Enhancement of Statistical Analysis for Memory Generation Platform

Thesis submitted in partial fulfillment of the requirements for the award of degree of

Master of Engineering
in
Computer Science and Engineering

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CERTIFICATE

I hereby certify that the work which is being presented in the thesis entitled, **"Enhancement of Statistical Analysis for Memory Generation Platform"**, in partial fulfillment of the requirements for the award of degree of Master of Engineering in *Computer Science and Engineering* submitted in Computer Science and Engineering Department of Thapar Institute of Engineering and Technology, Patiala, is an authentic record of my own work carried out under the supervision of **Mr. Shatrughan Modi** and refers other researcher's work which are duly listed in the reference section.

The matter presented in the thesis has not been submitted for award of any other degree of this or any other University.

Signature:
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This is to certify that the above statement made by the candidate is correct and true to the best of my knowledge.

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- Arjun

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Abstract

It is required to deliver the right product at right time to the customer with asked functionality and standard quality in semiconductor industry. It is very difficult and hectic to develop a product and check its quality manually and analyzing the result manually makes it a costly affair. This project is performed by keeping in mind the drawback of hectic manual time consuming process. To overcome the drawback of manual processing using automation because of configuration of hardware, modification in source code or operating system leads to identical and time consuming process. All these things can be reduced through automation.

Automation helps in doing predefine action written through code and also helps in result analysis. For doing this our team come up with Enhancement of Statistical Analysis for Memory Generation Platform tool, which helps in routine functioning of organization. This project is very helpful for these kinds of organizations (STMicroelectronics). It shows performance in one picture through this everyone can conclude that how they are performing and can figure out how to perform better, who two use their resources in fruitful manner, here WebSubPlus is a tool which doing the entire task in less time with less human efforts.

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Chapter-1
Introduction

Statistics plays an important role in our day to day life in different ways. The effects of statistics are everywhere. This chapter covers all the basic and general aspect of automation over manual development in semiconductor industry to deliver good quality product to customer with all features and quality checks.

Enhancement of Statistical Analysis for Memory Generation Platform is a project developed for frontend users who belongs to this company only (STMicroelectronics). WebSub is a tool which was used previously, But now as technology is growing very fast and everyone wants to perform better and accurate in our field they need some advance software which can perform more accurate with good desired speed to deliver product on time to the customer. That's way development team develop an upgraded version of WebSub which is WebSubPlus which is packed of lots of different feature which are required to users. This project is used to generate Performance Reports (Monthly, quarterly, and annually) to help the frontend user to full their requirement with the help of automation. It is mainly used for generating various types of report and gets a specific conclusion. It makes task easy for users because they get all required information by one tool only in pictorial form which is easier to understand to the user as compare with data which is generated by IP (Intellectual Properties) and they do not have to do manual work. Here Memory Generation refers IP. Our team design different types of memory IP for different gadgets. In electronic design a semiconductor intellectual property is a reusable unit of logic, cell, or integrated circuit (commonly called a "chip") layout design that is the intellectual property of one party. IP may be licensed to another party or can be owned and used by a single party alone. IP can be used as building blocks within application specific integrated circuit (ASIC) design [1] .This enhancement of statistical analysis for memory generation platform system basically aims towards enhancement of statistical analysis. Presently there is no way to monitor progress through automation. Websubplus is a tool which is used by our team to generate the stats through

automation and this process is error less, accurate, and very fast. In this project DesignSync commands are used to populate data from the DesignSync repository [2]. DesignSync repository is a licence repository like (SVN repository). Our team is working on developing an automated system which can easily populate data from DesignSync repository and convert that data in meaningful information through Data interpretation. Through which user can easily generate our performance reports. This system is taking inputs which are variety of information about the generation. These generations are submitted by the user to build memory. Parameters are adjusted according to the user requirements for example: size, number of pins, operating condition etc. This enhancement of statistical analysis process helps to generate performance reports. CSV (comma separated values) data sheets are generated from metadata and these data are populated into the MYSQL database.

1.1 Background

Enhancement of statistical analysis in memory generation platform is a tool (WebSubPlus). Out team use this tool to measure our performance and to identify any kind of defect or failure. An automated system created which automatically runs and identifying there is a failure or not, if there is no problem then it is good it will go in next step to generate a new memory or if found any kind of failure then user debug that failure and try to run that generation again. WebSubPlus helps us to measure the performance, give a vision to us to plan our projects and work flow how to work in future and give us a flexibility to identify errors and fixed them. WebSubPlus plays a very big roll here. WebSubPlus do all these things efficiently in less time with the help of automation.

A TCL (Tool Command Language) script is working in the background to fetch the data from DesignSync repository. TCL is a scripting language. Basically work on list data structure [2]. In this project user fetching data in list form and convert that data as user want. There are lots of options in this script which work on different parameters. These parameters are changeable according to need of the user.

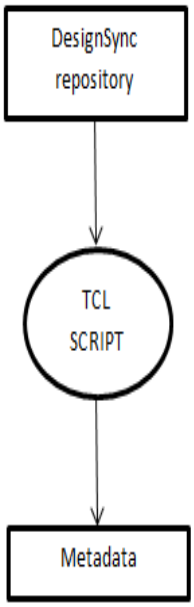

Figure 1.1: Fetching metadata from DesignSync repository

- WebSubPlus metadata is automatically populated on central repository (DesignSync repository), and from there user download data with the help of codex tool.
- Metadata data is converted into meaningful form with the help of data interpretation.
- For development VAB (Visual Basic Application) automation is used to generate performance report for the users who belong to company only.
- After data interpretation data analytics techniques are used to present data in pictorial form.

The structure of the data is very difficult and its difficult relationship exists among multiple attributes, entity relations, entities and attributes, and even between the databases. Visualization techniques were used. On the basis of the original visual structure [3], visual structure is continually changing according to the user's needs. To better understand this complex data, data analytics techniques are used.

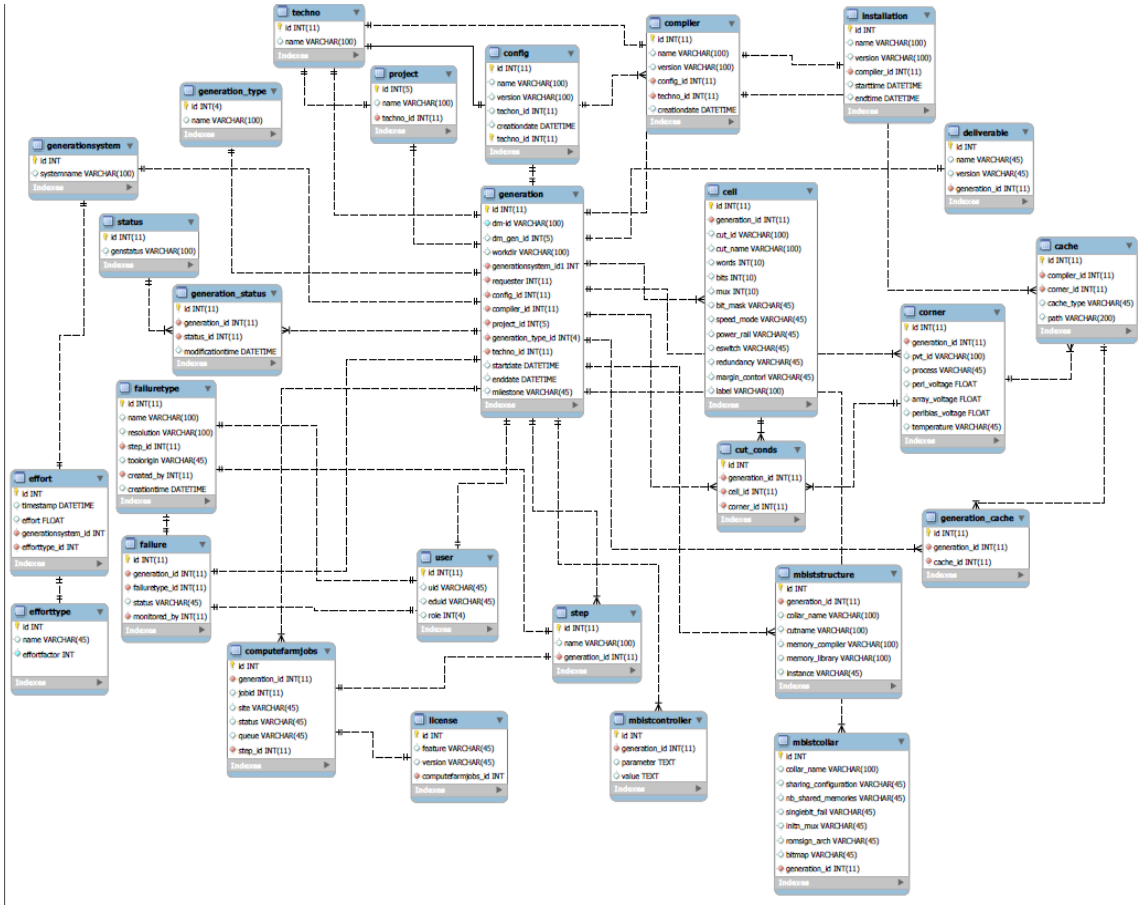

Figure 1.2: Data relationship architecture

1.2 Purpose

The aim of this project is to develop an automated system and enhance efficiency of memory generation platform. WebSubPlus is a tool which provides lots of functionality to the user to extract data and use that data as they want to measure performance with the help of data analytics. Enhancement of statistical analysis is firstly developed for stats generation. But after using this team conclude that this project can be used by the employee of the company also. So the purpose of the Enhancement system is to give the entire feature to every employee according to their different needs.

Component of data analytics is statistical analysis. In the field of business intelligence (BI), statistical analysis pertain to collecting and scrutinizing day to day data samples in a

group of item from which samples can be taken. Statistics plays an important role in our lives in many ways. From day to day activities in our home to schools to the business in making greatest city run, everyone can see statistics impact everywhere in our life.

Major objectives behind this thesis are as follows:

1. To assess the existing report generation methodology.
2. To enhance the existing report generation approach being utilized at STMicroelectronics.
3. To propose and deploy the improved report generation solution for providing client (i.e. backend user) support.

