



A Comparative Empirical Analysis of Working Capital Ratios and Profitability in India's Manufacturing and Services Sectors

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Abstract

This research investigates the influence of working capital components and financial ratios on the profitability of companies in the manufacturing and services sectors. Manufacturing sectors deal with production and sales of goods, whereas services sectors deal with different types of services. In the manufacturing sector, purchase of inventories is one of major components of the input cost and this will not be relevant to services sector. Cost of goods sold is treated differently in services sectors as the costs are incurred for the service operations and not for manufacturing operations. By examining a 10-year financial dataset of ten companies, five from each sector, the study identifies correlation patterns between working capital and key profitability indicators. Statistical tools, including Pearson correlation and two-sample Z-tests were employed to assess the relationship and similarity between sectors. Findings revealed a stronger positive correlation in manufacturing firms between the working capital and the profitability as compared to service firms. Despite sectoral operational differences, average financial metrics such as current ratio and net profit ratio were found to be statistically similar. The study concludes with targeted recommendations to improve working capital efficiency and profitability.

Keywords: Financial ratios; Manufacturing sector; Profitability; Service sector; Working capital management

1. Introduction

The working capital management is an integral part of the financial operations in a company. Business organizations require funds to perform various business activities such as procuring raw materials, paying salaries of employees, paying the rent of the premises, transportation of goods etc. and all these expenses are collectively referred as working capital. The difference in the value of the current assets and the value of current liabilities is termed as the working capital and indicates the short-term liquidity position of the company [9]. The current assets include inventory of goods, accounts receivable from the sale of products or services whereas the current liabilities include the accounts payable to suppliers are other expenses. A positive working capital will ensure that the operations of the company can run without any hindrances [3]. Working capital [4] is

also critical for sustaining the company's growth. The company must make investments in machinery to increase the production. Finally, to remain competitive working capital is required to execute activities such as product development or exploring untapped markets. A company may also have to invest in recruiting sales and marketing staff to sell to expand the sales force in newer geographies or untapped markets including export markets. Even in these cases working capital is required to fulfil these objectives. Broadly it can be understood that Working Capital Management (WCM) [13,14,15] is a critical element of the financial management in general which includes the aspect of raising and uses of the funds with-in organization to sustain the operations. Funds will be used for production, marketing, investment into future innovation, growth



and to achieve overall business objectives [5]. Manufacturing sector in India employs 27.3 million people and contributes to a GDP of 17% and it is a major foundation of the economy. Its expansion is facilitated by important industries like consumer durables, chemicals, engineering, automotive, and pharmaceuticals. The Services Sector contributes to more than 50% of the GDP and a sizable 30% of the total workforce and is an expanding pillar of the economy. With the exception of the pandemic year, it has continuously increased at a rate above 6% for the past 10 years. The current study focuses on understanding the commonalities and the differences with respect to the working capital management aspects between manufacturing and services sectors [10,11,12]. Five companies each from manufacturing and service sectors are selected for the purpose of analysis. A brief profile of the companies is provided below.

2. Literature Review

Rafuse [1] researched that the suppliers did not care about interest, but they wanted their money. According to his analysis, postponing payments to the creditors to augment the working capital was not a good idea and finally it is detrimental to its practitioners and the economy as well. The author suggested that minimizing or optimizing the inventory could be the key focus of those seeking focused working capital reduction [6]. The author suggested that minimizing or optimizing the inventory could be the key focus of those seeking focused working capital reduction solutions. The effect of working capital management on SMEs' profitability was investigated by Solano et al. [2]. 8872 small and medium-sized enterprises have been chosen for the period 1996–2002 to fulfil the objective. With the panel data approach, it was found that a smaller cash conversion cycle would make the company more profitable. Thus, the managers of the company should strive to reduce both their inventories and the duration of time their accounts are overdue. Prior research has largely focused on sector-specific analyses of WCM or individual company case studies. However, limited comparative studies exist evaluating the impact of WCM parameters on profitability across different sectors. Notably, while

several studies examined WCM in steel, pharmaceutical, and MSME industries, a direct comparative framework between manufacturing and services sectors was lacking. This study addresses that gap by offering empirical evidence on the differing roles and outcomes of WCM practices across these two major economic sectors.

3. Research Objectives

The research objectives of the study are as follows:

- Identify key working capital parameters and their impact on net sales and profitability.
- Conduct correlation analysis between working capital and profitability indicators.
- Compare financial ratios between manufacturing and services firms.

4. Methodology

The following steps describes the methodology which was followed.

