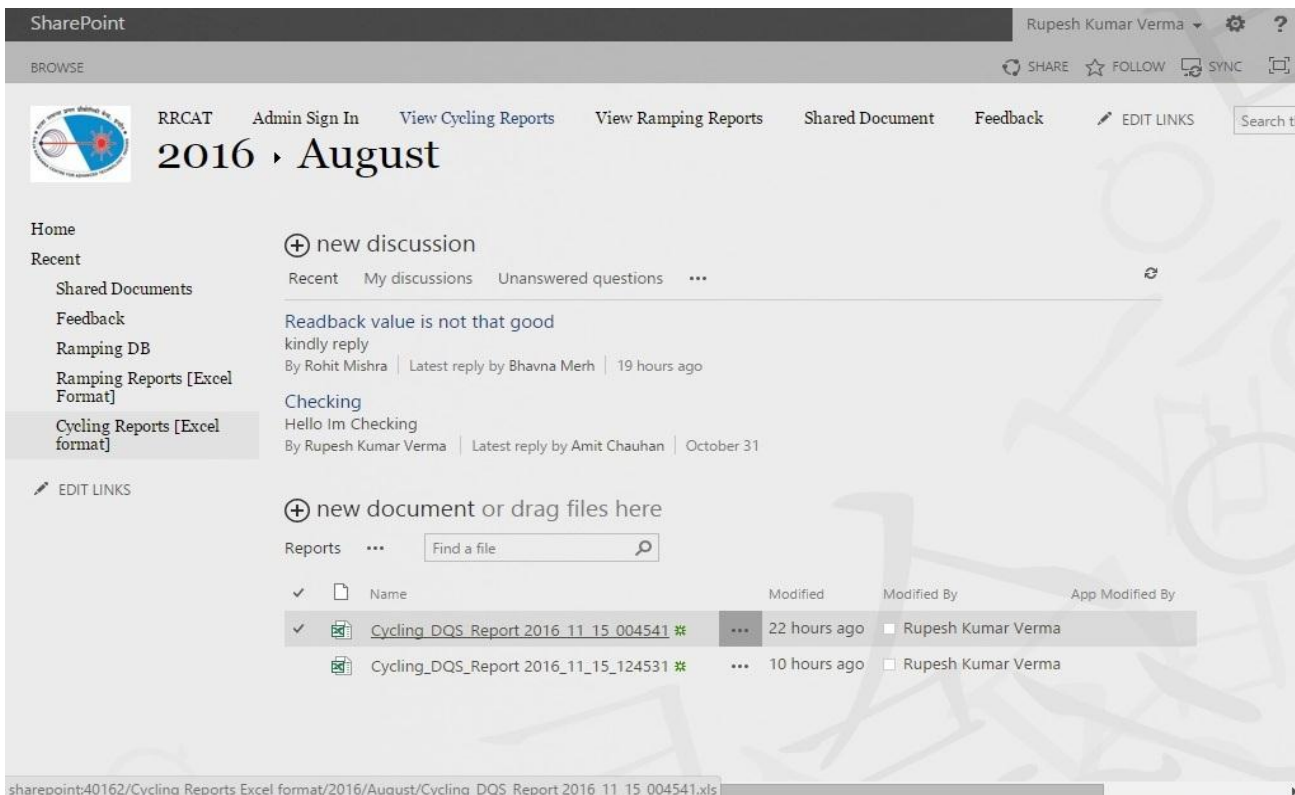


Figure 10: Deployed Report in excel format: Month Folder

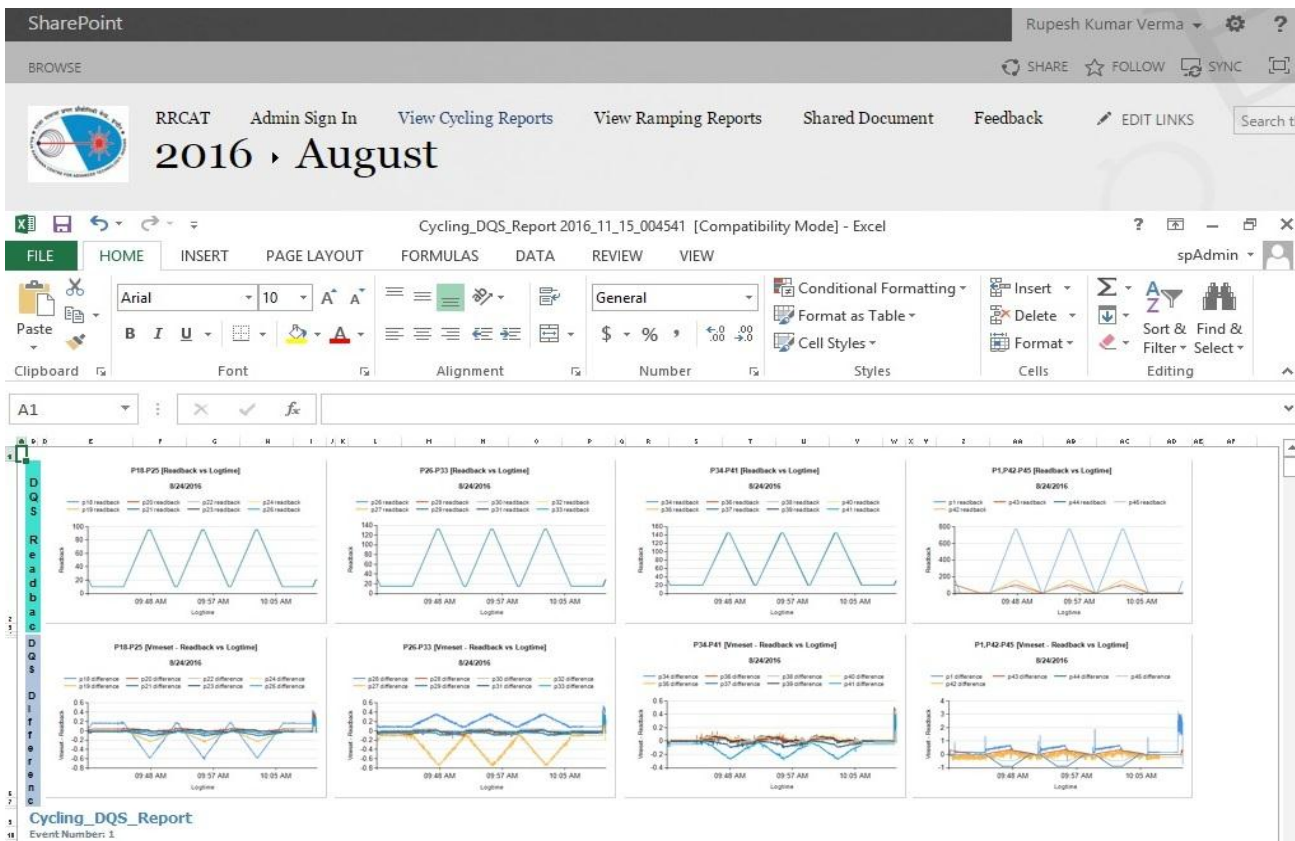


Figure 11: Excel Report: Scheduled Report

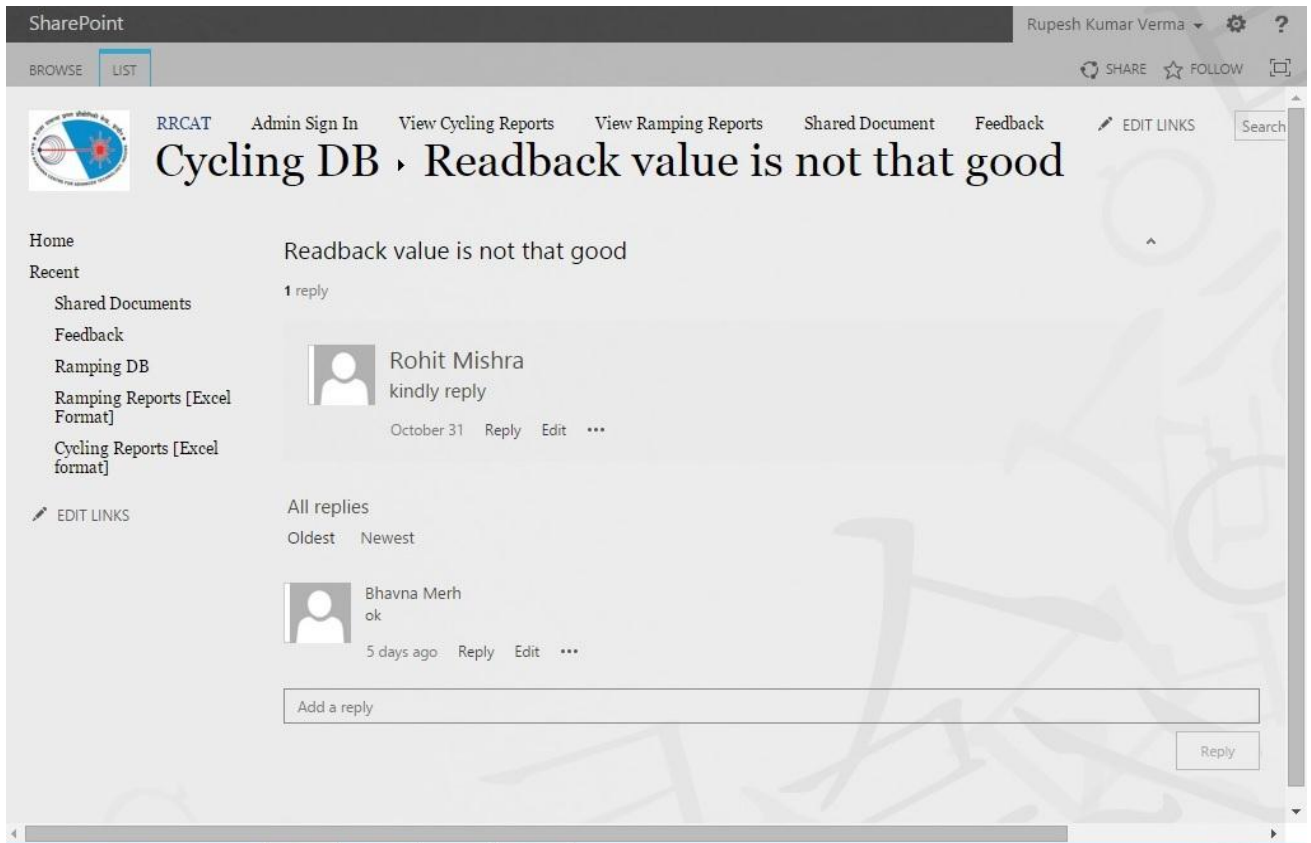


Figure 12: Discussion Board: Web-App in SharePoint

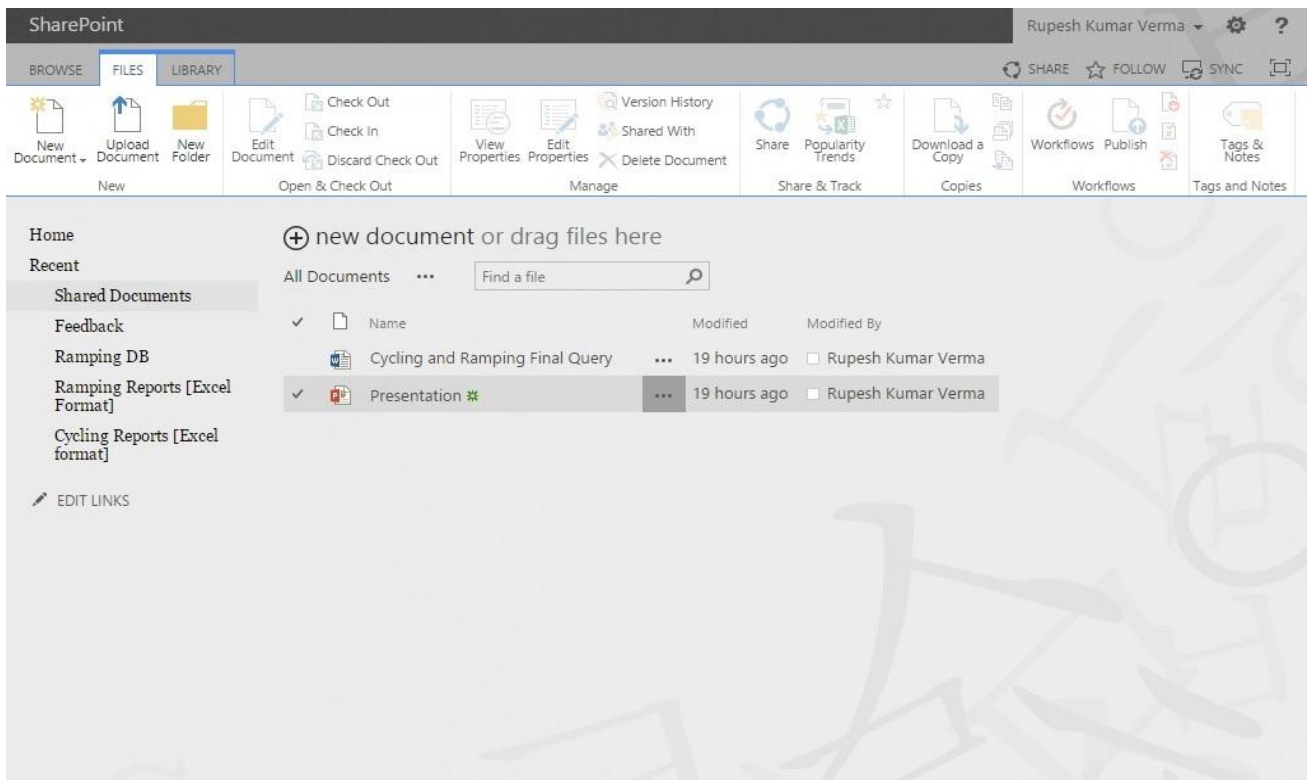


Figure 13: Shared Document Page- Document management feature

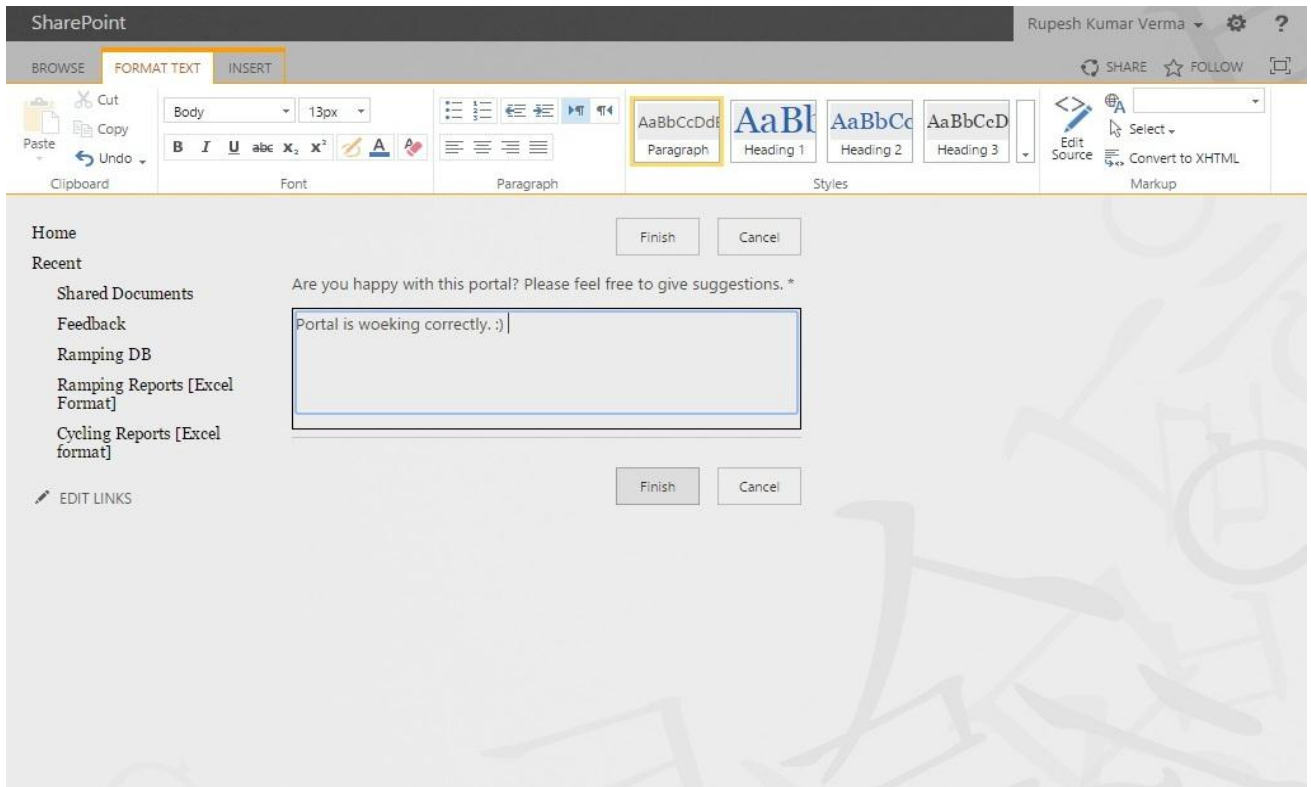


Figure 14: Feedback – Survey App

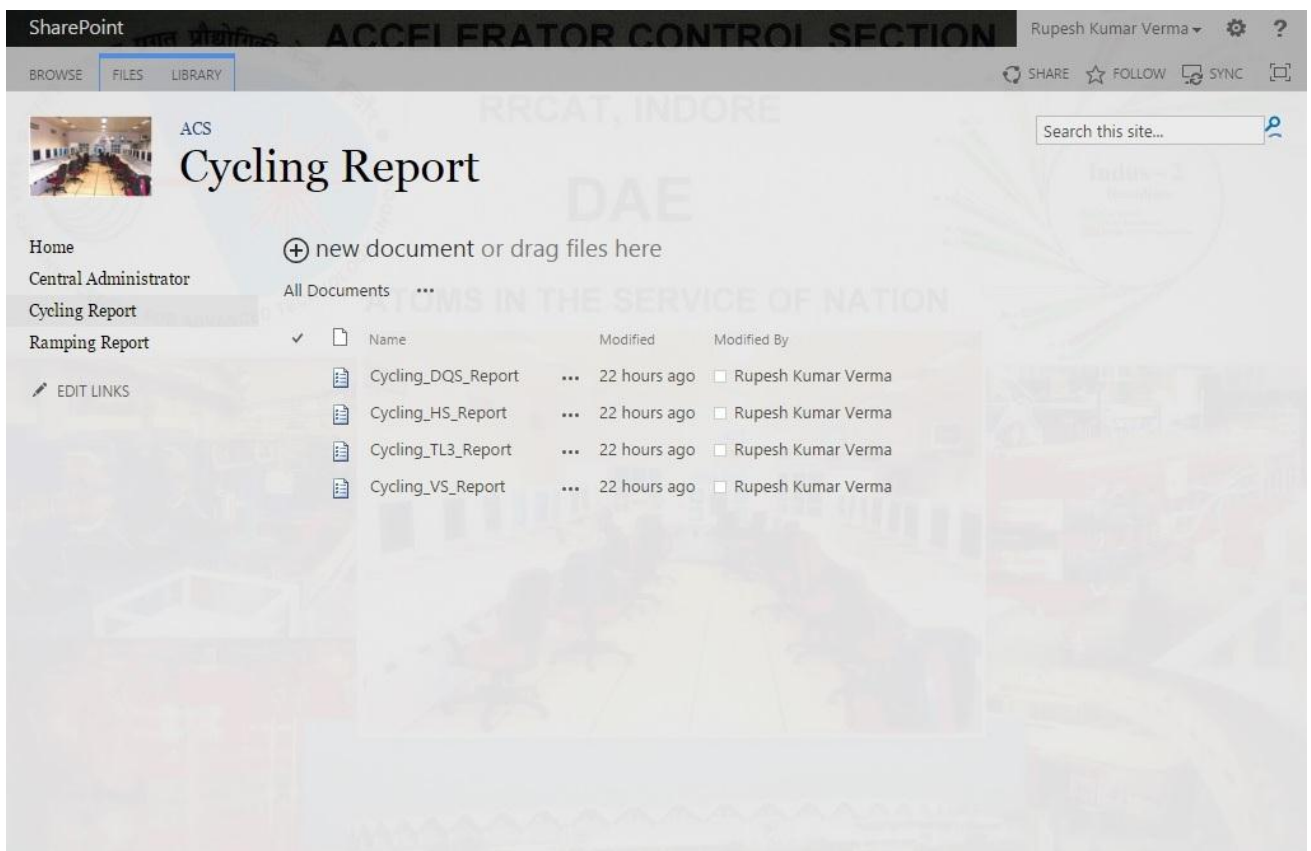


Figure 15: RDL file – deployed from SSRS

