Covid-19 & It's Effect on Manufacturing Cost Dynamics : An Insights From Fertilizer and Chemical Company

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ABSTRACT

The empirical study provides valuable insights into the cost variations experienced by GSFC Ltd and assists management in formulating effective strategies for cost management and resource allocation.The objective of this project was to conduct an empirical study to analyze and compare the cost variances in GSFC Ltd, a prominent company, before and after the COVID-19 pandemic.The research methodology employed a comparative analysis approach, utilizing averages and t-tests to determine the statistical significance of cost variance between the Pre and Post COVID periods. Data on various cost categories, including direct and indirect expenses, were collected and analyzed to identify significant variations.Specific cost categories, such as raw material expenses, labor costs, production-related expenses, administrative expenses, overhead costs, and utilities, exhibited variations between the Pre and post-COVID periods.The t-test analysis further highlighted significant cost differences in specific categories.The overall costs incurred by GSFC Ltd showed statistically significant differences, with average costs post-COVID being either higher or lower compared to the Pre-COVID period.

Keywords: Cost Analysis, Prime Cost, Factory Cost, Selling Cost, Total Cost, Administrative Cost, COVID- 19, GSFC Ltd.

About the Company

GSFC was founded in 1962, and its plants began producing fertilizers in 1967. GSFC became well-known for its groundbreaking achievements throughout its first decade of operation. To mention a few, it was the country's first joint-sector industrial complex, as well as the first corporation to set up fertilizer plants within two years of receiving the necessary approvals. It was also the first industrial initiative to secure farmers' direct and active equity participation, the first fertilizer unit to receive help from IDBI's help Fund, and the first company to use the Steam Naphtha Reforming process for ammonia production.

GSFC was founded as a fertilizer firm with the goal of giving agricultural support to Gujarat farmers and making the state self-sufficient in fertilizers. In 1974, GSFC was the first company in India to develop a Caprolactam facility. Caprolactam was in high demand at the time, mostly to produce downstream items such as nylon yarn, tyre cable, and so on.

Cost Analysis

Cost variation is crucial because it allows you to track the project's financial progress. It demonstrates how well you monitor and control potential threats. These calculations are part of the Earned Value Management (EVM) technique.

The goal of cost management in an EVM system is to identify whether a variation is positive, negative, or zero. Once project managers have this earned value analysis data, they can make the necessary adjustments to stay on track. If a variance is very high (negative), changes have to be made. A very small (positive) cost variance or none at all might be interpreted by them as a sign of effective cost control.

Components of Cost

The majority of the total cost is comprised of prime, manufacturing, office, and sales costs. Let's take a closer look at each of these elements:

1. **Prime cost:** This includes direct material, direct salary, and direct expenses. It is also known as basic cost, first cost, or flat cost. It can be defined as the total of the material cost, production labor, and direct costs.

Prime cost = Direct material + Direct wages + Direct expenses

The term "direct material cost" usually refers to the price of raw materials used or consumed over a given time period. To find out how much raw material was actually used over a given time period, you add the initial stock and the quantity of material purchased, then deduct the closing stock. The following is the formula for material consumed:

Material consumed = Material purchased + Opening stock of material – Closing stock of material

2. **Factory cost:** This is made up of the prime cost plus factory overhead, which includes indirect labor, indirect materials, and indirect costs. Manufacturing costs, production costs, and works costs are other terms for factory costs.

Factory cost = Prime cost + Factory overhead

3. **Office cost:** Office costs are the overall expenses associated with running and managing an organization's administrative functions. It is sometimes referred to as an administration expense or included in the total cost of manufacturing. The following formula is used to calculate office expenses:

Office Cost = Factory Cost + Office and Administration Overheads

4. **Total cost or cost of sales:** The total cost is the sum of all expenses incurred in producing and advertising a good or service. Included are production, selling/distribution, administrative, direct, and indirect costs. Total cost is an important figure because it displays the total cost of operations and helps determine the selling price and profit.

Total cost = Cost of goods sold + Selling and distribution overhead

During the production process, some product units are scheduled to be finished at a specific point in time. We call these incomplete pieces "work-in-progress." In these situations, calculating the factory cost of a product unit requires making adjustments for opening and closing stock in order to calculate the product's net factory cost. Direct material costs, direct expenses, and industrial overheads are usually associated with these unfinished goods.

