Forecasting Optic Fiber Deployment for enhanced Revenue Planning

A Proposal Report for the BDM Capstone Project

Submitted by

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Contents

Declaration Statement

I am working on a Project titled “Forecasting Optic Fiber Deployment for enhanced Revenue Planning”. I extend my appreciation to **Sterlite Technologies Limited (STL)**, for providing the necessary resources that enabled me to conduct my project.

I hereby assert that the data presented and assessed in this project report is genuine and precise to the utmost extent of my knowledge and capabilities. The data has been gathered from primary sources and carefully analyzed to assure its reliability.

Additionally, I affirm that all procedures employed for the purpose of data collection and analysis have been duly explained in this report. The outcomes and inferences derived from the data are an accurate depiction of the findings acquired through analytical procedures.

I am dedicated to adhering to the principles of academic honesty and integrity, and I am receptive to any additional examination or validation of the data contained in this project report.

I understand that the execution of this project is intended for individual completion and is not to be undertaken collectively. I thus affirm that I am not engaged in any form of collaboration with other individuals, and that all the work undertaken has been solely conducted by me. In the event that plagiarism is detected in the report at any stage of the project's completion, I am fully aware and prepared to accept disciplinary measures imposed by the relevant authority.

I understand that all recommendations made in this project report are within the context of the academic project taken up towards course fulfillment in the BS Degree Program offered by IIT Madras. The institution does not endorse any of the claims or comments.

Signature of Candidate:

Name: Archit Handa

Date: 5th March, 2024

1 Executive Summary and Title

This BDM Capstone Project aims to model and streamline the 'trenching and ducting' process for optic fiber cables at Sterlite Technologies Limited (STL). STL currently operates in the B2B segment and provides its clients with telecommunication infrastructure solutions.

'Trenching and ducting' is a crucial step in the capacity planning for the firm and in turn serves a major role in the overall revenue planning for the business vertical. The major issue that STL currently faces is inability to predict with high confidence how much optic fiber they will be able to lay per month or per quarter, and thus they are unable to effectively plan and execute their future revenue projections. Inefficiency planning leads to delays in turn around time (TAT) and resource wastage, increasing costs and indirectly affecting profitability.

To tackle this problem, the project aims to utilize regression analysis as the core machine learning principle along with the statistical concept of weighted moving-average (can help the model keep up-to-date by prioritizing latest trends) to come up with a forecasting model that can aid the organization to locate, understand and, potentially, bypass factors or variables that are acting as hindrances. The model further aims to make the capacity planning process more streamlined, and ultimately, plan revenue more effectively, allocating resources better to minimize costs by maximizing efficiency.

2 Organization Background

Sterlite Technologies Limited (STL) is an end-to-end data network solutions firm that started as a copper cable manufacturing venture in 1988 by Anand Aggarwal and has now expanded its portfolio to a wide array of products and solutions, including optical fiber and cable manufacturing, wireless products, access solutions, and enterprise network planning. With its 3 business verticals comprising *Manufacturing*, *Network Services* and *Digital Solutions*, STL's mission is to 'transform billions of lives by connecting the world'.[1]

Headquartered in Pune, India, the company has a global workforce of 3800 employees in 16 countries across Asia, Europe, Americas, and Africa.[2] Last Financial Year, FY 2023, STL

[1] *High Speed Transmission Solutions enabling Bharatnet - STL - Sterlite Technologies Limited.* (2023). Retrieved from https://stl.tech/about-us/
[2] IBID

generated revenue worth USD 863 million by serving telecom operators and enterprise clients in over 100 countries worldwide.[3] STL's vision is to enable a world with 'ubiquitous and future-ready digital networks', and aims for 'sustainable manufacturing' in the near future.[4]

This project, in particular, delves deeper into the *Network Services* business unit vertical of the Business-to-Business (B2B) firm, focusing primarily on the operation of 'Laying Network' for its clients.

3 Problem Statement

3.1 Problem Statement 1: Automating the manual planning tools

The current manual and time-consuming 'trenching and ducting' process planning adds to operational inefficiencies at STL. It is performed using obsolete strategies on spreadsheet softwares. Automation via an advanced mathematical model seems a viable solution to minimize project timelines.

3.2 Problem Statement 2: Optimizing 'Trenching and Ducting' planning process to forecast with high accuracy

STL previously tried to fit a model; however, very low accuracy was achieved since it was built upon simple arithmetic averages over 2-year old data. An advanced ML model with ability to identify and automatically weigh recent trends to forecast seems a feasible solution to handle the problem.