IV. TESTING

The proposed system needs to be tested under various layers. The Black Box Testing is performed are:

a) Database Testing:

Query Testing: Several test cases were made for testing the query. The main objective of the work is to trace the event of Ramping and Cycling. So for Ramping separate query is build which extracted the start time and end time of the ramping event. After that this extracted information is tested whether it is exact what expecting for in ramping event. Same case for cycling also, separate query is build which extracted the start time and end time of cycling event. When the start and end time of cycling and ramping are fetched, the next part of testing is to check all the power supplies values are according to the time provided.

Several test cases were made by dividing the total 174 power supplies into the small segments. There are total 138 supplies in MPS and 36 supplies in Transport Line 3. The segments are Magnet Power Supply (PS) 1 to 50, these 50 power supplies are from Quadrupole, Sextupole, Dipole magnets – 1st test case, PS 51 to 98 are from Horizontal Steering – 2nd test case, PS 99 to 138 are from Vertical Steering – 3rd test case and TL3: PS1 to PS36 are from Transport Line 3– 4th test case. After successful modular testing, whole query is tested which result in expected output.

b) Visualization Testing:

After tracing the events of Ramping and Cycling. The next phase is to generate the reports. Reports are in graphical as well as in tabular format. Graphical format includes charts which helps in diagnosing the problem easily. There are almost 10 charts in a single reports, every chart is tested individually whether they are giving the right information or not.

Test cases for charts includes: Legends of chart, horizontal axis value, vertical axis value and title of the chart. Each and every chart legend is tested before deploying the report. Horizontal and vertical axis is tested whether they are giving right value or not. Title of the chart is the important part of report as it includes which power supply data is representing in the chart. Each and every chart is tested.

There are in total 7 reports which are generated for this work: Ramping_DQS_Report, Ramping_HS_Report, Ramping_VS_Report and Cycling_DQS_Report, Cycling_HS_Report, Cycling_VS_Report, Cycling_TL3_Report. This report is saved as .rdl file which will be deployed to the report server. So before deploying every report is tested individually.

c) Report Deployment Testing

After generating all the reports successfully, the next phase is to deploy the reports to the report server. In our case, the reports are getting deployed into the SharePoint Server.

