Major Project Report on

Digital Negotiation Factory

by

Dushyant Singh (Reg. No.: 201700066)

Group ID: SE-54

In partial fulfilment of requirements for the award of degree in

Bachelor of Technology in Computer Science and Engineering

(2017-2021)

Under the Project Guidance of

Mr. Rajesh Prasad, Manager, CAM IT Proc. & GSP Department, TATA STEEL

And

Internal Review By

Mr. Suman Kalyan Kar, Assistant Professor – I, SMIT

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(A constituent college of Sikkim Manipal University)

MAJITAR, RANGPO, EAST SIKKIM – 737136

PROJECT COMPLETION CERTIFICATE

This is to certify that **Dushyant Singh** bearing registration number **201700066** Of Computer Science and Engineering Department of Sikkim Manipal Institute of Technology (SMIT) have worked under my guidance from **January** 2021 and has successfully completed the project entitled "Digital Negotiation Factory**"** in partial fulfilment of the requirements for the award of Bachelor of Technology.

………………………..

Name: Rajesh Prasad

Designation: Manager, Client Partner Department, TATA Steel

PROJECT REVIEW CERTIFICATE

This is to certify that the work recorded in this project report entitled "**Digital Negotiation Factory**" has been jointly carried out by **Dushyant Singh** of registration **201700066** student of Computer Science & Engineering Department of Sikkim Manipal Institute of Technology in partial fulfilment of the requirements for the award of Bachelor of Technology in Computer Science and Engineering. This report has been duly reviewed by the undersigned and recommended for final submission for Major Project Viva Examination.

……………………………

Mr. Suman Kalyan Kar

Assistant Professor I

Department of Computer Science and Engineering

Sikkim Manipal Institute of Technology

Majhitar, East Sikkim – 737136

CERTIFICATE OF ACCEPTANCE

This is to certify that the below mentioned student(s) of Computer Science & Engineering Department of Sikkim Manipal Institute of Technology (SMIT) has / have worked under the supervision

of ……………………… and …………………. of ……………………………from **29 January 2021 to 29 May 2021** on the project entitled **"Digital Negotiation Factory".**

The project is hereby accepted by the Department of Computer Science & Engineering, SMIT in partial fulfillment of the requirements for the award of Bachelor of Technology in Computer Science and Engineering.

University Registration No	Name of Student(s)	Project Venue
201700066	Dushyant Singh	Jamshedpur, Jharkhand - 831001

…………………………..

Dr Kalpana Sharma

Professor & HOD

Computer Science & Engineering Department

Sikkim Manipal Institute of Technology

Majhitar, East Sikkim - 737136

DECLARATION

I, the undersigned, hereby declare that the work recorded in this project report entitled "**Digital Negotiation Factory**" in partial fulfilment for the requirements of award of B. Tech (CSE) from Sikkim Manipal Institute of Technology (A constituent college of Sikkim Manipal University) is a faithful and Bonafede project work carried out at "**Jamshedpur**" under the supervision and guidance of **Mr. Rajesh Prasad, Manager** at **TATA Steel.** The results of this investigation reported in this project have so far not been reported for any other Degree/Diploma or any other Technical forum. The assistance and help received during the course of the investigation have been duly acknowledged.

…………………………….

Dushyant Singh (201700066)

ACKNOWLEDGEMENT

Dushyant Singh (201700066)

DOCUMENT CONTROL SHEET

1	Report No	CSE/Major Project/ External /B.Tech/ Internal/SE-54/2021
2	Title of the Report	Digital Negotiation Factory
3	Type of Report	Technical
4	Author	Dushyant Singh
5	Organizing Unit	TATA STEEL
6	Language of the Document	English
7	Abstract	A user interface to cater all negotiation pre-requisites for procurement executives and provide feedback to vendors.
8	Security Classification	General
9	Distribution Statement	General

Table of Contents

List of Figures

Abstract

Procurement of various materials and services is required for steel manufacturing. Bids are invited from vendors by procurement executives. At present they can only negotiate by leveraging bulk contracting thus, to get an edge in negotiations an interface to cater all negotiation pre-requisites is desired which would give them a better understanding of market dynamics and better visibility of open market trends by drawing conclusions from the unstructured past details (data).

Analytics of latest market trends and price movements, auto identification of best bidding price range for negotiation and auto identification of best qualifying vendors are the negotiation pre-requisite that are essential for having an edge in negotiations.

Along with Procurement executives the vendors can also derive assistance from the interface in the form of a feedback template which would highlight various comparison parameters such as product quality, punctuality, responsiveness etc. that affect business opportunities directed towards them.

This will lead to analytically driven negotiations, reduced negotiation time and increased vendor competitiveness just through a simple user-friendly interface for all procurement related users (procurement executives & vendors).

Introduction

1.1 General overview

A simple user-friendly interface is desired which would assist all procurement related users (procurement executives and vendors). The continuous guidance from key procurement executives and past data to analyze are the key resources needed for the functioning of the application.

The guidance from procurement executives refers to feedback of all previous services / materials provided by any vendor over parameters like quality, lead time, preferred location, avg. likelihood etc. This data would be used in giving a score to a vendor ranging from 1 – 5, which would help us prepare a ranking for the choosing the best vendor.