4 Background of the Problem

As aforementioned, 'Trenching and Ducting' planning process is conducted manually at STL. Such an obsolete approach hinders efficiency and has 2 major shortcomings:

- It does not give enough emphasis to the contribution of various ***non-quantifiable features*** because there is no direct way to incorporate them into the regression equation.
    - For instance, factors such as soil conditions vary from location to location. Hence, if STL wishes to forecast the optic fiber laid in Uttar Pradesh, a state in the Indo-Gangetic plain with loose upper-soil (a positive for the machine and overall

[3] IBID
[4] IBID

productivity) as compared to Himachal Pradesh, a state with rugged mountainous terrain and rocky upper surface (a negative for the overall productivity), STL cannot function with just one equation. Instead, they will have to devise separate regression equations for various terrains.

    - To emphasize this point further, terrain is just one example of non-numeric features out of many that directly and indirectly impact forecasting.

- It makes revenue planning a very ***time-consuming task*** because of the manual hours put in to churn the excel data and feed input variables.

STL has attempted to fit a model in the past. However, they were only able to achieve a 60% accuracy between actual and predicted values. Upon closer inspection of the model, I realized that only a few feature variables were being considered in comparison to the number of data points. Yet more importantly, simple arithmetic averages over past 2 year data was being considered for modeling, a major reason for inaccuracy.

5 Problem Solving Approach

As previously discussed, a ML Model that utilizes concepts of Regression analysis along with the statistical idea of Weighted Moving Averages seems as an adept solution for the problems at hand. It can tackle all 3 issues: automating the currently manual step, ability to predict based on latest trends, and thus, making the process time and resource efficient.

Firstly, shifting from an Excel-based approach to an advanced data analytical strategy can enhance STL's decision making processes and eventually, operational efficiency. With the ability to incorporate both quantitative and qualitative features (for instance, terrain can be considered as a categorical variable that can be one-hot-encoded for further processing) into the forecasting process, the ML model will enable STL to make more informed decisions based on more accurate predictions.

Moreover, by automating the process, the manual hours put into revenue planning can be reduced, resulting in more efficient allocation of resources by focusing on other tasks such as research and development.

Furthermore, the use of weighted moving average ensures that the model can adapt to recent trends by weighing them more in comparison to a data point recorded 2 years ago. With the

constant improvement in technology, trenching machines are likely to become more productive. In such a scenario, the model will automatically tweak itself to consider these dynamics, allowing STL to respond quickly to market changes in an ever-evolving industry.

While STL has been collecting data for the past 2 years, the number of variables captured in comparison are too few. This can lead to an overfitting model, where it starts capturing the noise in the data rather than the underlying pattern. This may cause the model to perform well on already seen data; however, struggle to perform on unseen data (a likely reason why STL's attempt was only able to achieve 60% accuracy). To mitigate this, certain new features, such as terrain type, might need to be introduced into the model. To prevent overfitting, certain complexity can be added in the form of polynomial regression, if required.

While substantial data is already gathered, data for terrain might need to be scraped from online resources. To construct the model, Python with its libraries such as scikit-learn and pandas seems to be the feasible way to build the model.

Overall, leveraging a ML-based approach for 'trenching and ducting' planning process will serve as a strategic business advantage for STL that can help it enhance its operational efficiency, deliver to its clients faster (improving customer satisfaction), and improve profitability maintaining a competitive edge over other players.