There are certain attributes which has to be filled to deploy the reports. They are: **TargetDataSourceFolder**, **TargetReportFolder**, **TargetServerURL**.

In the **TargetDataSourceFolder** text box, it include the data source destination folder in the report server. The default value for **TargetDataSourceFolder** is Data Sources. In the **TargetReportFolder** text box, the destination folder of where the report will be published is typed. The default value for **TargetReportFolder** is the name of the report work. In the **TargetServerURL** text box, the URL of the target report server is typed. Before the report get published, valid server URL properties must be set. As this is very crucial part of the work. Individual report properties are tested before deployment. When the report deployment is successful output is prompted into the visual studio output pane. Figure 0 shows the output message of successful deployment of report to the report server i.e.SharePoint server.

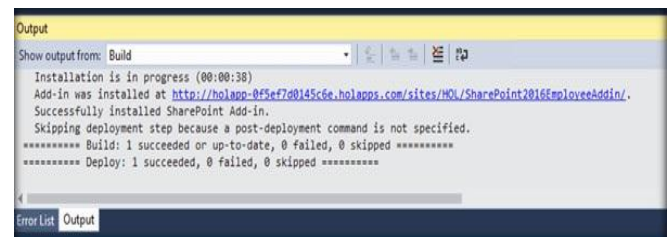


Figure 16 : Deployment successful message

d) Scheduling Testing

When the reports are deployed into the SharePoint Server, according to the objective the next phase is subscription of the reports. Subscription refers to scheduling the reports. Testing is performed to this phase also which results in successful delivery of report to the user. Each report i.e. .rdl file is being scheduled. Checking of the output folder, output file extension, delivery time is tested in this.

e) Security and Permission Level Testing

Only the authenticate user can access the portal are tested here. As per the requirement, the portal content (list and library) are opened for all the user whosoever is accessing it. Anonymous user are having different permissions and the authenticated user are having different permissions. So, in this testing, different permission is given to the user and then tested. In the portal, also discussion board is included for limited users, testing is performed here also by verifying that only the permitted user are contributing in the discussion board.

V. RESULTS

The present work has been resulted into:

1. Development of A user friendly interface to interact.
2. A user-friendly ease of retrieving data.
3. Readymade published report in Excel format.

4. Scheduled excel reports are easy to read as it contains Charts and Tabular data.
 5. Users can easily diagnose the behavior and characteristics of the beam.
 6. Discussion Board feature help the user to interact with other user on a shared platform.
 7. User can easily share files as it also serve as a document management system.
 - a.
 - b.
 - c.
 - d.
- Better reports can be created which can also include the hidden details, images or patterns regarding any favorable condition.
 - SharePoint also serves as document management, so better document management ways can be implemented in future.

VI. CONCLUSION AND FUTURE SCOPE

Information Sharing Portal for Indus sub-systems is a portal which will be beneficial for the Indus user to easily diagnose the characteristics and behavior of beam. At present, user directly interact with the database which increases the traffic to the database. In this portal reports will be automatically published from where the user can view it. Reports will be in excel format which contains readymade charts and tabular data which helps in easily diagnose the behavior of beam. As such there is no option to get the extracted filtered information regarding the ramping and cycling so this portal solves this problem by tracing the event of cycling and ramping which will save a lot of time. Also, discussion board is also provided to the authenticated users where they can discuss their queries and can participate in it. In future proposed work can be improved with following enhancements:

- As this portal is only for the Magnet power supply system only, it can be later configured with other Indus sub-systems

There are many in-built apps in SharePoint, in the work Discussion Board and Surveys is used. Other apps like announcement, contact lists, tasks etc can also be used which will definitely help the user to easily interact with the portal. In the work, Reporting Services feature of SQL Server is used. In the future, latest tools like Tableau, PowerBI can be implemented for better graphical view of data.

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