Literature Review

Teoh Choon Hung and Jaya Kumar Shanmugam (2023) intends to assess the impact of the sanctions on the process of managing the unit's performance as well as the degree to which the standard costing system can be used to rationalize financial needs decisions in the Baghdad Soft Drink Company. Students were given questionnaires to complete in order to explain the research problem using the descriptive analytical approach.

(Jaya Kumar Shanmugam, 2023) discusses the importance of standard costing and variance analysis as management accounting tools in controlling the cost of production.Standard costing includes establishing a method for estimating costs, providing guidance on how to control costs, and providing analysis that allows managers to evaluate the performance of the production process.

(Kunal Sil's, 2021) study aims to investigate how conventional costing can be used efficiently in even small-scale industries.Following the investigation, it was determined that a few classic approaches, such as Marginal and Absorption procedures, were highly criticized due to their lack of compatibility.Activity-Based Costing (ABC) has emerged as the most respected accounting practice in the service industry.

(Basiem Al-Shattarat, Husni Al-Shattarat, Zaid dannoum, 2021) demonstrates how Jordanian industrial companies' performance is affected by standard costing. According to the findings, the current study should teach management and shareholders that they are in charge of assessing performance levels using contemporary techniques in standard costing and management accounting. This will help the industries improve business performance and profitability.

(Kamila Fałat, 2020) primary purpose is to evaluate two techniques of calculating manufacturing operating income and presenting statistics when a business switches from normal costing to standard costing. The outcomes of both methods have been compared and examined, and the case study revealed that manufacturing operational revenue is identical in normal costing and standard costing techniques, even though the data that is required for calculations differs.

(Zeliha Kaldirim and Yusuf Kaldirim, 2020) purpose of this research is to apply activity-based costing and activity-based variance analysis in the food business. Variance data should show differences for every activity and cost item in an activity-based management setting. In an ABC context, ABVA supports sound cost management both immediately and over time and is consistent with ABC reasoning.

(Chinnabathini Sudeep, 2019) discusses the use of standard costing in the Indian Pharmaceutical Industry. It is a traditional cost accounting method used to calculate the expected cost of a product by using data from similar projects. It can be an effective management tool if variances are regularly evaluated. 73% companies still use standard costing as a cost accounting tool.

(Xi Chen *, Yiqing Zhao, Jiahui Tong, Shumei Xu, 2018) demonstrates how the "One Belt and One Road" initiative is accelerating the trend of globalization and creating new challenges for multinational firms to handle, with cost control being the most important control point. Cost planning, control, computation, and analysis are all combined in the standard cost method, which is used to strengthen the scientific and systemic aspects of cost management in overseas branches. They come to the conclusion that the standard cost method can provide prompt feedback on variations in different cost projects, which is helpful for assessing the effectiveness of pertinent departments and staff.

(Sadiq Rabin Abdullah, 2015) examines the effect of standard costing on the profitability of telecommunication companies to discovering that standard costing technique can give the effect on telecommunication companies and profitability,The effective application of standard costing has affected the company profitability positively.The company uses standard costing to eliminate the unprofitable products, provision of costing information and cost control.

(Cecily Raiborn, Janet B. Butler, and Lucian

Zelazny, 2013) discusses how standard cost variances can be utilised to detect probable fraudulent activity. Each basic type of variation (material, labour, and overhead) is treated with a consideration of probable incorrect causative factors.

(Tandung Huynh, Guangming Gong, and Phuoc Tran, 2013) article by investigates the integration of ABC with normal expenses as a means of overcoming its constraints, as well as innovation management accounting. Integrating ABC with Standard Costs assists managers not only in resolving indirect cost issues, realising value-added and non-value-added operations, but also in determining which activities fall significantly outside of the standards. Managers are notified that there must be issues that require action.

(John Parkinson, 2013) compares sales revenue, contribution margin, and full-cost margin as a numeraire for calculating sales volume variance. Additionally consider the correlation between sales volume and production volume variations.