6 Expected Timeline

6.1 Work Breakdown Structure

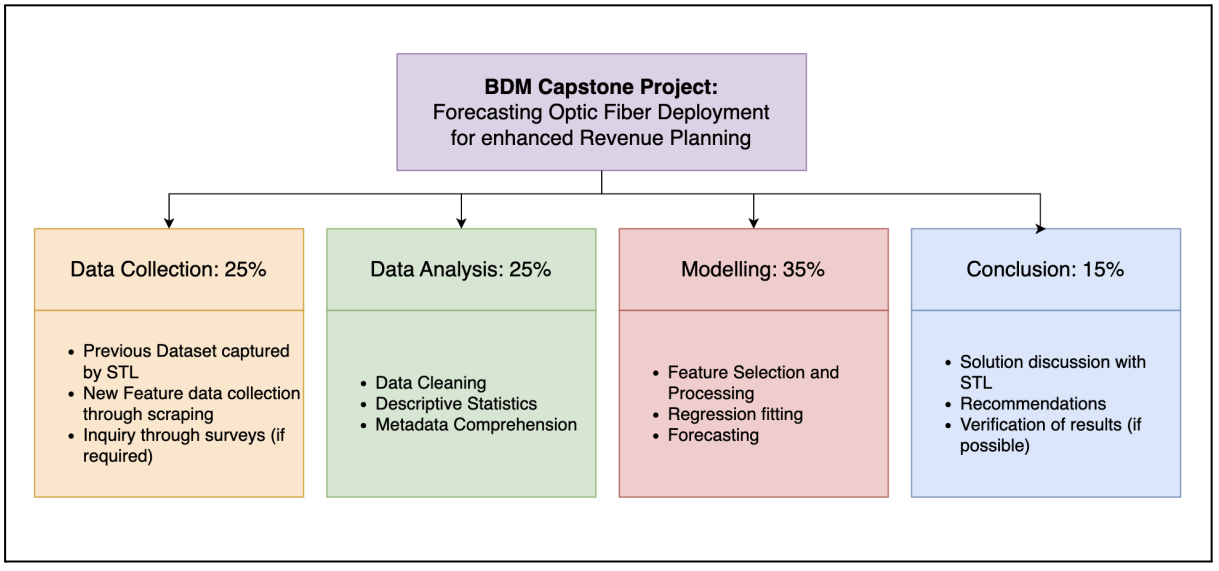
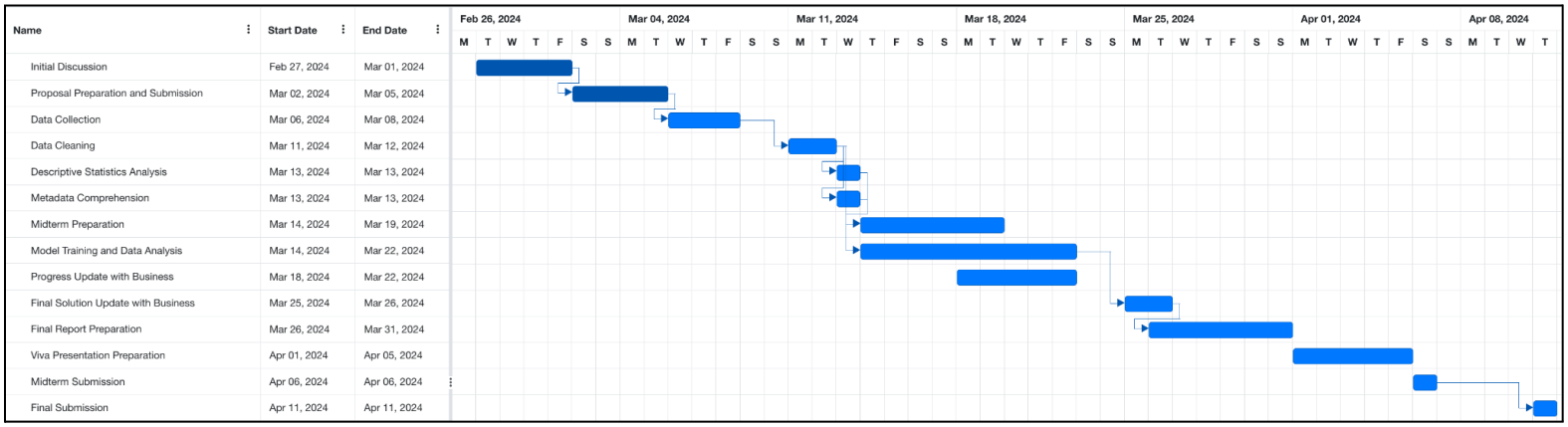


Figure 1: Workflow for Project Completion

6.2 Gantt Chart



Name	Start Date	End Date
Initial Discussion	Feb 27, 2024	Mar 01, 2024
Proposal Preparation and Submission	Mar 02, 2024	Mar 05, 2024
Data Collection	Mar 06, 2024	Mar 08, 2024
Data Cleaning	Mar 11, 2024	Mar 12, 2024
Descriptive Statistics Analysis	Mar 13, 2024	Mar 13, 2024
Metadata Comprehension	Mar 13, 2024	Mar 13, 2024
Midterm Preparation	Mar 14, 2024	Mar 19, 2024
Model Training and Data Analysis	Mar 14, 2024	Mar 22, 2024
Progress Update with Business	Mar 18, 2024	Mar 22, 2024
Final Solution Update with Business	Mar 25, 2024	Mar 26, 2024
Final Report Preparation	Mar 26, 2024	Mar 31, 2024
Viva Presentation Preparation	Apr 01, 2024	Apr 05, 2024
Midterm Submission	Apr 06, 2024	Apr 06, 2024
Final Submission	Apr 11, 2024	Apr 11, 2024

Figure 2: Expected Timeline for Project Completion

7 Expected Outcome

7.1 Improved forecasting accuracy through the ML model will ensure precise predictions enabling better capacity planning for STL. Since 'trenching and ducting' forms a major portion of their revenue (about 50-60%), STL will thus gain advantage by being better aligned to generate more profits.

7.2 Agile and adaptable model that serves as a one-stop solution despite changes in market dynamics enabling STL to be proactive.

7.3 More efficient resource allocation since revenue planning can be reduced significantly, thus STL can focus more on improving its current range of products. STL will also be better enabled to proceed towards sustainable manufacturing (STL's vision) through more efforts being put into innovation