1.3 Expectations from the New Solution

Functional (User):

- Automatically data fetch with the help of TCL (Tool Command Language) scripts.
- Easy population of codex data with time and date.
- More flexibility to user in terms of installation of cuts in memory generation platform.
- Incremental handling of failed installation. So that backend user can re-run only the failed installation with a single command.
- Flexibility to user to install multiple installations on same time.

Technical:

- Improved installation algorithms in terms of run time.
- More use of data structure than intermediate files.
- New architecture should be flexible enough to use any other In-house or Third party tool (other than WebSub).

1.4 Bottlenecks of system

The output cannot be generated from inputs in automation of memory generation system. All the basic requirements are fulfilling through this automation. When customer need some change then user have to do manual work, which is time consuming and also not

accurate. To make sure it is accurate user have to do some iterative work. Enhancement of this automation is required for customer satisfaction within 48 hours. This updation is needed to make system robust and universal to accept all inputs.

1.5 SCOPE

Enhancement of statistical analysis in memory generation platform is beneficial in the generation of stats of different types of projects which are Memories, Bits, and Verification. These projects are having various purposes. WebSubPlus is a command application which command base right now. For ease of the user our team developing a GUI (graphical user interface) of this Enhancement system. Through this GUI every user which is directly or indirectly connected to the system can use all the bases feature of WebSubPlus.

The scope of WebSubPlus is as follows:

- This stats generation system is only accessible to the customers who are working in our company or internal person.
- WebSubPlus is running over WebSubPlus compute farm which are interlinked and exchanges inputs.

1.6 Tools and Technology

- **Operating System:**

- RedHat Linux

- **Languages:**

- **Shell Script:** Shell is a command line language interpreter. It executes all the command that it has got from the standard input device (keyboard) or from a file. Shell script is a set of shell commands whose execution own can be changed [2].
- **TCL:** TCL is an abbreviation for Tool Command Language. It is a scripting language. It was designed with the goal of being very simple but powerful. It is mainly used for text processing and file handling. When we need data structures,

shell script does not provide them. In this case development team can use TCL [2].

- **VBA:** VBA is object-oriented, High-level Structured language and its methods are very efficient and powerful. VBA supports all kind of applications in Window environment for development [5, 6].

  A collection of classes available in Excel i.e. workbooks, worksheet, range chart etc. Just by controlling different class object, VBA attains the control of excel [4].

- **Tool:**

- **VNC:** VNC is an abbreviation of "Virtual Network Computer". It is a screen sharing system. It follows client-server model. So, one or more clients can connect to one server at a same time [5]. VNC is mainly used to access files at remote locations.
- **Microsoft Office:** Microsoft Office is well-known software in windows based operating system. It is a group of software which are server software, client software. For example Excel, Word, etc.

1.7 Thesis Outline

Chapter 1 (Introduction) this chapter describe how WebSubPlus Tool is used for generating performance report form metadata using data analysis.

Chapter 2 (Literature Survey) covering topics which describes the fundamentals required for this thesis, Data analytics techniques and data interpretation methods. It describes the WebSubPlus Architecture, WebSubPlus Working Development & Hierarchy.

Chapter 3 (Techniques and Methodologies) covering topic which describes the techniques and methods are using in this thesis. WebSub manual working This chapter is very important for this thesis because tis chapter tell our goals.

Chapter 4 (Design and Implementation) convening topic describes the how our team implement new techniques and how design this tool with the help of previous tool. This is the main chapter of this thesis. It explains all the implementation work.

Chapter 5 (Result and Analysis) describes the various experiments done on WebSubPlus and the analysis of result is outlined.

Chapter 6 (Conclusion and Future Scope) describes the conclusion of the thesis. Future directions in this area are also outlined in this particular chapter.

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Chapter 2

Literature Survey

Before development brief knowledge of WebSubPlus working, Architecture and knowledge of its History is necessary to completely understand WebSubPlus flow [18].

2.1 WebSubPlus Terms

- **Product Repository:** It is a centralized repository, where all products are stored at one place. Here all the products and there older versions are listed which are tested and used in production [7].
- **Configuration:** A combination of product that is used for specific memory chip fabrication [7].
- **OPCOND:** Operating condition, it tells at what condition memory will work like temperature, voltage [7].
- **Cut:** Cut represent memory configuration in semiconductor industry (STMicroelectronics) [7].

2.2 Modules and Architecture of WebSubPlus

WebSubPlus architecture is dependent on four different modules

1. Installation of compiler
2. Compatibility
3. Cut Generation
4. Publish

There are lots of other modules which are developed to support the functionality of these modules

1. **Compiler installation:** Compiler installation is very important process in terms of memory generation. It is based on different terms like Installation of compiler, Compatibility, Cut Generation, Publish.
2. **Compiler compatibility**: This represents various platforms for verification. Against this at least one platform is needed to be set to check validity of our compiler installation.
3. **Operating condition and Cut Generation:** Operating condition and cuts generation represents the memory cuts (e.g.: no. of pins, view) and operating conditions for memory for example: temperature and voltage, etc. For fabrication on memory all these parameters are very important to set while generating libraries. Other than this WebSubPlus architecture contains some supportive modules: product management, Cut status, Technology management, Design Flow management, Generated Libraries, News etc.
4. **Publish**: Library config is finally published on WebSubPlus so that customer can download the same.

2.3 WebSubPlus Development Stages

Development process of WebSubPlus is divided into three steps.

- **WebSubPlus Development step (Dev):** this is the step where a developer develops a product or makes some modification in existing one. This code is only used by the coder no other person is allowed to do any kind of modification in this code.
- **WebSubPlus Quality Assurance Step (QA):** When developer is done with the development process then its code is deployed for QA (quality analysis) test. QA test is conducted to identify whether it fulfill customer criteria or not.
- **WebSubPlus Production step (Prod):** when developer code passes all QA tests then it is ready to be deployed for customer use. After WebSubPlus deployment on to prod server it can be used by any customer.

2.4 WebSubPlus Compute Farm

Apart from these modules to support the functionality of WebSubPlus and to give platform for running WebSubPlus on more important part is compute farm. This compute farm is Cluster of interconnected computers provides service as server system. These computers are having big role in all functionality of WebSubPlus. While doing stats generation the job is queued into one of the request processor waiting for processor to serve them. This request processor is one of the part of the architecture of WebSubPlus other than this request processor other processing servers are also part of WebSubPlus architecture.

2.5 Statistical analysis

Mathematical method of statistical analysis is used to interrogating large amount of data for finding relationship between various datasets [8, 11, 12].

Different type of statistics:

- **Inferential statistics:** A part of dataset (sample of population data).
- **Descriptive statistics:** What was observed is a part of (sample) numerical summaries dataset.

Here Using Descriptive Statistics as main statistical approach. Descriptive statistics because to summarized data into a shorter form and descriptive is the best approach to do this. Figure 2.1 is showing how raw data is converted in meaningful form using data analysis techniques.

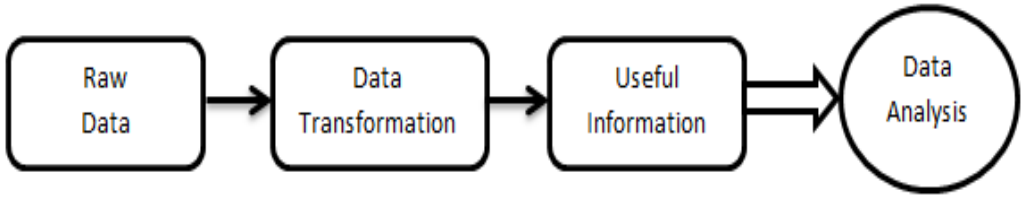


Figure 2.1: Data Analysis Process

In Microsoft excel there are lots of functions which use statistical analysis, Excel is a very powerful tool of Microsoft which is used to analyses descriptive statistics at very easy level, it is also useful in exploratory analysis of data, pivot charts, by pictorial presentation of data using graphs it become very easy to analyze trends, pattern, detect error, unusual value, and summarize data with mean and standard deviation [13, 14]. Table 2.1 showing pros & cons of Microsoft Excel.

Table 2.1: Microsoft Excel Tool Pros & cons

	Pros	Cons
MS Excel	Commonly used and widely available.	Not possible to record of previously conducted analysis.
	Used for basic Business Intelligence or data analysis.	If dataset is in small range or sorted then only Statistical analysis is possible.
	Easy to import information from different sources.	Size limited is very big issue in MS excel, there is only 256 columns.
	Charts and graphs generation is very easy.	There is also row issue with MS excel, there are only 65,500 rows meaning it has limited capacity for analyzing larger datasets.

The method of evaluating data using logical and analytical reasoning to check every component of the data provided. Select one of these forms to analyze data that must be used when conducting an experiment. Data is collected from various sources, reviewed, and then analyzed to identify some conclusion. There are different type of data analysis methods, which uses data mining technique, text analytics, BI (business intelligence), and visualizations of data. Figure 2.2 shows concept of data analysis.

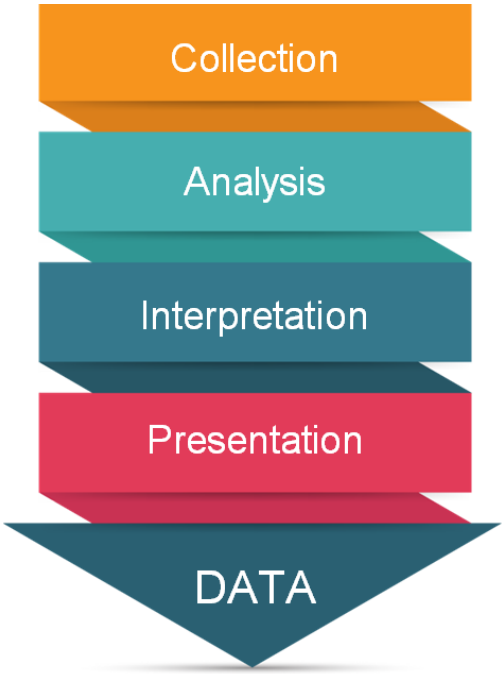


Figure 2.2: Data Analysis Concept

2.6 Data Interpretation

Data interpretation is a technique which is used by most of people. It is the method of making sense/meaningful information from numerical data that has been collected, analyzed, and presented. Data interpretation usually needs two basic steps. First charts (graphs) to find some meaningful information. And second to manipulate the information in order to gain some info or to achieve our goal. Figure 2.3 represent data interpretation process, how numerical data is converted in meaningful form.