(Manjunath H.S. Rao, CMA, and Andrew B Argerstock, P H.D., CPA, 2011) propose a research technique for establishing how mature lean manufacturers' use of conventional costing contrast to lean accounting theory in this article. Furthermore, they provide viewpoints on why mature lean manufacturers might choose to use normal costing and variance analysis.

Problem Statement

This project aims to empirically investigate the cost variances in GSFC Ltd. before and after the COVID 19 pandemic, shedding light on the financial impacts and identifying areas of cost escalation or reduction for the company's operations, enabling strategic decision making and effective cost management.

Objective

- To analyze the cost variances of GSFC Ltd.
- To examining the variances before and after COVID.
- To interpret the momentum of various cost variances pre and post COVID.

Research Design

Descriptive research aims to describe and analyze a particular phenomenon or situation, without manipulating any variables or attempting to establish causality. In this case, the research is focused on describing the cost variances before and after the pandemic, using data gathered through the descriptive method.

Data Collection

For conducting this research, secondary data is required, such as the annual reports of GSFC Ltd. An extensive study was carried out of the existing data of the fertilizer company to do the analysis and interpretation.

Sample Size

In this research study the cost variances consisted of only GSFC Ltd. .

Time Frame

5 years Data has been analysed from the period 2017-18 to 2021-22. While 2019-20 year is considered as the Base Year for the study.

Data Analysis

Table 1: Direct Expenses

DIRECT EXPENSES					
	2017-2018	**2018-2019**	**2019-2020 (BASE YEAR)**	**2020-2021**	**2021-2022**
Raw Materials					
Cost of materials consumed	3,23,115.17	4,22,602.07	3,59,702.25	3,95,174.89	4,88,159.64
Labour					
Employee Benefit Expenses	50,926.24	52,122.73	71,425.77	68,431.40	65,584.99
Prime Cost	**3,74,041.41**	**4,74,724.80**	**4,31,128.02**	**4,63,606.29**	**5,53,744.63**

Table 2: Prime Cost Percentage Variances

Percentage Variances					
	2017-2018	**2018-2019**	**2019-2020 (BASE YEAR)**	**2020-2021**	**2021-2022**
Raw Materials					
Cost of materials consumed	90	117	100	110	136
Labour					
Employee Benefit Expenses	71	76	100	96	92
Prime Cost	**87**	**102**	**100**	**78**	**128**

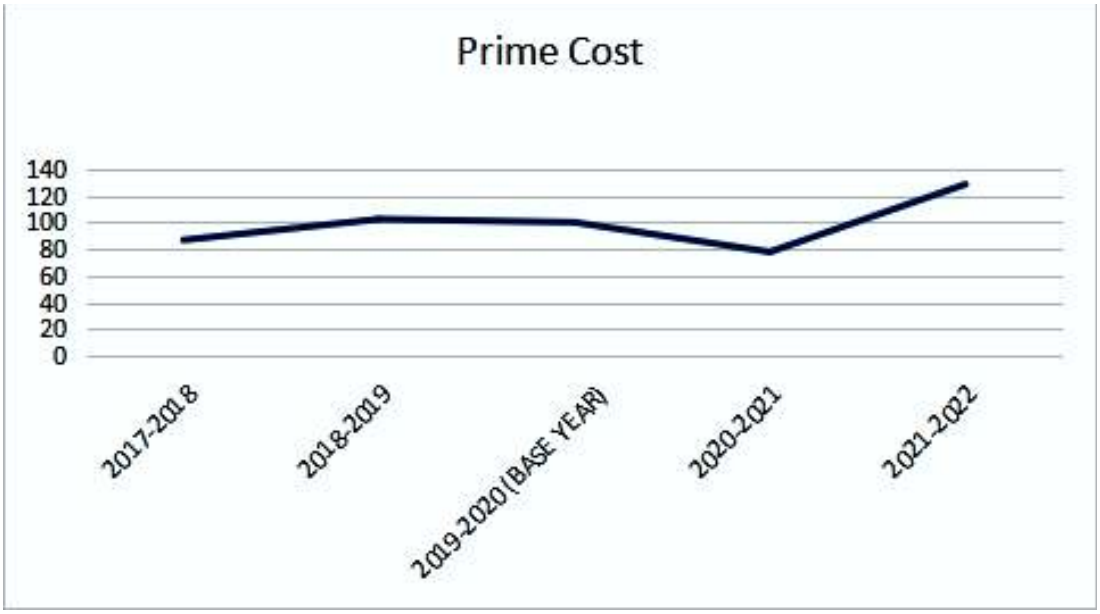


Figure 1: Prime Cost Graph

Keeping the base year 2019-2020 as constant, we can interpret that there is an increase in cost, in the year 2018-2019 as compared to 2017-2018 during Pre Covid and there is an increase in cost in the year 2021-2022 as compared to 2020-2021 during post Covid period.