The past data to analyze is the details of the all the orders placed by the procurement executives which were fulfilled by the various vendors. The details encompass the order ID, PR number (this indicates a particular class of service / material), UMC (Unique Material Code), date of request, price per unit, quantity requested, vendor ID, vendor name and total price. The pre-processing and analysis of this data will help us visualize a market trend of each material supplied by any of the vendors. Minimum user input consisting of PR number or UMC would be required for presenting the intended analytical results.

The vendors would have access to a templated score card which would highlight comparison parameters such as quality, price, lead time, spend (business share) etc. for encouraging more competitive bidding.

The interface would be developed such that the functionalities and data processing algorithms can be easily swapped or re-trained according to the requests of the users, without causing any change to the basic architecture of the application.

1.2 Literature Survey:

YEAR	JOURNAL	TITLE/AUTHOR	FINDINGS	RELEVANCE
2020	International Journal of Engineering & Information Systems	Book's Rating Prediction Using Just Neural Network **Authors:** Alaa Mazen Maghari, Iman Ali Al-Najjar, Said Jamil Al-Iaqtah, Samy S. Abu-Naser	Normalization is required when rating values to be predicted are very small compared to input integer parameters	We don't need to perform normalization as input values are in the same range as ratings to be predicted
2003	ELSEVIER	Credit rating analysis with support vector machines and neural networks: a market comparative study **Authors:** Zan Huang, Hsinchun Chen, Chia-Jung Hsu, Wun-Hwa Chen, Soushan Wu	SVM (Support Vector Machine) achieved accuracy comparable to BNN (Backpropagation Neural Network)	We need to decide whether to use a neural network or a ML algorithm (SVM) to make our vendor rating prediction. As overall rating is subject to individual judgement neural network seems more feasible

1.3 Problem Definition

The absence of visibility of open market trends and dynamics due to unstructured details of the past procurements, executives are left with bulk contracting as the only leverage for price negotiations. Thus, they cannot get more economically viable options for the company.

Time in between getting a proposal and making a counter proposal is essential to establish a better footing in negotiations, but the procurement executives experience a loss of negotiation window due to absence of negotiation pre-requisites. (Analysis of market trends and price movements, auto-identification of best qualifying vendors, auto-indication of best bidding price range)

There is no negotiation feedback for vendors available therefore competitive bidding not promoted.

Absence of a one-stop platform for assisting to all procurement related users.

1.4 Analysis of the problem & SRS

1.4.1 SRS Introduction

A web application can act as a one stop platform for assisting all procurement related users, therefore the system is developed as a web application. Also, there is no issue of portability. The application must be accessible by any modern web browser (Chrome, Firefox, Edge etc.) and be responsive to the device it is accessed on (Mobile, laptop, tablets). The application should be dynamic and respond to the requests made by the user. The application should show efficiency, as in maximum results and visualizations with minimum user input.

The application must be able to integrate the analysis results and reflect them in the views for the different users (feedback template for vendors, market trend charts, statistical results etc. for executives). We must be able to change these views, embed more functionalities to be performed on the data resources and swap or re-train the models for predictions without causing any change to the basic structure of the application.

1.4.1.1 Hardware specification of the Developing environment

- Modern operating system (Windows 7 or 10 & higher, Mac OS X 10, 11 or higher, 64 bit)

- x86, 64-bit CPU (Intel, AMD Architecture) or apple M1 chip

- Minimum 4 GB RAM

- Minimum 5 GB free disk Space

1.4.1.2 Software specification

- Front – End: HTML, CSS, JS, Bootstrap

- Back – End: Python version 3.5+ or Python 2.7, Flask, SQL-Alchemy package, Jinja, Werkzeung, MarkupSafe, ItsDangerous, Click, WTForms, Pickle, Pandas, Numpy, Keras, Matplotlib, Scikit-Learn, pickle, h5, D3.js, Anaconda Virtual Environment.

1.4.2 Goals of Implementation

The algorithms for data processing and analysis can be developed independently and can be used in the main application as we please.

The algorithms and trained neural network models can be swapped or re-trained from time to time as the need arises.

The functions and dependencies which relay the results and visualizations after processing of the data can also be swapped or manipulated if changes in the template visualizations are requested.

The application should be efficient as in it should show maximum results and visualizations with minimum user input.

1.4.3 Functional Requirements

PR Number/ UMC/ Vendor Login Creds.

Display Corresponding visualizations and results.
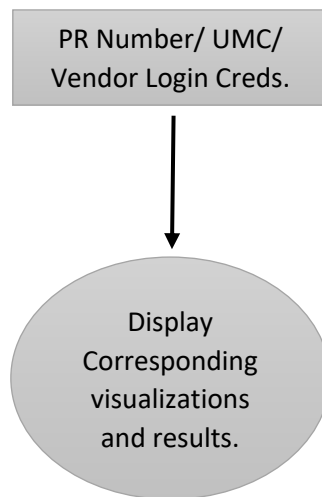
Fig. 1: Interaction View of Users and the application functionality

1.4.4 Non-Functional Requirements

The application must be responsive so that it can be viewed on wide range of devices which can support a modern browser without any difficulties. The application functions can be swapped and manipulated any number of times to meet the user requests without making any changes to the basic application structure.