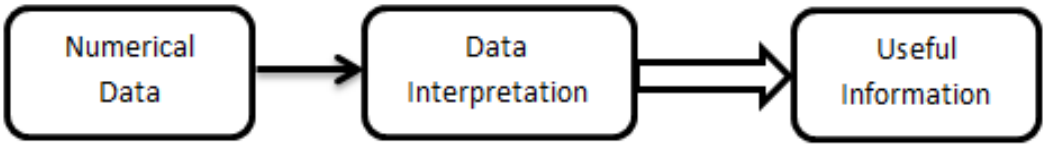


Figure 2.3: Data Interpretation Process

2.7 What is DesignSync?

DesignSync Data Manager is used by our company (STMicroelectronics). Which manage our data at “directory level”, and at a “modular” level of abstraction.

With DesignSync, you will be able to:

- Connect and deal with entire design chain with a unified DDM system.
- For a rapid payback and strong ROI it significantly boosts design productivity.
- It gives flexibility to reuse existing version and software.
- As a part of the design process it manages all design hierarchy.
- Reduce time-to-market by increasing collaboration efficiency.
- For EDA tool vendors it manages complex data types.
- By using Microsoft Visual Studio and Eclipse plug-ins it manage software projects.

2.7.1 DesignSync Overview

It is not easy to develop a complex electronic product; integrated circuit (IC) design teams have relied on “ENOVIA Synchronicity DesignSync Data Manager” to help manage the hardware and software data in their products [10]. Today, more than 130 development organizations, including top semiconductor companies, take advantage of “ENOVIA Synchronicity DesignSync Data Manager” to increase design productivity. “ENOVIA Synchronicity DesignSync Data Manager” was designed specifically for (Design Data Management) of complex IC design, and continues to evolve as challenges facing the semiconductor industry evolve as well [9].

2.7.2 Module Views

Designers often work on a subset of project data, workspaces can be populated with specific module views of the design. RTL designers could populate their workspaces with the “RTL View”, containing only RTL data, whereas documentation writers could fetch only files associated with documentation.

2.8 Excel

Formatting: Excel has extensive options for formatting data charts, cells, tables *etc*. Other Sheets has limited formatting capabilities compared to Excel so tool looks more effective and attractive. Excel brings data information together from various file and documents.

Formulas: Min-Song Li [4] recommends excel provides important and efficient formulas for financial, logical, text, math or trigonometry fields *etc*.

Location: Excel can be used at any location, it is supported everywhere.

2.8.1 VBA - Visual Basic for Application

VBA is used to generate highly developed automated tools which can be used in business. Macros are allowed to code to generate customized graphs, charts, reports automatically. And perform some other processing function.

Developer can fully utilize the excel formulas and all the features by shifting it to back end. All these feature are present in the Microsoft excels developer tab that makes one to use the visual basics application. In the developer tab there is an option of visual basics that open an editor where user can write code. VBA is object-oriented, High-level Structured language and its methods are very efficient and powerful. VBA supports all kind of applications in Window environment for development [5, 6]. A collection of classes available in Excel i.e. workbooks, worksheet, range chart *etc*. Just by controlling different class object, VBA attains the control of excel [4].

VBE - Microsoft Excel has its own editor that is Visual Basic Editor. In this editor developer can write macro codes for worksheets. Visual basic Editor is very accurate editor, and it helps to write a code as well. If programmer has done any syntax mistake then it will show it immediately with error message box. It also provides debugging facility, so that one can track flow of your code and find out errors efficiently at particular line only. Microsoft Excel gives lot of in-built functions to user. Users can write their own functions for performing particular task by using Excel macros. Further,

user can add their macros as excel function list, thus user can use it same as like in-built functions. [5]

Recording Macros - Microsoft Excel provides functionality like macros recording. This feature is a replacement option for users, if they don't want to write a code and directly do an action from Excel toolbar and using Excel’s basic functionality then they can record entire process and it will convert this process into code in Visual Basic Editor.

Chapter 3

Techniques and Methodologies

3.1 Initial working of WebSub

Websub installation request manual:

Initially there is no user interface in Websub installation process. There are many tasks which have to be performed before installation actually starts. As presented start point of Websub installation process is when customer modifies product name and version on PRS. Here Figure 3.1 is showing stages of WebSub with input files.

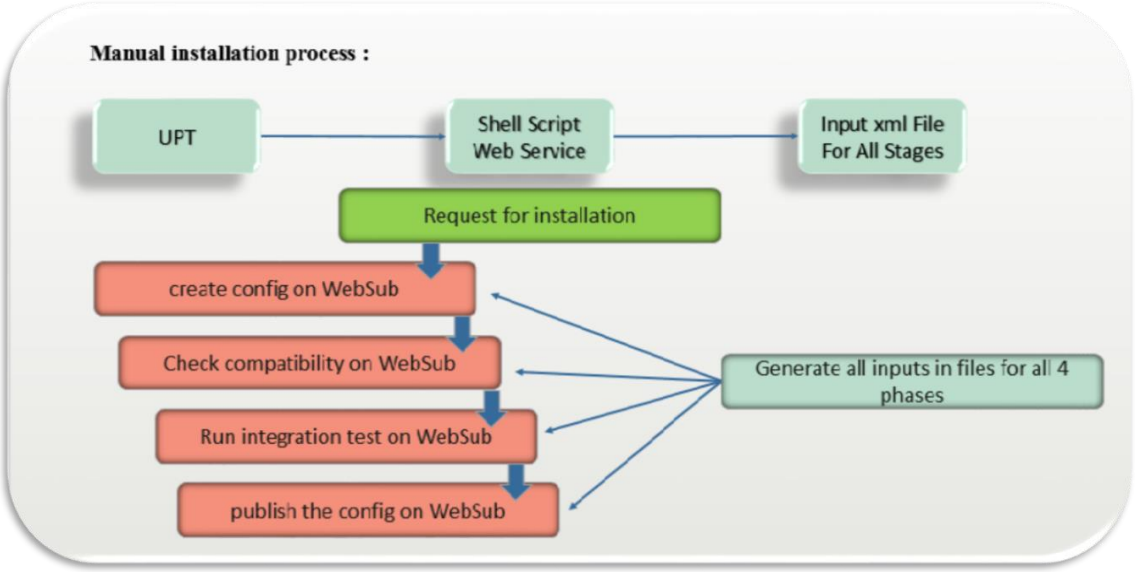


Figure 3.1: Stages of Websub with Input File

Initially it will trigger the script which is written in shell which initiates xml creation process. All necessary checks which are created by these scripts after some pre decided dates these scripts checks primaries changed. If there are any changes, then very important process is initiated by these scripts. This process is product installation from

PRS to Websub corresponding to its primary. Next step is creation of directories for logging activity by the product, setup area, then making on file for product declaration on Websub which contains name and version of products. After completing the process the next step is creating input files for every stage at least once. As depicted in the figure Websub config installation process will take place after input in xml format is available. When process of input generation completed user get mail which is a request for compiler installation and it also contains path where all these input files are stored.

3.1.1 Description of Manual Process

Expectation of Config Installation:

There are few things which should be taken care while installing configuration on WebSub these are as follows:

- Library filter, Asik kit, flow and views filter
- Technology present in PRS should match with websub
- Maturity model of both PRS and Websub should be aligned.

The initial step for this process is as follows:

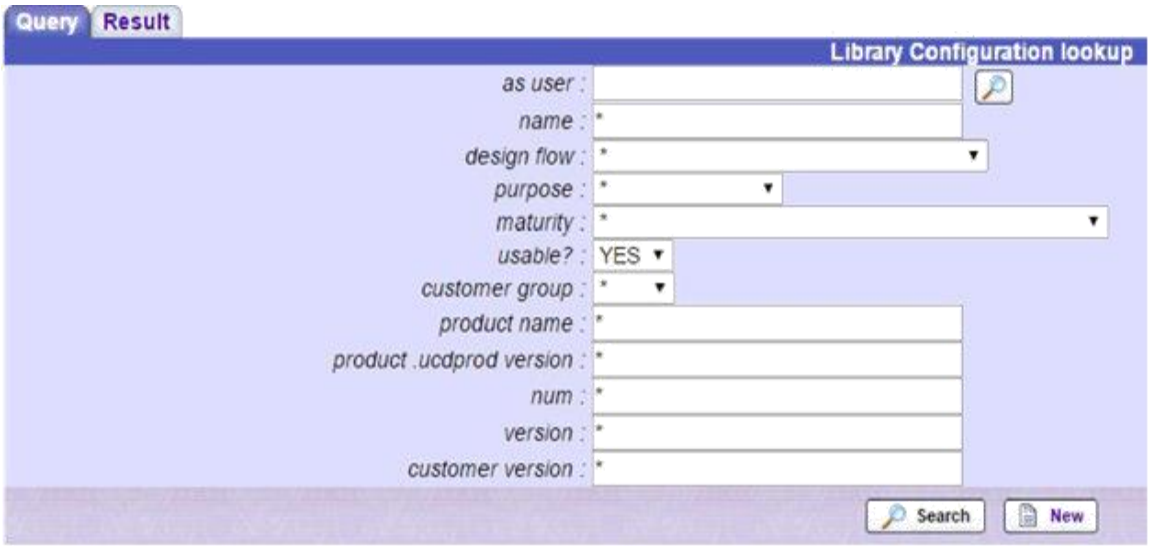


Figure 3.2: Installation Config Search

1. Search for Library Configuration: Using name and design flow to check configuration is exists or not. And rest of the fields is optional to specify. If user using interface user have to specify necessary fields and then click on search button. Will get either empty or list of configuration that are already installed. Figure 3.2 show installation configuration search interface.

2. **Create and Edit:** when no result found create new config using new tab. If needed enter is present in the list, then choose the latest one and start editing by clicking EDIT tab. First tab is config info, the fields required to fill are config Name, PRS name, Design flow, Maturity, Purpose, exec constraints. The next one will be identifier they are flow type, view filter, asic kit and library filter, must edit field is the value of PRS parameter generator parameter changed.