Table 3: Indirect Expenses

INDIRECT EXPENSES					
Factory Overhead					
	2017-2018	**2018-2019**	**2019-2020 (BASEYEAR)**	**2020-2021**	**2021-2022**
Consumption of stores and spare parts	8,917.39	10,325.57	12,747.32	10,472.73	14,080.54
Water	2,683.44	2,906.41	2,946.28	3,305.61	3,744.57
Repairs to buildings	294.35	430.61	337.14	309.83	660.21
Repairs to machinery	5,508.58	6,334.35	6,249.08	6,689.80	8,449.67
Other repairs	669.06	829.61	673.99	556.61	701.39
Rent, rates and taxes	342.48	157.18	2,121.97	324.42	109.39
Transportation, distribution & loading & unloading charges	26,914.67	35,472.07	33,382.84	36,033.80	25,503.52
Power and Fuel	52,226.29	67,691.75	65,253.35	64,998.14	98,083.24
Depreciation and amortization expense	11,944.83	12,625.39	17,020.92	17,644.74	17,817.54
Work in progress	44,999.40	1,09,594.06	87,975.49	46,779.81	63,668.59
Factory Cost	**1,54,500.49**	**2,46,367.00**	**2,28,708.38**	**1,87,115.49**	**2,32,818.66**

Table 4: Factory Cost Percentage Variances

Percentage Variances					
	2017-2018	**2018-2019**	**2019-2020 (BASE YEAR)**	**2020-2021**	**2021-2022**
Factory Overhead					
Consumption of stores and spare parts	70	81	100	82	110
Water	91	99	100	112	127
Repairs to buildings	87	128	100	92	196
Repairs to machinery	88	101	100	107	135
Other repairs	99	123	100	83	104
Rent, rates and taxes	16	7	100	15	5

Transportation, distribution & loading & unloading charges	81	106	100	108	76
Power and Fuel	80	104	100	100	150
Depreciation and amortization expense	70	74	100	104	105
Work in progress	51	125	100	53	72
Factory Cost	**68**	**108**	**100**	**82**	**102**