The application is designed such that there is minimum effort on the user's part and maximum conclusions, results and visualizations can be relayed as a template corresponding to user input.

The neural network models or Statistical processing models may need to be re-trained over a course of time (usually one financial year).

1.5 Proposed Solution Strategy:

An interface capable to relay the results derived from the statistical modelling or processing of data in the backend to the template (web page) corresponding with the minimum user input received at the front end is developed.

The diagram below gives us an overview of the application functionality and the users it would cater to. The other players involved are the Admin and the Company who are responsible for smooth functioning of the application and providing the data resources needed for processing to our application functions.

The Administrator is responsible for verifying and authorizing users. He adds the details of the new users in the database and communicates the login credentials to the new users for accessing the application. The management of users of the application is the responsibility of the administrator. The administrator is a sub-entity of the company and is also responsible for swapping the data files (past procurement & feedback data) used in processing by the various functions for the functioning of the application.
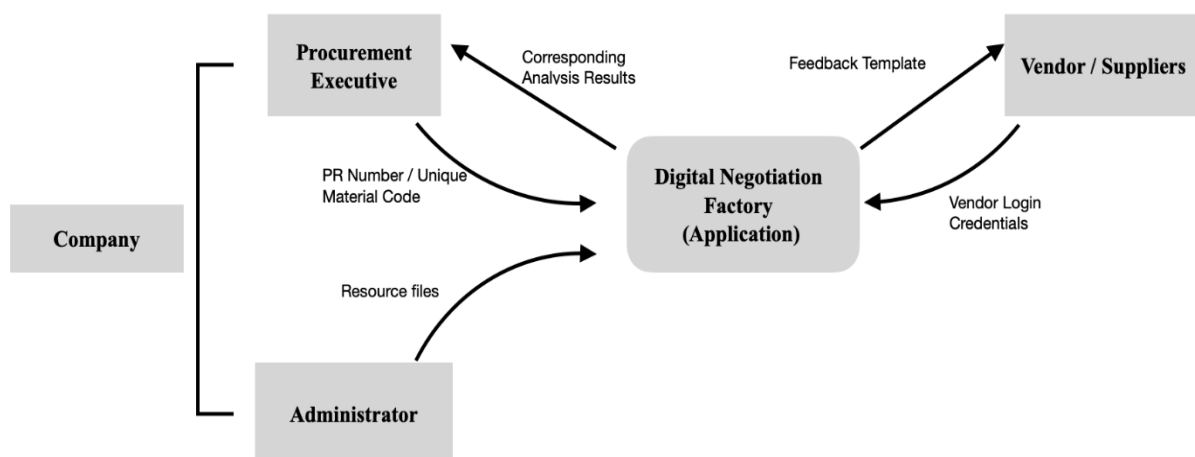
Fig. 2: Application Interaction with all users and other involved entities

Flask micro web framework is a choice for developing this interface. It would be a web application hence easily accessible and there will be no portability issues.

Due to many libraries available mostly all data processing, analysis, statistical modelling etc. are done using the Python language. So, a python web framework for developing the web application would make it easier to relay the analysis results to the templates. Hence, we are developing web application using flask micro web framework.

The different users (vendor / company exec.) would be able to have different views as the application would direct them to their respective pipelines. The procurement executives would receive the analysis results and visualizations corresponding to the PR number or Product ID entered by them. The respective vendors would receive their feedbacks & visualization templates assembled for them.

The data needed for processing is loaded as dataframes in python from excel/csv files stored in the server which can be updated quarterly or monthly as the case may be. The dataframes can be extracted from any excel/csv file if it's address has been correctly specified.