The last button is to specify products; just put the products in websub by using Product file which is generated when user installed the products on websub. Click Product file tab and copy this product file content and just past in popup box save your config. After saving configuration user will be redirected to other page where user can identify configuration is installed or not. Here our request is processed by request processor and the result of generation will be displayed as a field GENERATION. The answer ok means generation of config is successful and user can use it into our later stages.

Check of Configuration Compatibility

This check is conducted to find suitability of our configuration. The link configuration compatibility is used to open this lookup page. user need to start design flow as per primary configuration. Then comes the configuration name which is our primary product name which checking suitability for. Set source and target purpose and choose search. If result of search is empty, then next go for integration test where user generating libraries. If this too doesn't work user need to set compatibility by choosing version and configuration name. The values need to be taken from PRS. Next step is to search deliverable name on PRS site and select primary from the list. Then click on the field

coordinator for checking verification platform name. Select yes if any platform name specified on PRS.

Figure 3.3: Set Compatibility

Generation Cut

- Project name should be: Demo cut
- Enter the name of project as *Demo cut* by selecting design flow then search for project.
- If result was empty then create another project. If purpose is generation then go to memories tab.

Now there are two options, if it is new project then by adding library and selecting appropriate version. And second option is for editing purpose, here choose from existing library. If library is already present, then choose appropriate library and select the version specified by clicking on it and then one pop up box will open, it contains list of library configuration with version, then select the version which was already installed.

Figure 3.4: Generation Cut

3.2 WebSub services monthly report

Service Report Overview

Websub service monthly report is done for monitoring the monthly stats, which are generated by front end team. Through these stats development team can conclude that how many failures occurred of which type in particular month, in particular year, this is very good method to monitor progress with less efforts. In year 2017, total 320 men days spent and out of total efforts 30% efforts spent on IT infrastructure issues. In year 2018, total 225 men days spent and out of total efforts 30% efforts reduction with respect to 2017

Pre-requisites

- Unix workstation
- Unix account able to reach Websub database
- Office 2007/10/13 (Excel, PowerPoint)
- Windows mapping on websub server

Steps for Websub services monthly report

1. **Extract CSV files from Websub DB**
    - There is a Unix Crontab in place to automatically dump the data from Websub DB:
2. **Get the last Excel files to fill**

   Files to get:
    - Stats Generation_Reports_Service.xlsm
    - Stats Generation_Reports_Licenses.xlsm
    - Stats Generation _Reports_Cache.xlsm
    - Stats Generation _Reports_Service.pptx
3. **Fill the Excel sheets with CSV files**
    - Open the Microsoft PowerPoint presentation of the previous month, and remove all previous graphs (keep first slide), to store the new ones.

Part Generation

Open the Excel Worksheet « StatsGeneration_Reports_Service.xlsm » And populate the data into excel sheet and generate stats.

Click on step 1: *Update dates on sheet*

Click on step 2: *Import Data from CSV*

Click on step 3: *Refresh Data*

Click on step 4: *Copy to Slides*

Part Licenses

Open the Excel Worksheet « Stats Generation _Reports_Licenses.xlsm » And populate the data into excel sheet and generate stats.

Click on step 1: *Import Data from CSV*

Click on step 2: *Refresh Data*

Click on step 3: *Copy to Slides*

Part Cache

Open the Excel Worksheet « Stats Generation _Reports_Cache.xlsm » And populate the data into excel sheet and generate stats.

Click on step 1: *Import Data from CSV*

Click on step 2: *Refresh Data*

Click on step 3: *Copy to Slides*

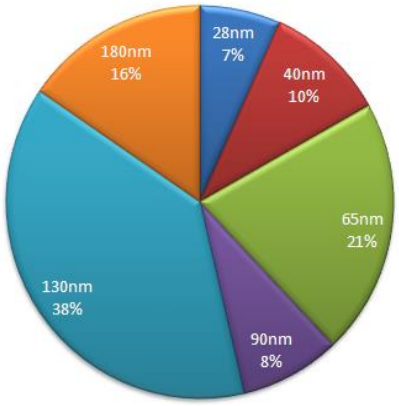


Figure 3.5: Websub generators by techno node (Demo)

3.3 WebSubPlus Working

First securely login in WebSubPlus site, and then create a file in which product name and product version is present for sourcing. For memory generation in WebSubPlus user have to source required product. After sourcing product, users have to set a path where all necessary files are present. Then check available configuration on the server by running DesignSync commands on the server. Then run API's for generating memory in WebSubPlus. After this in backend many scripts will run and user will get a mail regarding memory generation successful or failure.

```
                    mlibGetAvailableConfigurations
    _MEM_UNIGENPLUS/0.0-01
    _MBIST_UNIGENPLUS/0.0-01
T   _MEM_TCAM_SIGNOFF/1.0-01
E   _MEM_PERFS/0.0-00
C   _MEM_CONFIG_SIGNOFF/2.5-00
H   M_CONFIG_SIGNOFF/1.0-00
N   _MEM_CONFIG_SIGNOFF_SPACE/1.0-01
O   _MEM_CONFIG_ENABLEMENT/2.5-03
S   M_CONFIG_IMPLEMENTATION/1.0-PRELIM-00
```

Figure 3.6: Available configuration of the product

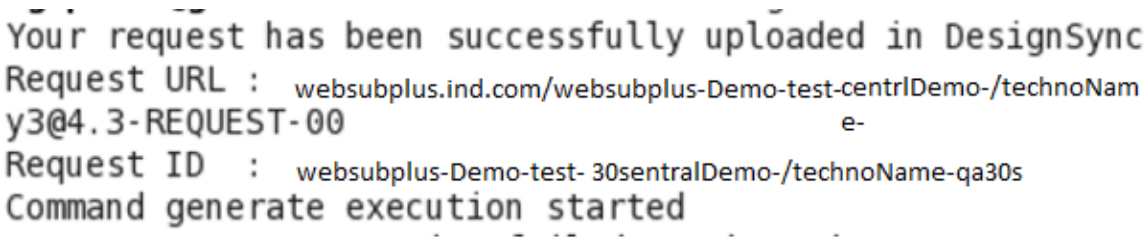


Figure 3.7: Request uploaded on the server

Chapter 4

Design and Implementation

4.1 WebSubPlus working through automation

WebSubPlus Memory Generation Monthly Stats Report generator is an automated tool which generates some performance measures stats [15] using VBA (visual basic application), Microsoft excel [16, 17], Microsoft PowerPoint. Few inputs are taken from user to generate stats like

- **Start date and End date**

  Start date and end date, starting date describe from which date user want to generate stats and ending date describes till which date user want to calculate.

- **Refresh data**

  It refresh all data, here old data is replaced with new data, where new data is used to generate new charts after applying data analysis and data interpretation techniques. Development team applies some mathematical formulas to convert raw data into meaningful data; on that meaningful data further apply data analysis techniques to decrease the size of data because it is very difficult to work with very huge data so to summarized data to understand it better and then apply data interpretation techniques to understand that data, to understand data flow [19, 20], how the flow is going. Here figure 4.1 shows how data looks before applying data analysis technique. Figure 4.2 shows how data is changed after applying data analysis technique. Figure 4.3 shows how data is transformed from numerical data to graphical data. Through this user can easily understand the trend of the data.