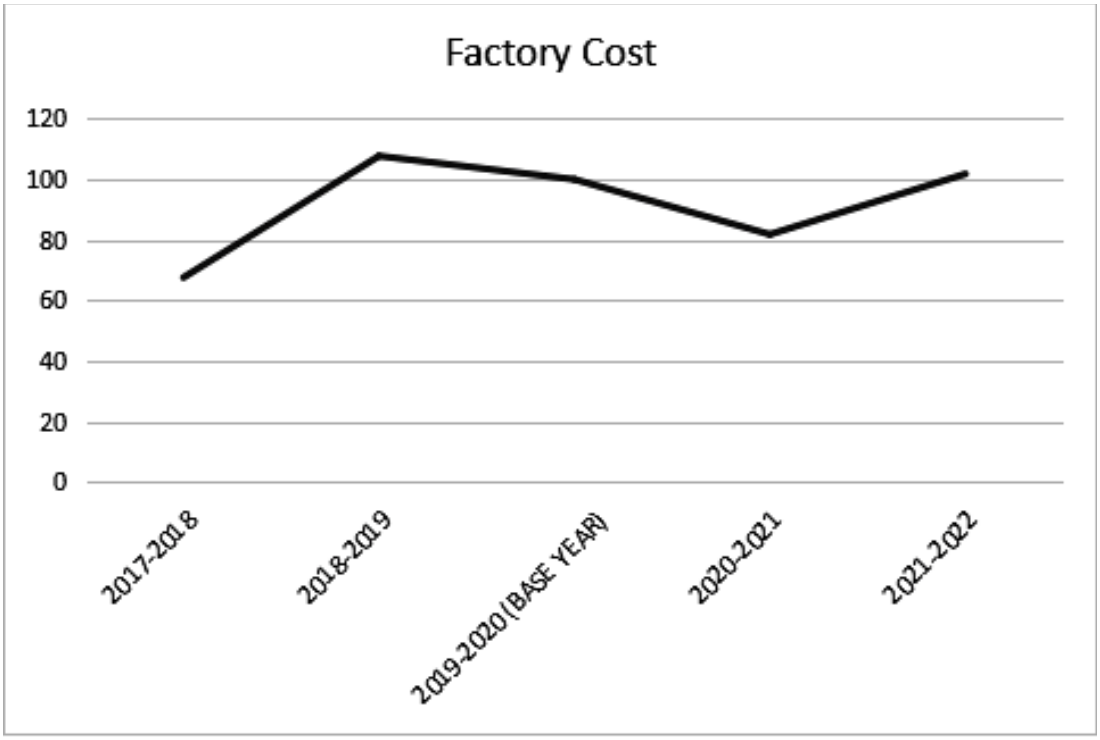


Figure 2: Factory Cost Graph

We can interpret that there is an increase in cost, in the year 2018-2019 as compared to 2017-2018 during Pre Covid period and there is an increase in cost in the year 2021-2022 as compared to 2020-2021 during the post Covid period.

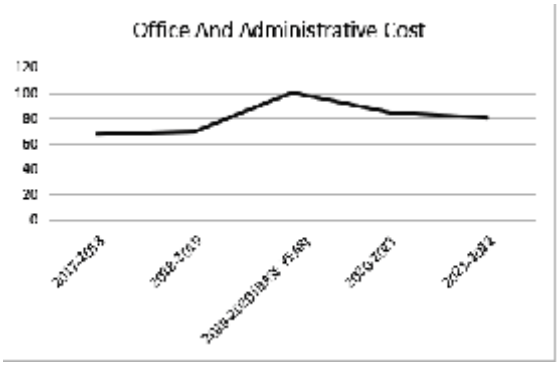
Table 5: Offices And Admin Expenses

Office & Administrative Overhead					
	2017-2018	**2018-2019**	**2019-2020 (BASE YEAR)**	**2020-2021**	**2021-2022**
Insurance	666.68	580.82	1,011.02	1,538.16	1,671.92
Depots and farm information centers expense	3,692.14	4,037.10	4,560.16	2,388.35	1,381.34
Directors sitting fees	6.12	7.3	8.9	12.48	17.14
Auditors' remuneration	23.2	25.15	23.07	21.18	21.63
Cost auditors' fees	5.28	5.16	5.17	5.48	4.61
Salaries	37042.69	38,092.09	56,130.04	48,047.00	46,329.96
Office & Administrative Cost	**41436.11**	**42747.62**	**61,738.36**	**52,012.65**	**49,426.60**

Table 6: Office and Admin Cost Percentage Variances

Percentage Variances					
	2017-2018	**2018-2019**	**2019-2020 (BASE YEAR)**	**2020-2021**	**2021-2022**
Office & Administrative Overhead					
Insurance	66	57	100	152	165
Depots and farm information centers expense	81	89	100	52	30
Directors sitting fees	69	82	100	140	193
Auditors' remuneration	101	109	100	92	94
Cost auditors' fees	102	100	100	106	89
Salaries	66	68	100	86	83
Office & Administrative Cost	**67**	**69**	**100**	**84**	**80**

Figure 3: Office and Admin Cost Graph



The value of the office and Administrative overhead in the year 2017-2018 was 67%, which decreased to 69% in the year 2018-2019. But again there is little increase in the cost to 84% in the year 2020-2021, which decreases 80% in the year 2021-2022.