Design

The interface would relay the analytical results derived from the data resources provided by the company corresponding to the user input. The dynamics of the functioning of the application are represented in the diagram below. It depicts the pipeline the users follow to get assistance from the application.
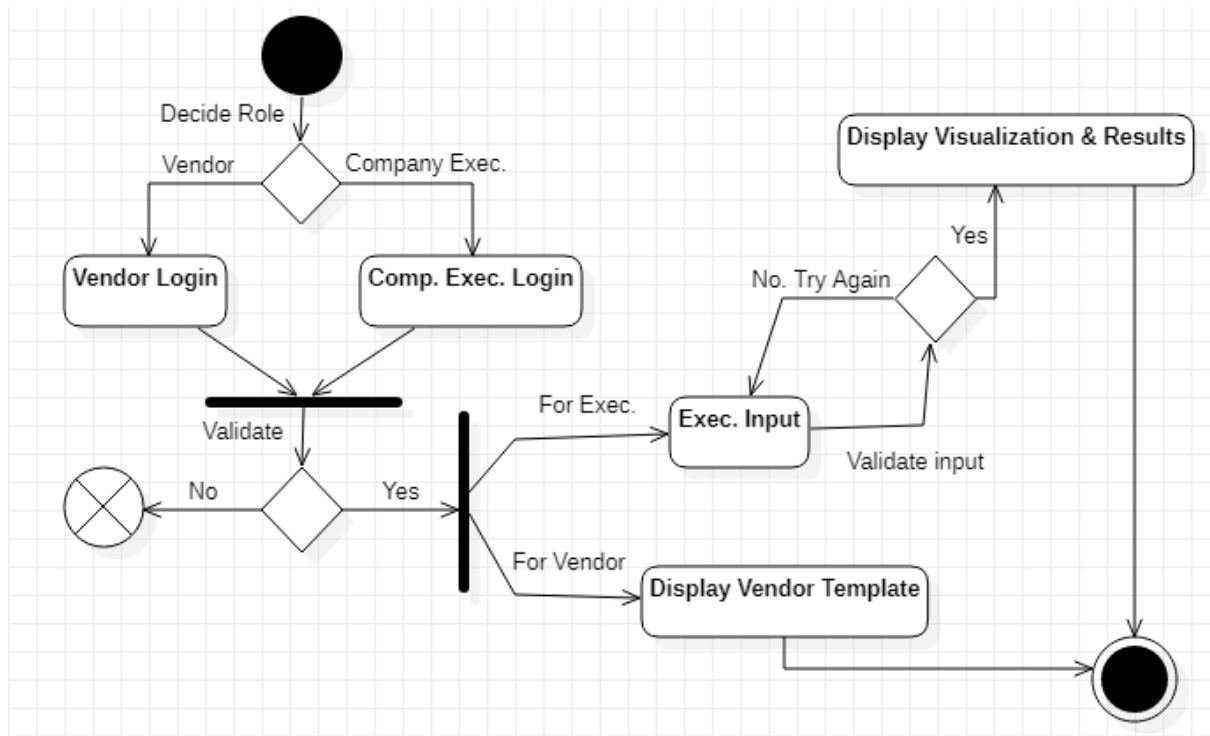
Fig. 4: Activity Diagram

Various processes are integrated for the functioning of the application. An overview of these processes and their integration in the application is represented by the Data Flow Diagram below.

Fig. 5: Context Diagram

20

PR Number / Product ID

Vendor login credentials

Process data for results and visualisations

0.1

Process data for feedback and visualisations

0.2

Past procurement details data

Performance Review data frame

Conclusive Results & Visualisations

Conclusive Feedback & Visualisations
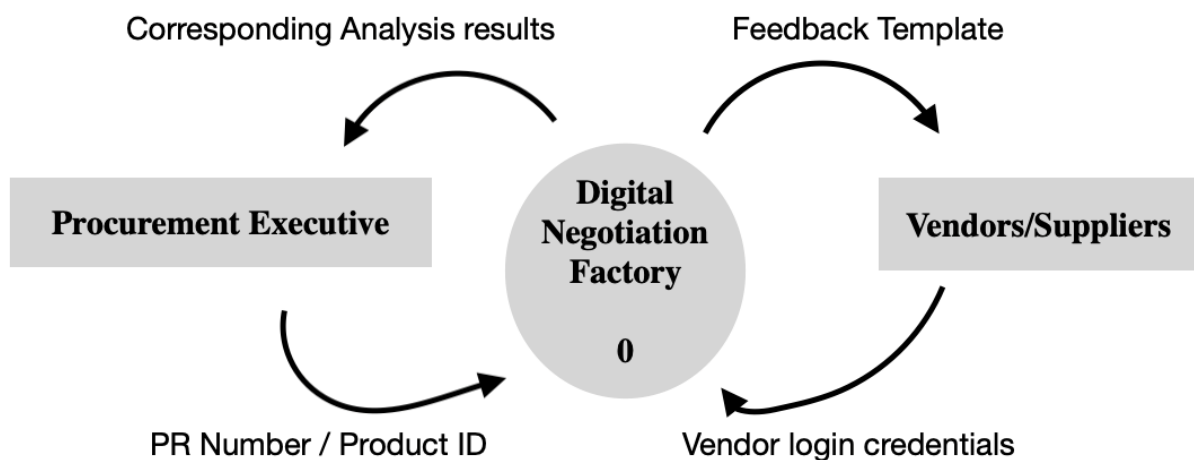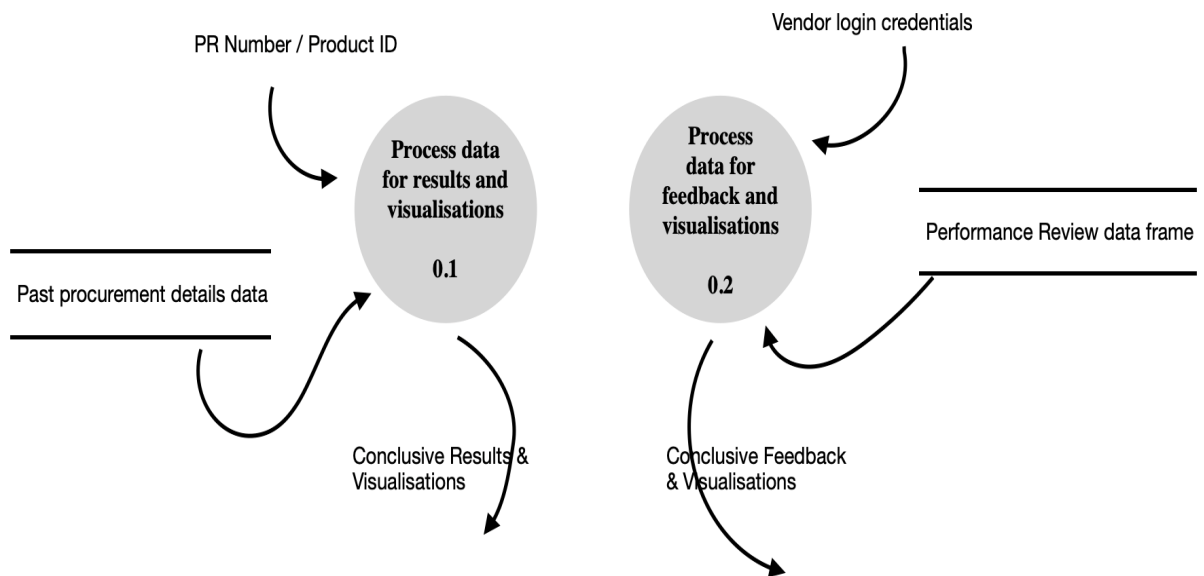
Fig. 6: 1ˢᵗ Level of Data Flow Diagram