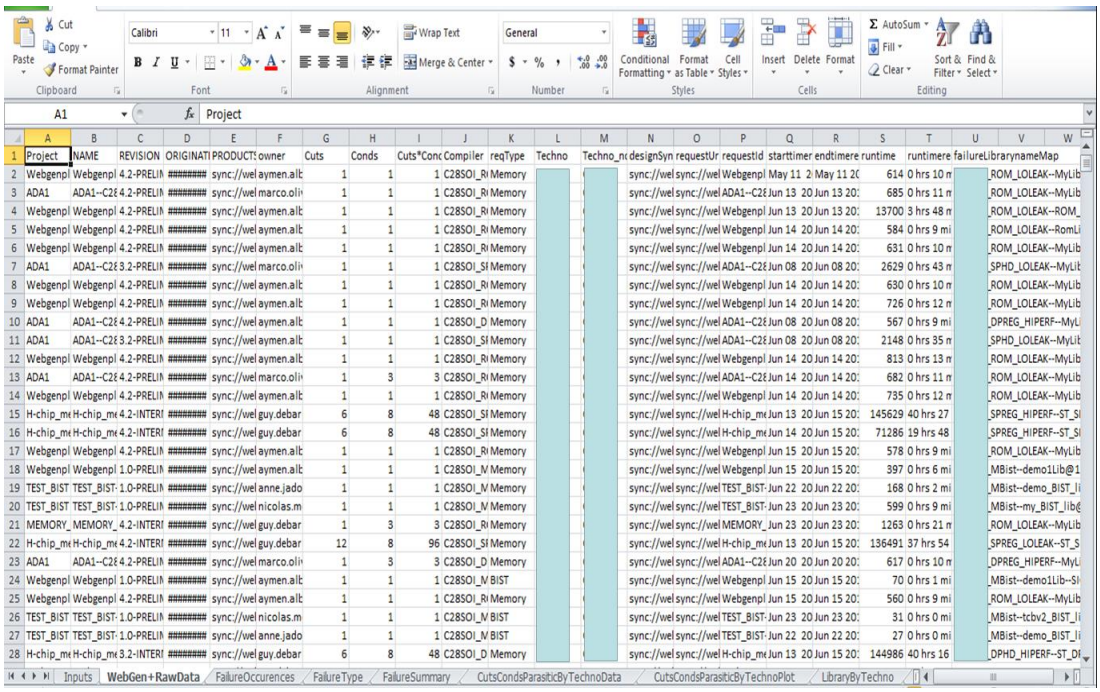


Figure 4.1: Raw data before data analysis technique

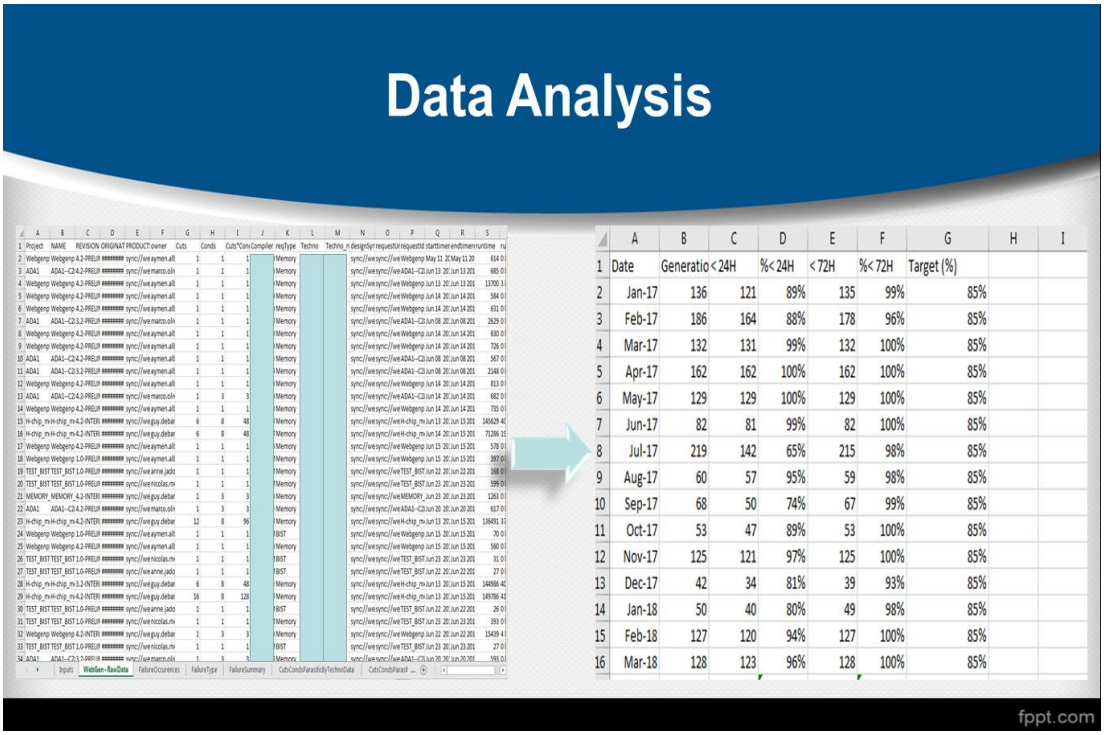
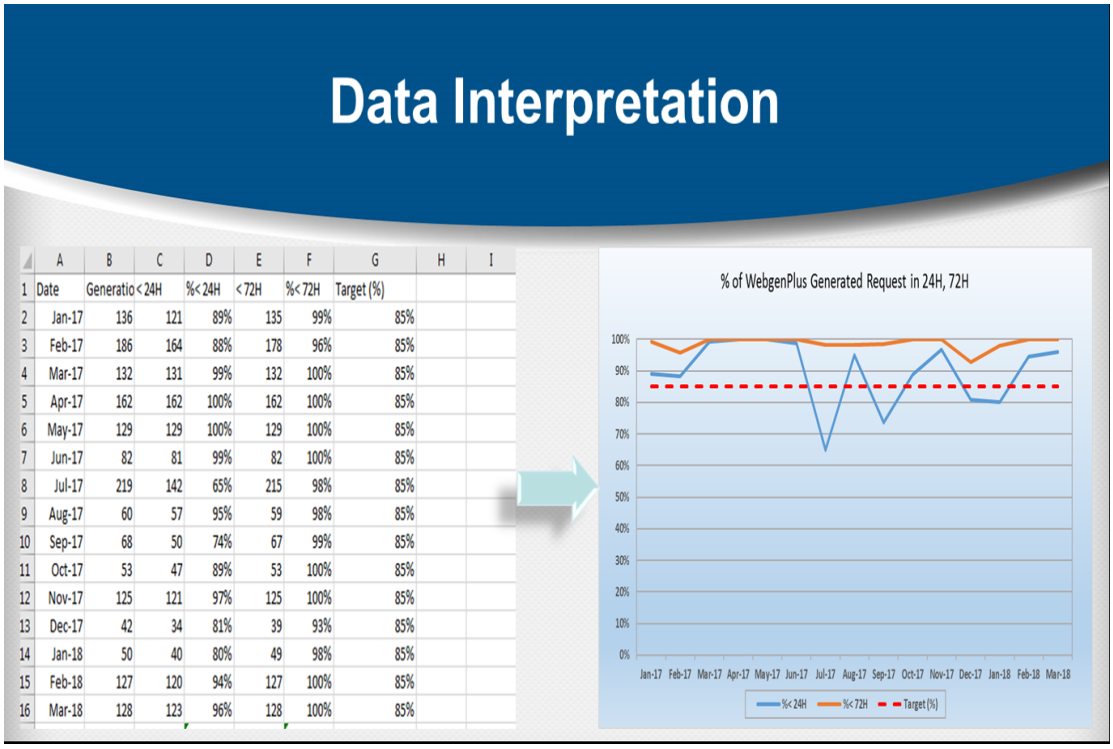


Figure 4.2: Raw data after applying data analysis technique



	A	B	C	D	E	F	G	H	I
1	Date	Generatio	< 24H	%< 24H	< 72H	%< 72H	Target (%)		
2	Jan-17	136	121	89%	135	99%	85%		
3	Feb-17	186	164	88%	178	96%	85%		
4	Mar-17	132	131	99%	132	100%	85%		
5	Apr-17	162	162	100%	162	100%	85%		
6	May-17	129	129	100%	129	100%	85%		
7	Jun-17	82	81	99%	82	100%	85%		
8	Jul-17	219	142	65%	215	98%	85%		
9	Aug-17	60	57	95%	59	98%	85%		
10	Sep-17	68	50	74%	67	99%	85%		
11	Oct-17	53	47	89%	53	100%	85%		
12	Nov-17	125	121	97%	125	100%	85%		
13	Dec-17	42	34	81%	39	93%	85%		
14	Jan-18	50	40	80%	49	98%	85%		
15	Feb-18	127	120	94%	127	100%	85%		
16	Mar-18	128	123	96%	128	100%	85%		

Figure 4.3: Data after applying data interpretation technique

- **New Charts Generation**

  New charts generation is the next and very important step in WebSubPlus Memory Generation Monthly Stats Report generation, it create all new charts form new data which was changed in previous step (refresh data). After clicking on new charts generation user got some charts which represent performance. To compare performance compare at least one year of data, one year of data is minimum necessary to analyze trend. Figure 4.4(a) and 4.4(b) shows the sample of charts generated after statistical analysis technique.

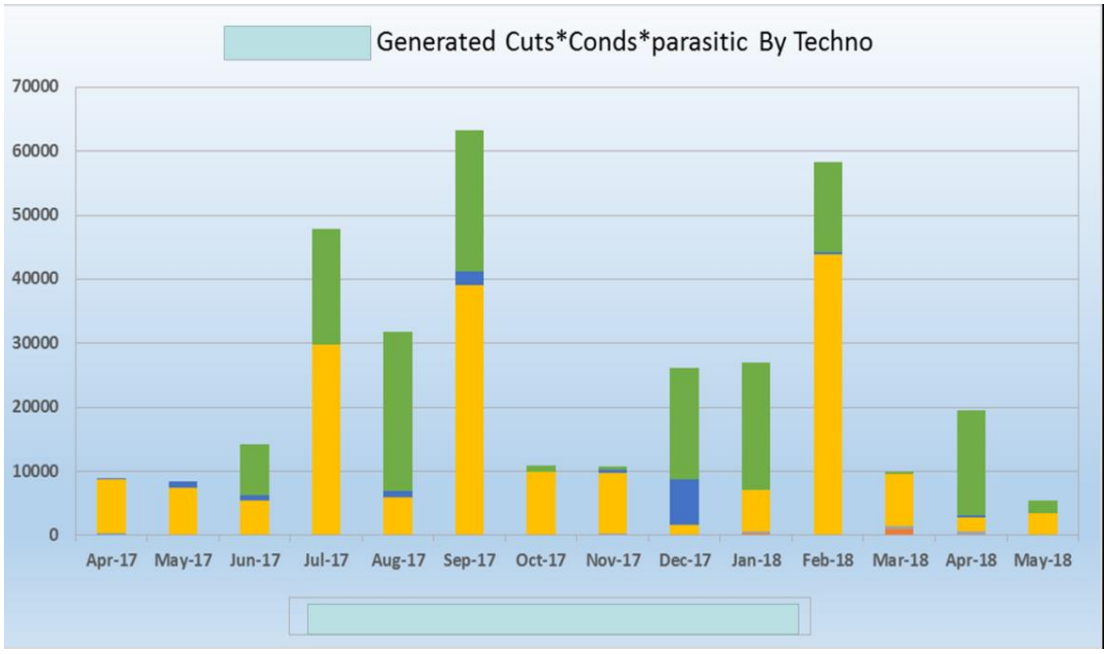


Figure 4.4(a): Sample of charts generated after statistical analysis

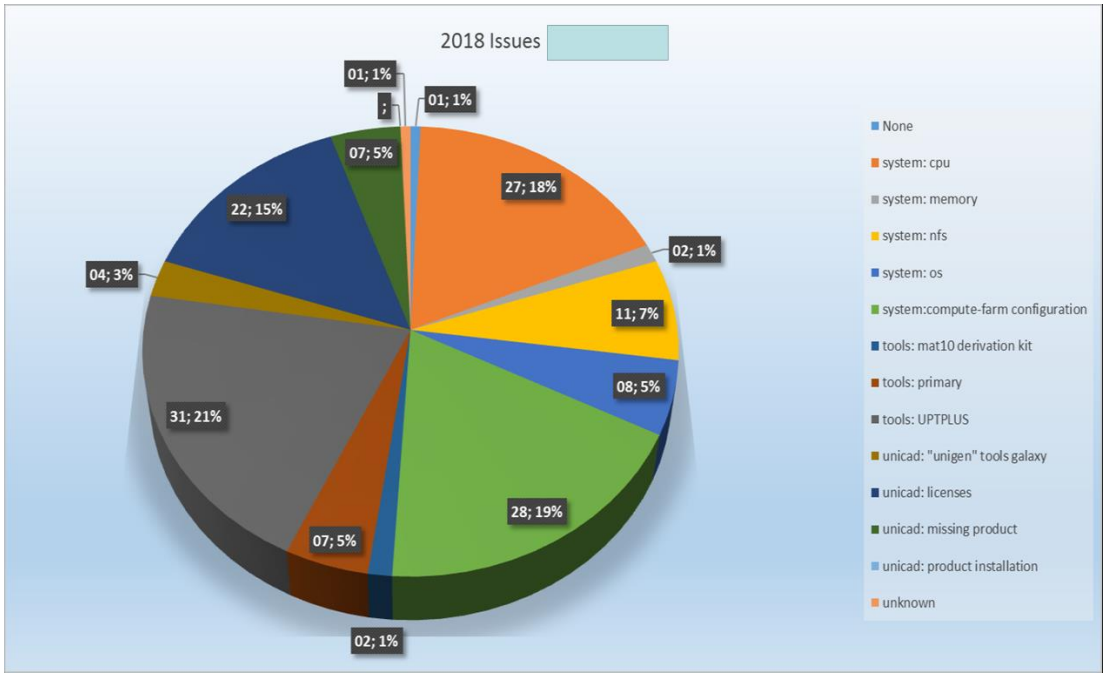


Figure 4.4(b): Sample of charts generated after statistical analysis

- **Insert platform analysis**

  In this step user inserting some performance analysis charts from a particular location; these charts are representing overall performance of the generation, how many generations are successfully generated.