Table 7: Selling and Distribution Expenses

Selling Overhead					
	2017-2018	**2018-2019**	**2019-2020 (BASEYEAR)**	**2020-2021**	**2021-2022**
Packing expenses	9,037.96	9,669.91	8,464.38	9,595.13	10,638.13
Selling Cost	**9,037.96**	**9,669.91**	**8,464.38**	**9,595.13**	**10,638.13**

Table 8: Selling Cost Percentage Variances

Percentage Variances					
	2017-2018	**2018-2019**	**2019-2020 (BASE YEAR)**	**2020-2021**	**2021-2022**
Selling Overhead					
Selling Cost	**107**	**114**	**100**	**113**	**126**

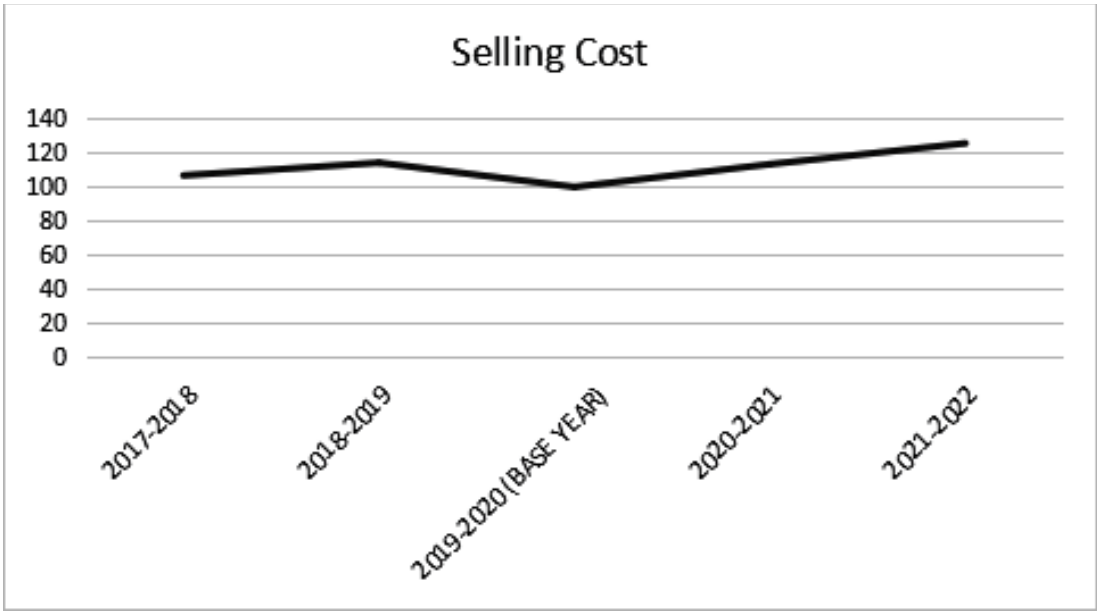


Figure 4: Selling Cost Graph

the value of the selling cost in the year 2017-2018 was 107%. , which increased to 114% in the year 2018-2019. But again there is a little decrease in the cost to 113% in the year 2020-2021, which increases 126% in the year 2021-2022.

Table 9 : Total Cost

Total Cost					
Total Cost	579,015.97	773,509.33	730,039.14	712,329.56	846,628.02

Table 10 : Total Cost Percentage Variances

Percentage Variances					
	2017-2018	2018-2019	2019-2020 (BASE YEAR)	2020-2021	2021-2022
Total Cost	79	106	100	98	116