Login Creds

PR Number or Product ID

Data Processing based on user input

0.1.1

Conclusive results data

Data Processing based on login credentials

0.2.1

Conclusive feedback data

Display results as visualisations

0.1.2

Display Feedback as visualisations

0.2.2

Feedback figures and visualisations

Intended figures & visualisations
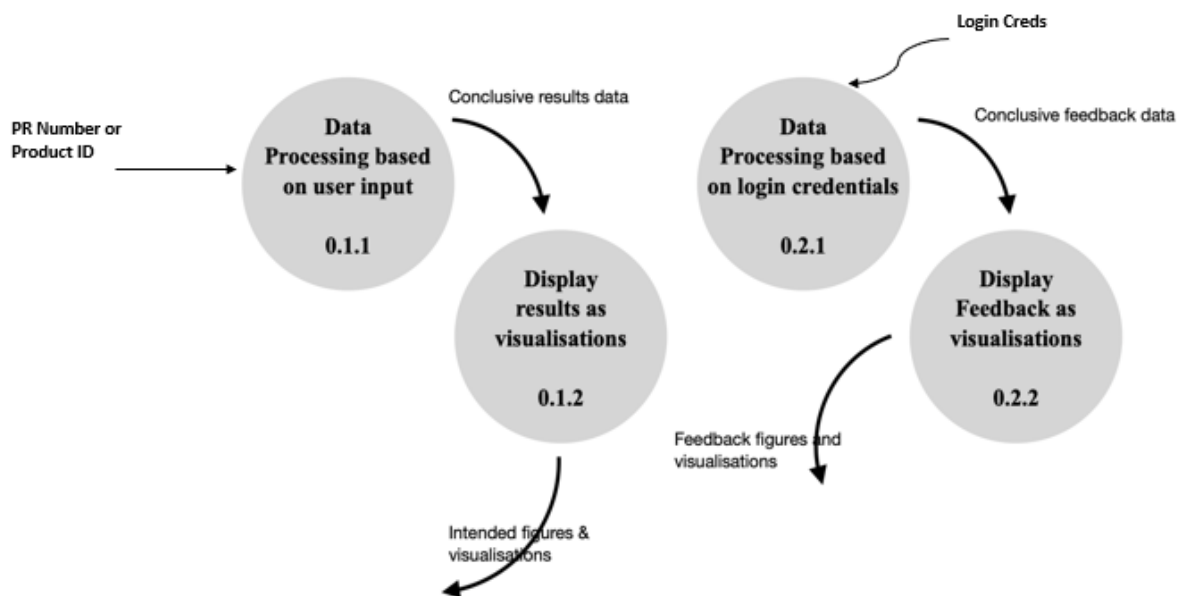
Fig. 7: 2ⁿᵈ Level of Data Flow Diagram

The application receives PR number (Product class) or Product ID (UMC: Unique Material Code) from the procurement executives logged in for assistance. It processes the available data resources to generate analysis results and data corresponding to the user input. These data and analysis results are relayed to the user via a template which also shows a visualization of these results.

Similarly, the application returns the vendors their corresponding feedbacks when it receives their login credentials.

Each view function in the application has a corresponding template file (.html file). The data processing and statistical modelling algorithms can be independently developed within the main application as functions or be imported from different files or packages. Similar is the case for Neural network models.

Methodology

Data processing, Statistical modelling, and deep learning networks are usually developed in Python due it's rich library of packages which significantly reduces the codebase required to carry out our operations.

To integrate these statistical models, neural networks, data processing algorithms in Python to a web application to display the visualizations and results obtained by them, using the flask micro web framework is the best choice. Flask does not require any external tools and libraries and therefore is independent of third-party libraries / packages.

The data resources will be provided by the company and managed by the Administrator. The Administrator will also be responsible for user verification and authorization.

The different views in the flask application will communicate with the processes and algorithms; and they can accept or return any kind of parameters and data respectively, it can be variables, lists, tuples, strings, etc. The algorithms, models, network models can be swapped, manipulated, and re-trained without affecting the application architecture.