- **Insert license**

  In this step user insert license charts from a particular location; which tell about how many external licenses were used for cut generation in WebSubPlus.

- **Copy to ppt**

  After all steps are successfully done then go to copy to ppt step to copy all the charts which were generated in all previous steps. This step is very important as company prospective; this ppt is used by the company employee/Users to measure the performance. Figure 4.5 shows interface of WebSubPlus.

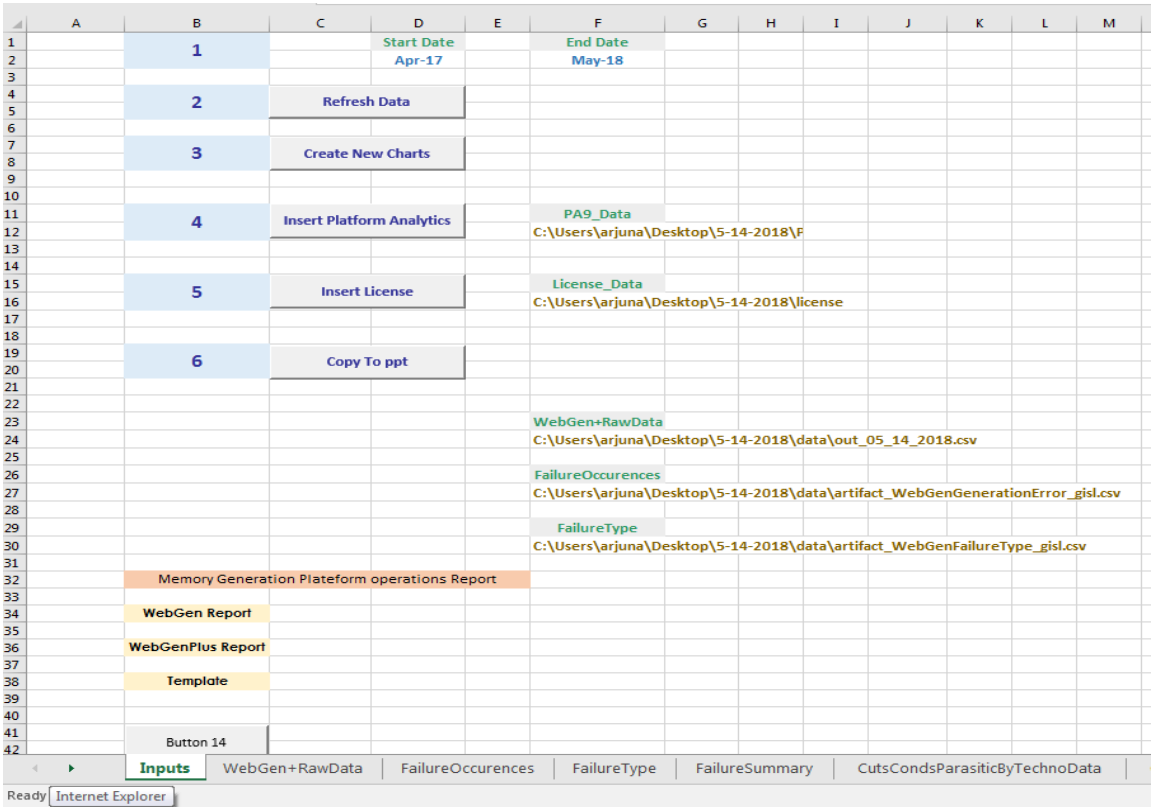


Figure 4.5: WebSubPlus Interface

4.2 WebSubPlus services monthly report

Service Report Overview

WebSubPlus service monthly report is done for monitoring the monthly stats, which are generated by development team. Through these stats development team conclude that how many failures occurred of which type in particular month, in particular year, this is very good method to monitor progress with less efforts. In year 2016, total 280 men days spent and out of total efforts 70% efforts spent on IT infrastructure issues. In year 2017, total 118 men days spent and out of total efforts 60% efforts reduction with respect to 2016

Pre-requisites

- UNIX workstation
- UNIX account able to reach WebSubPlus database
- Codex account
- CAD-Analytic (PA9) account
- Office 2016 (Excel, PowerPoint)

Steps for Websub services monthly report

1. Download all the required data for new charts generation.
    - Websub+ RawData
    - FailureOccurences
    - FailureType

    Get the last PowerPoint file to fill

    File to get:

    WebSubPlus Memory Generation Operations Report

2. Get the last excel file to fill

    File to get:

    WebSubPlus Statistics Report Generator

3. Download PA9 data

- Slots by User CAPACITY CONSUMPTION
- Slots by Cluster CAPACITY CONSUMPTION
- Jobs by User CAPACITY CONSUMPTION
- Jobs CPU EFFICIENCY by Queue
- CPU EFFICIENCY By Queue
- %JOBS WITH PENDING TIME _ nn MINS Wait Time

4. Download License data

5. For creating WebSubPlus report:
   - Open the Microsoft PowerPoint presentation of the previous month, and remove all previous slides (keep only first three slides).
   - Open the Excel Workbook << WebSubPlus Memory Generation Monthly Stats Report.xlsm>>.
   - Go to <<Inputs>> sheet

Step 1: Update all paths of the files, which downloaded before

1. WebSub+RawData

2. FailureOccurences

3. FailureType

4. PA9_Data

5. License_Data

Step 2: Update dates on sheet (Start Date and End Date)

Step 3: Click on *Refresh Data*

Step 4: Click on *Create new charts*

Step 5: Click on *Insert Platform Analytics (before click change path accordingly)*

Step 6: Click on *Insert License (before click change path accordingly)*

Step 7: Click *copy to PPT (to copy all the charts into ppt file).*

Automation portal and controller

- One Click Automation – Instead of launching one-one script development team create a single click system through which user can run any script directly by just a single click.
- Some scripts are need to run ones in a month and they take some time to generate data so for saving time Crontab is created for those kind of scripts, through Crontab user got required data directly into our working area without involving men effort.
- User got a notification mail when data is successfully generated.

4.3 Monitoring

4.3.1 Implementation

The following scripts are executed as terminal command while monitoring jobs.

- **GetWorkingDir:** This script is used to get working directories from compute-farm based on various parameters. Options accepted by the scripts are:
    - -w : Path(s): 'path1 : path2'.
    - -r : Requester name.
    - -s : Status: 'stat1/stat2'.
    - -l : Library name.
    - -cfg : Configuration name.
    - -p : Project name.
    - -cat : Category name.
    - -j : Lsf main job id.
    - -o : Obsolete directory yes/no.
    - -r team : Team name.
    - -orph : Directories without LSF jobs.
    - -started after : Date to start searching
    - -started before : Date to stop searching.
    - -dm id : Designsync ID.
    - -display : Display type. Default is 'plain'.

- -lr : Display latest for each designSync request.
- -help/-h/-u/-U : Display the script usage.
- -GUI : Graphical user interface.

Figure 4.6: Output of script - GetWorkingDir

- **IsLatestGeneration:** The script will check whether a generation is the latest that is to be launched or not. If it is not latest generation then it will display the working directory of latest generation. Option accepted by this script:
  - -w : Generation Working directory.
  - -help/-h/-u/-U : Display the script usage.
  - -GUI : Graphical user interface.

- **RemoveWorkDir:** This script will check if generation having specified working directory is released or marked as obsolete then it will delete the working directory. The reason behind it is to make room for other generations. Option accepted by this script:
  - -w : Generation Working directory.
  - -help/-h/-u/-U : Display the script usage.
  - -GUI : Graphical user interface.

- **GetTankedJobs:** This script will display all generations that are not progressing for hours. Options accepted by the scripts are:
  - -main : Time main-jobs RUNNING (hours).
  - -sub : Time Sub-Jobs RUNNING (hours).
  - -pend : Time all-Jobs PENDING (hours).
  - -jobGroupBase : jobGroupBase.
  - -help/-h/-u/-U : Display the script usage.
  - -GUI : Graphical user interface.

- **Daily Alert:** This script will send mail about failed or tanked generation to the team members that are responsible for monitoring task on daily basis. The script runs at specified intervals of time. It generates results and sends them as mail to responsible team members. Scheduling of script is being done by Crontab. Cron is software utility that schedule jobs. It is available for UNIX based environments. It is useful in running jobs at specified intervals of time. Crontab (or Crontable) is a configuration file that determines shell commands that are to be run at specified intervals of time.

Options accepted by the script are:

- -mail : No screen display, send mail instead.
- -recipients : Display recipients currently registered.
- -repository : User repository.
- -help/-h/-u/-U : Display the script usage.
- -GUI : Graphical user interface.

- **Find Failed:** This script is used to identify if there is any error in a given generation directory. Option accepted by this script:
  - -w : Generation Working directory.
  - -help/-h/-u/-U : Display the script usage.
  - -GUI : Graphical user interface.