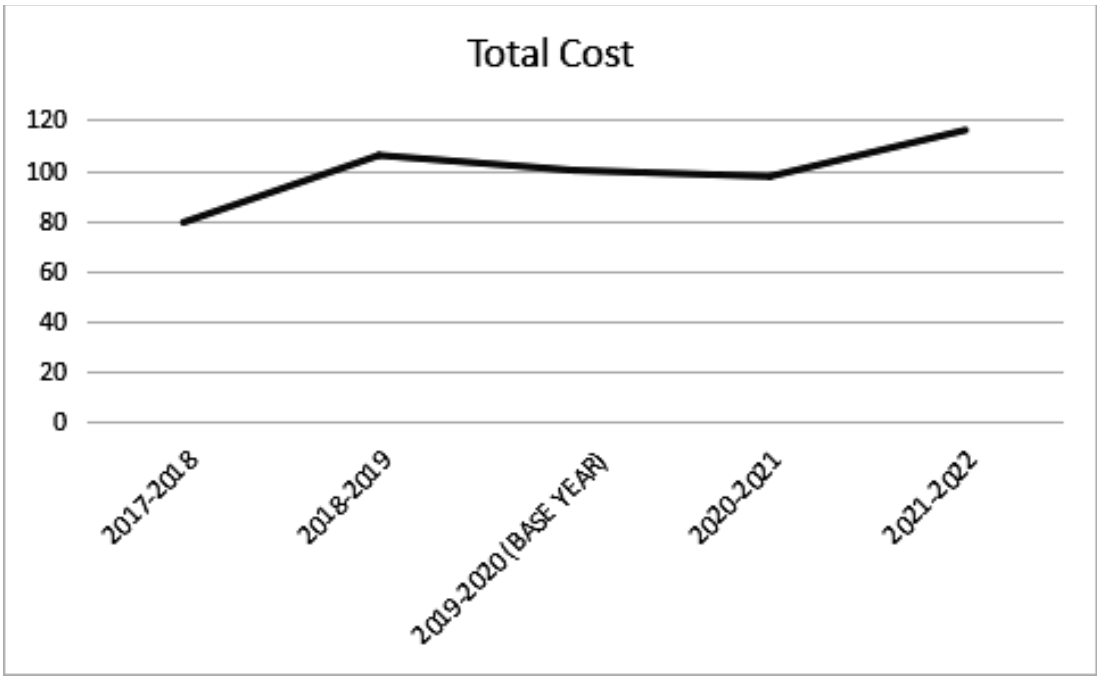


Figure 5: Total Cost Graph

the value of the total cost in the year 2017-2018 was 587%. , which decreased to 106% in the year 2018-2019. But again there is a decrease in the cost to 98% in the year 2020-2021, which increases 116% in the year 2021-2022.

Hypothesis Testing:

To prove the effect of Cost variance Pre and Post Covid duration, T- test has been applied.

H01 = There is no significant difference between the cost Pre and Post Covid in Prime Cost

Ha1 = There is a significant difference between the cost Pre and Post Covid in Prime Cost.

Table 11: T-Test: Paired Two Sample for Means for Prime Cost		
Prime Cost		
	Variable 1	Variable 2
Mean	424383.105	508675.46
Variance	5068572511	4062460169
Observations	2	2
Pearson Correlation	1	
Hypothesized Mean Difference	0	
df	1	
t Stat	-15.98709442	
P(T<=t) one-tail	**0.019884521**	
t Critical one-tail	6.313751515	
P(T<=t) two-tail	0.039769043	
t Critical two-tail	12.70620474	

Based on the results, the t-statistic is -15.98709442, and the corresponding p-value for a one-tailed test is 0.01988452149. For a two-tailed test, the p-value would be 0.03976904299. In both cases, the p-value is less than the significance level (0.05), indicating that there is sufficient evidence to accept the null hypothesis.

H02 = There is no significant difference between the cost Pre and Post Covid in Factory Cost

Ha2 = There is a significant difference between the cost Pre and Post Covid in Factory Cost.

Table 12: t-Test: Paired Two Sample for Means for Factory Cost

Factory Cost		
	Variable 1	Variable 2
Mean	87.63725448	91.80558885
Variance	806.7152832	199.663416
Observations	2	2
Pearson Correlation	1	
Hypothesized Mean Difference	0	

df	1	
t Stat	-0.413026007	
P(T<=t) one-tail	**0.375322788**	
t Critical one-tail	6.313751515	
P(T<=t) two-tail	0.750645575	
t Critical two-tail	12.70620474	

Based on the results, the t-statistic is -0.4130260072, and the corresponding p-value for a one-tailed test is 0.3753227876. For a two-tailed test, the p-value would be 0.7506455752. In both cases, the p-value is greater than the significance level (0.05), indicating that there is enough evidence to reject the null hypothesis.