The front-end templates corresponding to the different views have various scripts supporting the dashboard visualizations that we intend to provide.
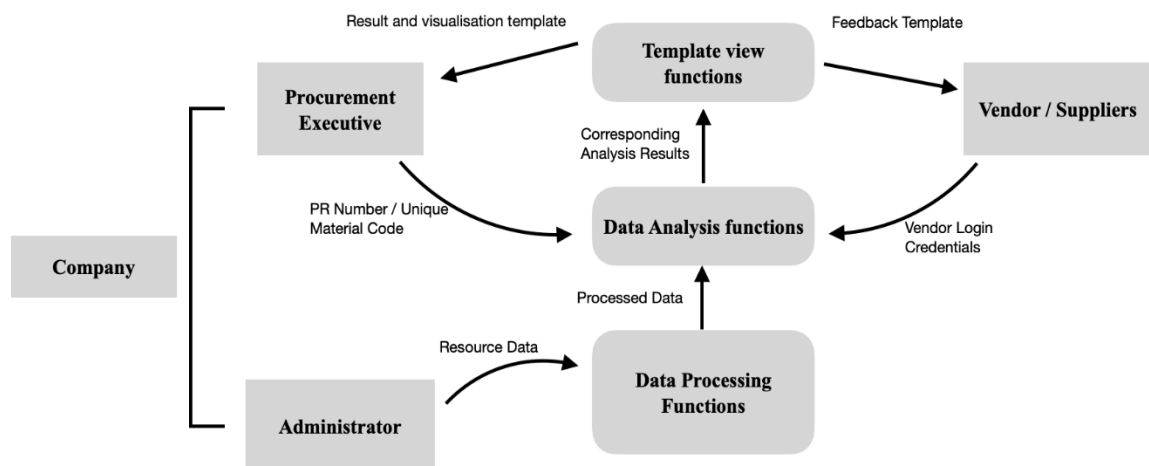
Fig. 8: Methodology chart

Implementation Details

Flask does not enforce any particular project layout. Below is a feasible organization of the application.

```
∨ FLASKPROJECTFOL...  ⬚₊  ⬚₊  ↺  ⊟
  ∨ .vscode
    {} settings.json
  ∨ static
    ∨ css
      #  main.css
    ∨ data
      ▦ Book1csvMAC.csv
    ∨ js
      JS main.js
      JS pieChart.js
  ∨ templates
    <> adminpanel.html
    <> base.html
    <> base2emp.html
    <> empassist.html
    <> empsignin.html
    <> home.html
    <> vendorassist.html
    <> vendorsignin.html
  🐍 run.py
```
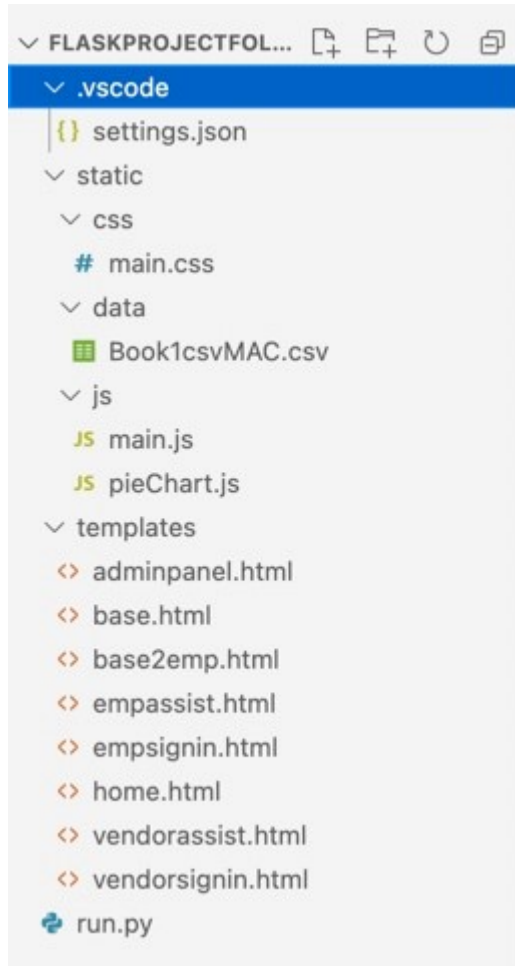
Fig. 8: Application Organization

The different views in the flask application will communicate with the processes and algorithms; and they can accept or return any kind of parameters and data respectively, it can be variables, lists, tuples, strings, etc. The algorithms, models, network models can be swapped, manipulated, and re-trained without affecting the application architecture.

SQL-Alchemy package can be used to create data base of authorized users by the administrator and is stored as .data file in the server along with the application. The data resources will be provided by the company and managed by the Administrator. The Administrator will also be responsible for user verification and authorization.

RESULTS AND DISCUSSIONS

The application being developed as flask web application significantly reduced the codebase required for such an undertaking. Due to its function-oriented structure application can be easily molded in response to future requirements of the users without disturbing the basic architecture.

Flask also provided inbuilt security configurations for the data entered by the users. However, the security of the data provided by the company for analysis is not in the scope of this project.

Due to availability of so many python libraries for data processing and analysis majority of such operations are performed using python so it was given that a python framework for interfacing results of the processing and analysis of data would be ideal. We had a choice between Django and Flask, we chose flask over Django because unlike Django, flask is a micro web framework rather than a high-level framework with almost no dependencies on external tools and libraries.