Figure 4.7: Output of script - DailyAlert

- **CreateCodex:** This script creates Codex entry for tracking failures. Options accepted by the script are:
  - -workDir : list of work directory.
  - -cmd : Codex Command to execute. Default is 'add'.
  - -tracker : Codex Tracker to use.
  - -user : Codex UserName.
  - -pf : Codex password file.
  - -id : Codex Id to use for update operation.
  - -site : Site to be used prod/qa/.
  - -status : Tracker Status.
  - -stepName : Failure Step Names.
  - -description : Failure Description.
  - -correctiveAction : Failure Corrective Action.
  - -failure type : Failure Type id.
  - -artifact id : Codex to update.
  - -summary : Failure Summary.
  - -help/-h/-u/-U : Display the script usage.
  - -GUI : Graphical user interface.

- **RestartGeneration:** This script is used to restart a finished/non-running generation. Options that are accepted by the script:
  - -workingDirectories : Directory(ies) as 'path1' 'path2'
  - -jobGroupBase : jobGroupBase.
  - -help/-h/-u/-U : Display the script usage.
  - -GUI : Graphical user interface.

- **SetObsolete:** This script is used to make generation obsolete when it is not a latest run. Options that are accepted by the script:
  - -w : Generation Working directory.
  - -help/-h/-u/-U : Display the script usage.
  - -GUI : Graphical user interface.

4.3.2 Steps for Job Monitoring

Failed Generations

- Check mail or run command GetWorkingDir -s Failed for failed to get all failed generations.
- Go to working directory of failed generation and touch Your Name Is Working There file.
- Execute command FindFailed to see the list of log files of the failed steps.
- Investigate inside the log files of the failed generations to see the cause of failure.
- Once the failure is identified, the next target is to track this failure occurrence. If this is a known issue with similar previous existing Codex artifact, then user need to just create a new Codex artifact for this failure occurrence capturing the required details as mentioned below. If this is a new failure with no recorded occurrence existing, then user have to create Codex failure type artifact and Codex occurrence type artifact. Details to be populated in Codex occurrence artifact are:

- Failure summary: Single line entry containing <workingDir> and the error message.
- Failure type: Codex failure type artifact id for this type of failures
- Step name: Select the name of the step which you see failure in.
- Working Directory: Complete path of working directory of the failed generation in question.
- Project name: Name of the project from which this generation was launched.
- Requestor name: Name of the person who had launched (requested) this generation.
- Status: Select from open or close depending upon the resolution.
- Severity: usually used option is error.
- Assigned to: Name of the person who is working on this failed generation being reported.
- Description: This contains 2 parts:
- Error: List of failed steps, error message as seen from the compute farm.
- Analysis: The analysis for actual reason of failure.
- Corrective Action: The action taken for this kind of failures to resolve the issue if possible or to report to the right people responsible if the issue cannot
- be resolved by monitoring team.
- Once the reason for failure and the corrective actions have been identified, then one of the following actions have to be performed:
- If the issue can be resolved by monitoring team, then:
- If this is the latest launch for this library, then perform the corrective action and restart the generation to let it continue and finish.
- If this is not the latest launch of this library, then make this generation obsolete to indicate that this is not the latest generation and not to be processed with failures.
- If the issue cannot be resolved by monitoring team, then report the issue to the right people responsible.

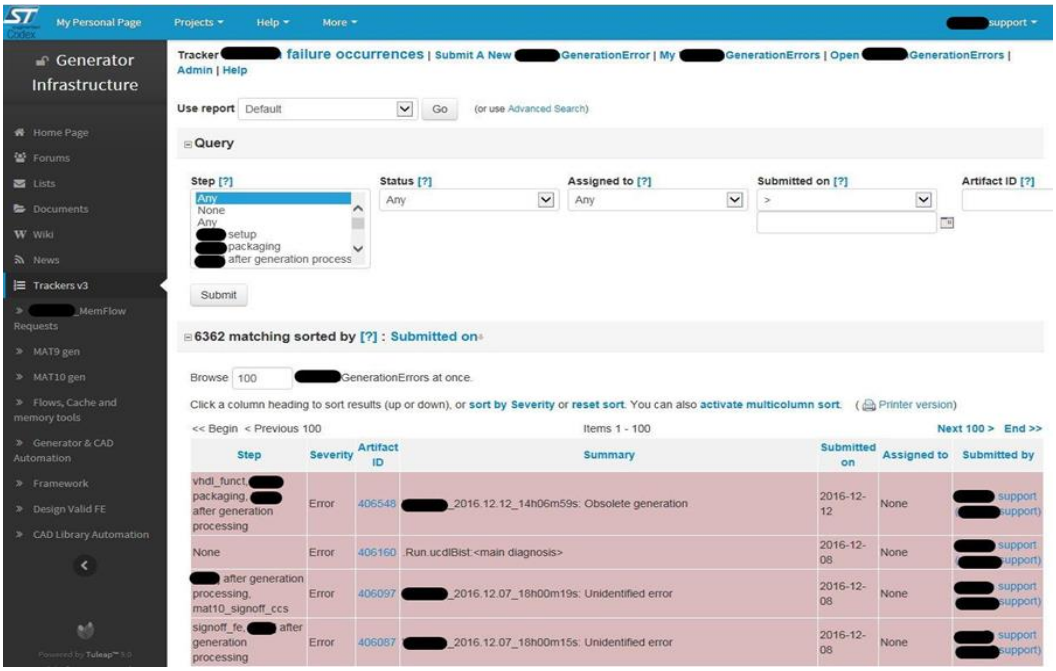


Figure 4.8: Failure occurrences

Tanked Generations

1. For each tanked job, go to the working directory for the jobs.
2. For each running task, check the log file for when was the last update to file done and that there is no error message inside the log file. If the log files have failures, then cancel the generation and debug it. If the files were modified files than 12 hours, then leave the generation (if it has no errors) running. Figure 4.9 shows all the failure type.
3. For each tanked generation If there is no error inside the log files of sub-tasks and the last updates were made more than 24 hours ago, do the following procedure:
    - If this is the first instance of tanked generation, then create a Codex (occurrence) touch Your Name Is Working There file and restart the generation.
    - If this library has already been restarted earlier, then cancel the generation.

The whole monitoring process flow chart is shown in Figure 4.10.

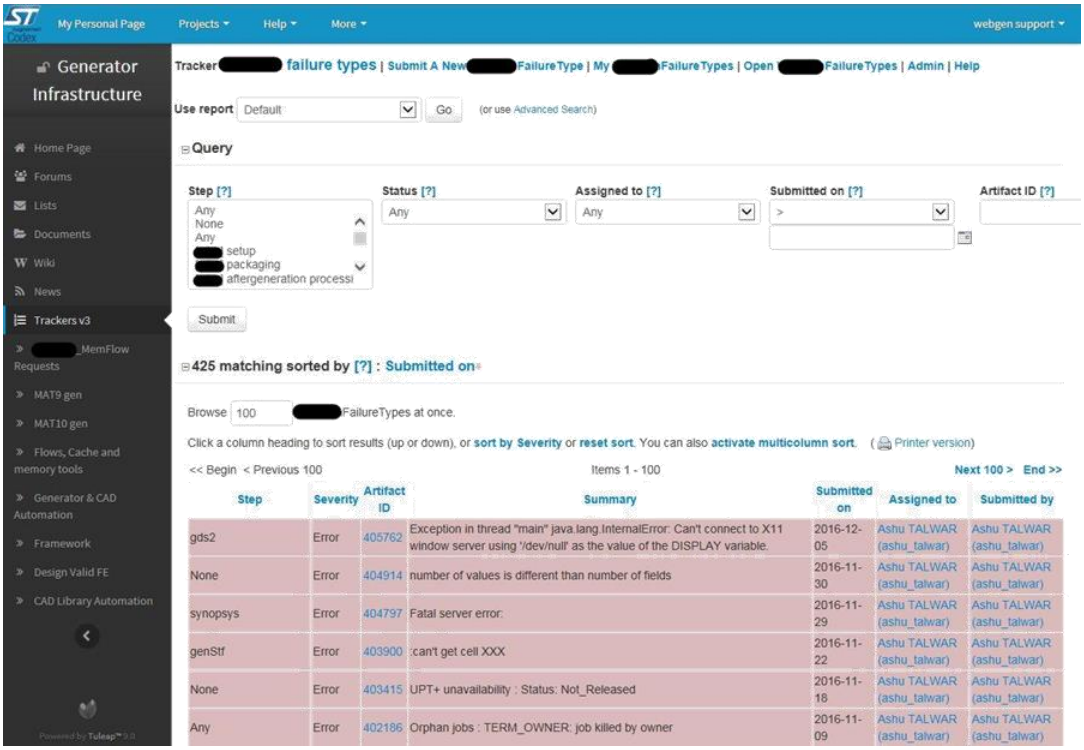


Figure 4.9: Failure Types

4.3.3 Automation

Failed Generation Categorization According to Responsible Team

- **Previous Scenario:** Mail about all failed generation is sent to the team members that are responsible for monitoring.
- **Problem:** Team members responsible for monitoring have to send mail to initiator team about generation failed due to fatal error.
- **Solution:** Check for failed generation and automatically send mail to responsible team.