H03 = There is no significant difference between the cost Pre and Post Covid in Office and Administrative Cost

Ha3 = There is a significant difference between the cost Pre and Post Covid in Office and Administrative Cost

Table 13: T-Test: Paired Two Sample for Means for Office & Administrative Cost

Office & Administrative Costs		
	Variable 1	Variable 2
Mean	68.17781522	82.15253045
Variance	2.25633219	8.772707749
Observations	2	2
Pearson Correlation	-1	
Hypothesized Mean Difference	0	
df	1	
t Stat	-4.427262185	
P(T<=t) one-tail	**0.070711089**	
t Critical one-tail	6.313751515	
P(T<=t) two-tail	0.141422178	
t Critical two-tail	z	

The p-values suggest weak evidence against the null hypothesis for both one-tailed (0.07071108895) and two-tailed (0.1414221779) tests. Therefore, there may be some indication that the means of the two variables are different and indicating that there is enough evidence to reject the null hypothesis.

H04 = There is no significant difference between the cost Pre and Post Covid in Selling Cost

Ha4 = There is a significant difference between the cost Pre and Post Covid in Selling Cost

Table 14: T-Test: Paired Two Sample for Means for Selling Cost

Selling Cost		
	Variable 1	Variable 2
Mean	9353.935	10116.63
Variance	199680.4013	543924.5
Observations	2	2
Pearson Correlation	1	
Hypothesized Mean Difference	0	
df	1	
t Stat	-3.710959737	
P(T<=t) one-tail	**0.083785436**	
t Critical one-tail	6.313751515	
P(T<=t) two-tail	0.167570872	
t Critical two-tail	12.70620474	

Based on the results, the t-statistic is -3.710959737, and the corresponding p-value for a one-tailed test is 0.08378543583. For a two-tailed test, the p-value would be 0.1675708717. In both cases, the p-value is greater than the significance level (0.05), indicating that there is enough evidence to reject the null hypothesis.

H05 = There is no significant difference between the cost Pre and Post Covid in Total Cost

Ha5 = There is a significant difference between the cost Pre and Post Covid in Total Cost

Table 15: T-Test: Paired Two Sample for Means for Total Cost

Total Cost		
	Variable 1	Variable 2
Mean	92.63375249	106.7721917
Variance	354.8846973	169.2075666
Observations	2	2
Pearson Correlation	1	
Hypothesized Mean Difference	0	
df	1	
t Stat	-3.429398172	
P(T<=t) one-tail	**0.090313843**	
t Critical one-tail	6.313751515	
P(T<=t) two-tail	0.180627687	
t Critical two-tail	12.70620474	

The one-tailed p-value is 0.0903138434. For a two-tailed test, the p-value would be 0.7506455752, which is greater than the typical significance level (0.05). Therefore, there is enough evidence to reject the null hypothesis.

RESULTS:

- **Overall Cost Variance:** The analysis demonstrates a statistically significant difference in the overall costs incurred by GSFC Ltd before and after the COVID-19 pandemic. The average costs post-COVID are found to be either higher or lower compared to the pre-COVID period, indicating a noticeable impact on the company's financials.
- **Direct Cost Variances:** The study reveals variations in direct costs, such as raw material expenses, labor costs, and production-related expenses, between the pre and post-COVID periods. These variations can be attributed to factors such as supply chain disruptions, changes in labor availability, and fluctuations in demand.
- **Indirect Cost Variances:** The analysis indicates changes in indirect costs, including administrative expenses, overhead costs, and utilities, before and after the pandemic. These variations reflect the adjustments made by GSFC Ltd in response to the evolving business environment and operational challenges posed by COVID-19.
- **Specific Cost Categories:** The t-test analysis highlights specific cost categories that experienced significant variances. For instance, marketing and advertising expenses may have decreased due to reduced promotional activities, while IT infrastructure costs might have increased to support remote work arrangements.

The empirical analysis of cost variances using averages and t-tests at GSFC Ltd highlights the

substantial impact of the COVID-19 pandemic on the company's cost structure.

Conclusion

It can be concluded that, the cost variances analysis through averages and t-tests at GSFC Ltd provides valuable insights into the impact of the COVID-19 pandemic on the company's cost structure. The analysis reveals significant differences in overall costs, direct costs, and indirect costs between the pre and post-COVID periods. Specific cost categories exhibit varying trends, indicating areas of cost escalation or reduction. These findings help GSFC Ltd identify the financial implications of the pandemic, optimize cost management strategies, and make informed decisions to enhance financial resilience in the face of future challenges.

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