At last, this project showed me an excellent way to showcase the results of various statistical modelling, Machine Learning and Deep Learning algorithms and models in a dashboard view

Following are some screenshots of the prototype:-

Digital Negotiation Factory

Kindly select your role to access facilities.

Vendors have access to template scorecards/feedbacks.

Employees can get info on market dynamics and auto indication of best choices for bidding price range as well vendors for a given product class (PR number).

Kindly Select Your Role

Employee
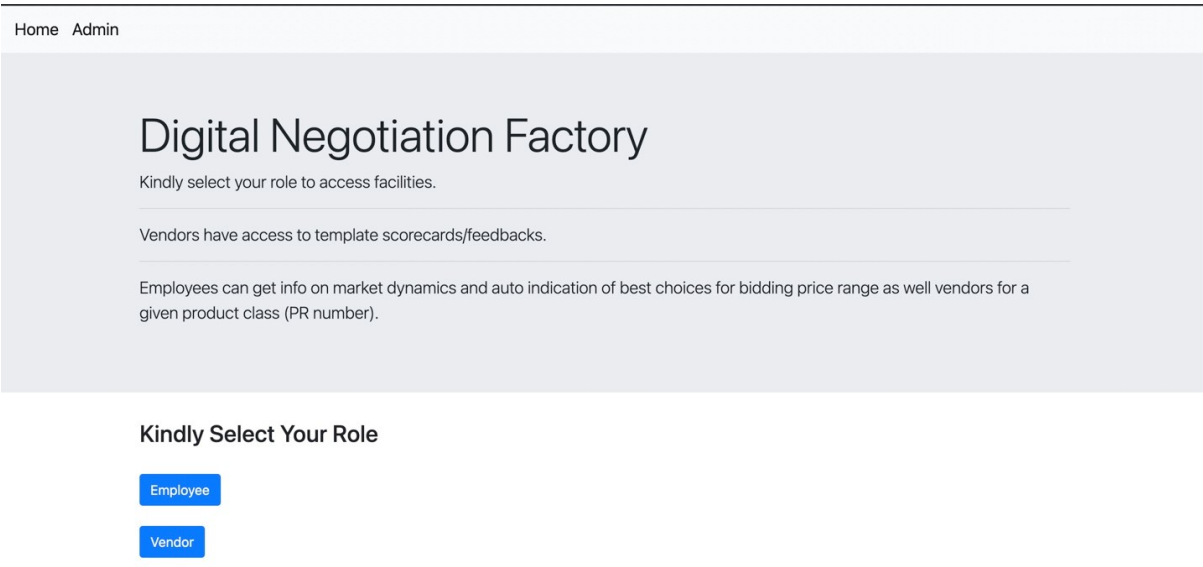
Vendor

Fig. 9: Application Homepage

Welcome Nagarjuna Construction(N100)

* RFQ

Select RFQ

Parameter	Actual Score	AVG. Likelhood Score	Top Score
▆▆▆▆	1.5	2	3.2
▆▆▆me	3	2.8	4
▆▆▆▆	3.5	4	4.2
▆▆▆▆	2	3	4.1

< 1 >

Vendor Score Card

Fig. 10: Vendor feedback template

PR No.: ▮
Negotiat▮
Vendor Code: TE52, Z029, J050, BJ28, B706, R333, ZZ99
Vendor Name: TNS HEAVY ENGINEERING PVT LTD, ZATAKIA COMMERCIAL CORPORATION, JANA & CO, BEVCON WAYORS PVT LTD, BTL EPC LIMITED, ROYAL ENTERPRISES ,, DUMMY VENDOR FOR RATE CONTRACT

Fiscal Year   FY 2020 FY 2021
(All)   ▼   ✓   ✓

		Vendor								
		J050			TE52			Z029		
Material	Product Description	Avg. RFQ Price (First)	Avg. PO Price (Final)	Price Difference (%)	Avg. RFQ Price (First)	Avg. PO Price (Final)	Price Difference (%)	Avg. RFQ Price (First)	Avg. PO Price (Final)	Price Difference (%)
54▮9	CNV IDLR;RETURN, 2000MM,1100MM,				₹ 6,140	₹ 5,920	3.58%			
54▮3	CONV IDLR;IMPACT ,1400 MM,530 MM,	₹ 7,850	₹ 7,056	10.11%				₹ 7,800	₹ 7,644	2.00%
54▮2	CONV IDLR;CARRYING ,14..	₹ 4,910	₹ 2,818	42.62%	₹ 3,987	₹ 3,620	9.20%			
54▮3	CONV IDLR;RETURN ,1400 MM,800 MM,	₹ 4,667	₹ 3,960	15.14%	₹ 5,113	₹ 4,780	6.52%			

UMC #	Optimal Price Range	Current Price	
5▮9	5000-6050	5650	Click to view details
5▮3	7200-7550	7340	Click to view details
5▮2	3880-4020	3955	Click to view details
5▮3	4100-4800	4578	Click to view details