Algorithm:

foreach failed generation

read details

find responsible team

run mail command to send e-mail to corresponding team members

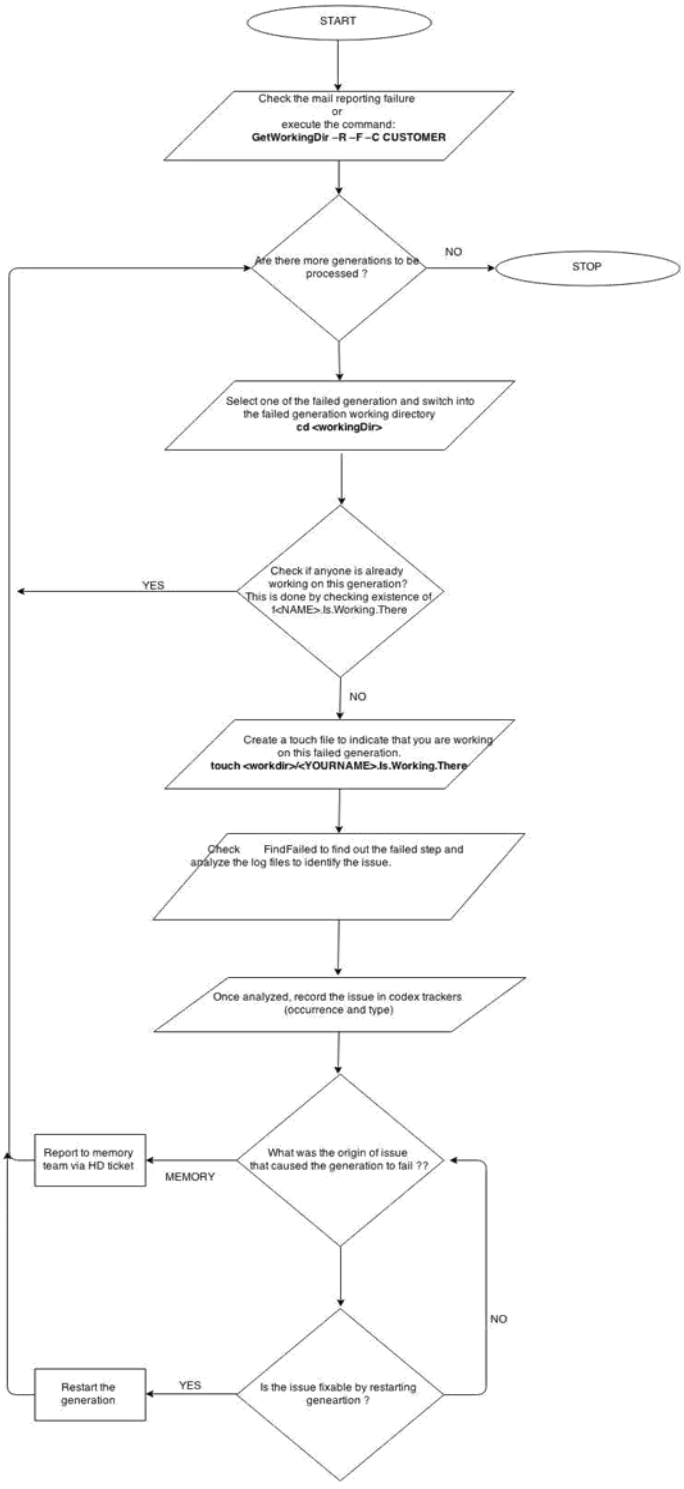


Figure 4.10: Flow of Monitoring Process

Restart Tanked Generation

- **Previous Scenario:** Manually checking if tanked generation is already restarted or not, and then take action according to that.
- **Problem:** Team member have to check every interval of time for tanked generation.
- **Solution:** Write a script that automatically searches for tanked generation every interval of time and checks that if generation is already restarted or not and the takes action according to that as per steps for monitoring for tanked generations.

Algorithm:

```
foreach running jobs
        find job name
          If  job name contains cellData or gds
                If  job is running for more than specified amount of time
                        find main job from job group
                        Add main job ID and working directory in
    array foreach job ID and working directory in array
        Read log files from working directory
          Foreach log file
                Read log file line by line
                If generation is already restarted
                        Set flag
          If flag is set
                Get design management ID for that working directory
                cancel generation
                restart generation
```

```
Else
    find subjobs of job
    foreach subjobs
        get jobname
        if job name contains cellData or gds
            get job ID and kill job
```

Auto-completion of Script Options

- **Previous Scenario:** Users have to write whole script name, options and their possible values to pass as an argument to run that script.
- **Problem:** User have to remember all script options and their values type or possible values.
- **Solution:** Write a script that auto complete the script name and give list of options by pressing tab after script name and give possible values by pressing tab after relevant option.

Standard Completion

Linux provides standard completion mentioned below:

- **Variable name completion:** When we type $ in terminal and then press tab, all shell variables that are available is displayed.

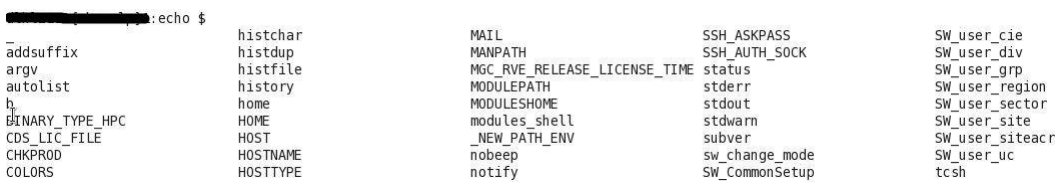


Figure 4.11: Variable Name Completion

- **Username completion:** When user type tilde (~) and then press tab, all usernames are displayed automatically.

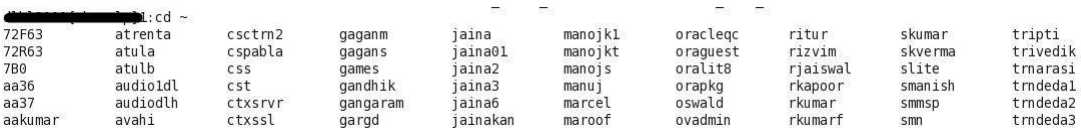


Figure 4.12: Username Completion

- **Filename and directory completion:** Display all the available files and directories.

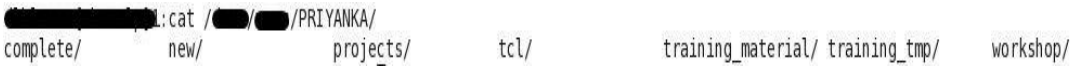


Figure 4.13: Filename and Directory Completion

Proposed Completion

Our developer team proposed a completion of name of scripts - used in monitoring process, options that are given to those scripts and values of those options.

There were two approaches available to us:

- Extract script name, options and their possible values from one file of product.
- Get script name from file name of that script and extract options and their possible values from that file.

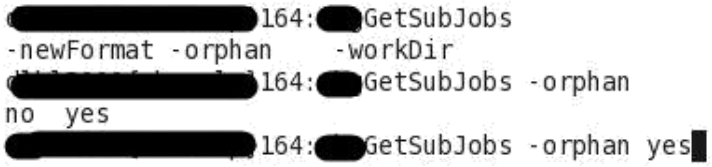


Figure 4.14: Script Option Completion

Developer team implemented proposed completion in both approaches, as they products in both of these approaches. Example of proposed completion is shown in Figure 4.15.

As you can see in Figure 4.15, proposed completion shows possible values of given option, if values are Boolean or enum.

Chapter 5

Result and Analysis

5.1 Analysis

Objective is achieved to do automation with the helps of statistical analysis in memory generation platform. Through this user monthly analysis of how many failures occurred of which type in year 2017 to 2018. In year 2017, total 320 men days spent and out of total efforts 30% efforts spent on IT infrastructure issues. In year 2018, total 225 men days spent and out of total efforts 30% efforts reduction with respect to 2017.

5.2 Different WebSubPlus performance report approaches

Manual performance report generation is less established and less through kind of approach. Manual performance report generation required analyzer to perform manual operations on library.

A person generating manual performance report should process the following qualities:

- Observant
- Creative
- Open-minded
- Skillful
- To be patient
- Resourceful

Benefit with manual performance report generation

- Automation can’t support human instinct, surmising, and inductive thinking.
- It requires less time and cost to start profitable generation using this approach.

- Computerized development can't change course amidst a trail to analyze something that had not been already considered

Problems with Manual Development

- Manually performance report generation is very time consuming job. Generation of a single report of a month takes 2 days.
- Manual approaches are less reliable approaches, because it is done by the human and there are many possibilities of error.
- This is approach is the less dependable then the automated one (as in many situations it won't cover all the cases).

Automated Performance Report Generation

Automation is the use of strategies and tools to diminish the requirement of human involvement or interaction in repetitive or redundant tasks. Automated generation, when done effectively can have many points of interest and be extremely valuable to the organization.

Benefit of Performance report generation through automation

- As all know that automation is fast and accurate as compare with manual work.
- There are less chances of error because there is less human interaction.
- In repetitive work Machine can perform better and accurate than human.
- Programmable, can program complex codes for a single time and can be reusable again and again without any problem.
- Quality is very big challenge for these kinds of organizations (STMicroelectronics) they cannot compromise with their quality as they cannot rely on human for such a large development.
- The second big challenge for these kinds of organizations is delivery on time. STMicroelectronics is a brand for their products and quality and they deliver their product on time, for this automation is needed.

Comparison between WebSub and WebSubPlus shows lots of improvement in WebSubPlus. It also proves why STMicroelectronics need a new tool like WebSubPlus. Here Table 5.1 is showing difference between WebSub and WebSubPlus

Table 5.1: Comparison between WebSub & WebSubPlus

	WebSub	WebSubPlus
Ease of use	Yes	Yes
Automated Data fetching	No	Yes
Automated data generation	Yes	Yes
New changes	No	Yes

Table 5.2 shows difference between old WebSubPlus and new WebSubPlus. Why STMicroelectronics need further development of WebSubPlus. New WebSubPlus shows it is much better then old one in performance, it takes less amount of time, and addition of new feature is very easy because of new version of WebSubPlus.

Table 5.2: Comparison between old WebSubPlus & New WebSubPlus

	Old WebSubPlus	New WebSubPlus
Time Taken	2 days	2 hours
Error possibility	High	Low
Addition of New feature	Difficult	Easy
Human interaction	No	No

Chapter 6

Conclusion and Future Work

6.1 Conclusion

Every organization requires management of information and it is a tedious work but user can do this task more efficiently by WebSubPlus Tool. Report generation is the best feature of this tool because user can get all the required data together with some pictorial presentation which make easy to understand reports. User can get overall review of the data and can do their task easily. This tool is quite efficient since it maintains huge storage of data, server connections are well maintained and user can see all the data about there project.

6.2 Future Work

As a future work GUI is our primary goal. More automation in monitoring process can be done to reduce efforts required to handle failures. The next step is to develop GUI for stats generation process, because GUI in stats generation can make this process very easy and handy. There is a need to work on some new technologies which can reduce the hectic process of modification in code regularly. Through this user can add new feature in this tool.

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