Material: 5▮
Material Description: C▮
Vendor Code: TE52
Vendor Name: TNS HEAVY ENGINEERING PVT LTD
Price Difference (%): 6.52%

Fig. 11: Executive assistance dashboard template view 1

Ball ▮   Price   173.95 ▼ -0.85 (-0.49%)

Basic Chart   Advance Interactive Chart   Technical Chart

1D 1W 1M 3M 6M 1Y 2Y 5Y ALL

7▮0   Price 164.00   High : 165.85   Low 160.50

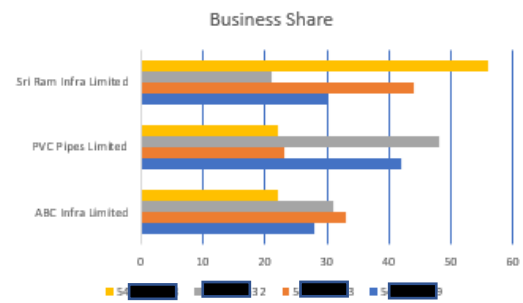**Fig. 12: Executive assistance dashboard template hyperlink view**
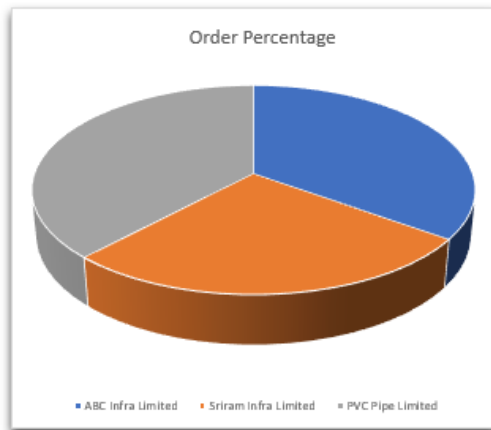
Fig. 13: Executive assistance dashboard template view 2

The project files allowed to be viewed can be viewed at the following link-

https://github.com/dsjsr/Major_Project_Flask_Digital_Negotiation_Factory.git

SUMMARY AND CONCLUSION

Summary of achievements

This was a project with various themes ranging from data analysis and visualization to application development. The analysis and visualization teams provided worked to determine the best algorithms for data processing and the most helpful dashboard visualizations. It was our job as application developers to interface the results of their analysis algorithms and visualizations to the users on a simple user-friendly interface.

It saved a lot of the time and efforts of the procurement executives and promoted competitive bidding among the vendors. This all ultimately led to economic gains for the company and better service/product quality from the vendors at more economical prices.

The development of the application required us to have knowledge of python functions, routing & redirecting concepts and other functionalities of the flask, seaborn and matplotlib packages along with other web development languages (HTML, CSS, JavaScript).

Limitations of Project

Although the project has been made to the best of it but the assistance the application provides is not fully automated.

The models that learn from the data and give prediction results need to be re-trained to keep the performance at its best.

The administrator is needs to make a lot of preparations before the application is initialized and accessed by users (making authentic user data base and providing login credentials to new users).

There is no fixed time interval to update data resource files for optimum results.

Trust on the administrator is paramount.

Future Scope

The application can be restructured to handle real time data for analysis, as in a corporation of this magnitude even a day's data is worth a lot of information and insights.

Gantt Chart

ACTIVITY	Time Frame (For year 2021)									
	January		**Feb**		**March**		**April**		**May**	
	29th	31st	1st to 15th	16th to 28th	1st to 15th	16th to 31st	1st to 15th	16th to 30th	1st to 15th	16th to 31st
Feasibility Study	🟥	🟥								
	🟩	🟩								
Case Study	🟥	🟥	🟥	🟥	🟥	🟥	🟥	🟥	🟥	🟥
	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
Problem Identification	🟥	🟥	🟥	🟥						
	🟩	🟩	🟩	🟩						
Learning Flask					🟥	🟥	🟥	🟥		
					🟩	🟩	🟩	🟩		
Integrating Application modules							🟥	🟥	🟥	🟥
							🟩	🟩	🟩	🟩
Documentation	🟥	🟥	🟥	🟥	🟥	🟥	🟥	🟥	🟥	🟥
	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩

🟥 Proposed activity.   🟩 Activity achieved.

Fig. 14: Gantt Chart

References

[1]. Python and Flask Bootcamp: Create Websites Using Flask By Jose Portilla.
Link: https://www.udemy.com/course/python-and-flask-bootcamp-create-websites-using-flask/
Last accessed on: 28 April 2021

[2]. Flask tutorial at Tutorialspoint
Link: https://www.tutorialspoint.com/flask/index.htm
Last accessed on: 28 April 2021

[3]. Flask Pallet Projects
Link: https://flask.palletsprojects.com/en/1.1.x/tutorial/
Last accessed on: 3 March 2021

[4]. KDNuggets Link: https://www.kdnuggets.com
Last accessed on: 31 March 2021

[5]. Book's Rating Prediction Using Just Neural Network.
Link: https://philarchive.org/archive/MAGBRPv1
Last accessed on: 28 April 2021

[6]. Credit rating analysis with support vector machines and neural networks: a market comparative study.
Link: https://doi.org/10.1016/S0167-9236(03)00086-1
Last accessed on: 30 April 2021