- Identification of the representative companies for the study
- Understand any limitations to obtain the required financial data.
- Identify statistical and predictive tools for analysis and visualization.
- Obtain financial data and analyse data using statistical and predictive methods.
- Validate the findings with finance professional and draw conclusions

Ten companies (five each from manufacturing and services sectors) were selected based on size and data availability with the period spanning FY2015–FY2024. The companies representing manufacturing sectors are Chambal Fertilizers and Chemicals Ltd, Cipla Ltd, Force Motors Ltd, Ratnamani Metals and Tube Ltd and Wellspun Living Ltd. The companies from services sector are Apollo hospital, Bluedart Express, Patel Engineering Ltd, Shriram Finance Ltd and Zee Entertainment Ltd. The time window of 10 years was selected such that there are enough data points even prior to the duration of covid pandemic to avoid the influence of covid pandemic on the observations and results. Financial data were sourced from public platforms such as Screener.in. Several attributes were taken directly from the financial statements and populated in the tables and these are Net Sales, Gross profit, Net profit, Current Assets,

Current Liabilities, Opening stock, Closing stock, Inventories, Direct cost, Equity, Beginning assets, Ending assets, Total assets, Opening trade receivables, Closing trade receivables, Debt, EBIT, Finance cost, PBT and Purchases.

Attributes which are calculated are Working capital, Cost of goods sold, Average stock, Quick Assets, Average trade receivables and Average trade payables. They are calculated as follows.

- Working Capital = Current Assets – Current Liabilities
- Cost of Goods Sold = Direct Costs + (Opening Stock + Purchases) – Closing Stock
- Average stock = (Opening Stock + Closing Stock) / 2
- Quick Assets = Current Assets – (Stock + Prepaid expenses)
- Average trade receivables = (Open trade payables + Closing trade payables) / 2
- Average trade receivables = (Open trade receivables + Closing trade receivables) / 2

For the purpose of correlation analysis, working capital and current ratio are identified as independent variables as these are determined by the internal financial operations stakeholders of the company. The sales and the net profit ratio are determined by the market conditions and sales efficiency and hence may be considered as dependent variables. Correlation coefficient is computed between pair wise for working capital vs sales, working capital vs net profit and current ratio vs net profit ratio.

Key financial metrics and ratios were calculated using MS Excel, and statistical tools like Pearson correlation and Z-tests were applied to validate findings. The study excluded outlier data where appropriate, particularly in instances of significant financial restructuring or equity infusion.

5. Results and Discussion

A representative tabulation for one of the manufacturing sector company Chambal Fertilizers and Chemical Ltd is as follows:

Table 1 10-Year Financial Data of Chambal Fertilizer and Chemical Ltd

CHAMBAL FERTILISERS AND CHEMICAL LTD (Rs.in Crores)					
Attributes	FY-2014-15	FY-2015-16	FY-2016-17	FY-2017-18	FY-2018-19
NET SALES	9,737.74	10,527.32	7,573.61	7,546.07	10,177.36
GROSS PROFIT	459.24	325.58	565.63	736.67	833.43
NET PROFIT	294.61	216.08	358.96	495.41	584.84
Working capital	322.76	96.74	478.66	463.96	-20.24
Cost of goods sold	2,811.81	2,465.40	1,529.45	1,786.81	2,785.63
Average stock	712.12	841.61	896.93	822.23	1,059.12
Quick Assets	3,691.77	4,399.50	4,020.51	2,994.25	5,182.07
Current Assets	4,430.47	5,344.01	4,869.86	3,789.35	6,505.21
Current Liabilities	4,107.71	5,247.27	4,391.20	3,325.39	6,525.45
Opening stock	685.53	738.70	944.51	849.35	795.10
Closing stock	738.70	944.51	849.35	795.10	1,323.14
Inventories	738.70	944.51	849.35	795.10	1,323.14
Equity	2,251.11	2,371.21	2,040.96	2,418.19	2,785.26
Beginning assets	8,043.03	7,638.28	8,734.86	8,057.13	9,479.54
Ending assets	7,638.28	8,734.86	8,057.13	9,479.54	13,926.26
Total assets	7,840.66	8,186.57	8,396.00	8,768.34	11,702.90
Opening trade receivables	3,559.49	3,171.16	3,913.82	3,036.19	2,534.69
Closing trade receivables	3,171.16	3,913.82	3,036.19	2,534.69	4,827.40
Average trade receivables	3,365.33	3,542.49	3,475.01	2,785.44	3,681.05
Opening trade payables	304.35	355.21	558.56	240.57	319.73
Closing trade payables	355.21	558.56	240.57	319.73	988.16
Average trade payables	329.78	456.89	399.57	280.15	653.95
Debt	3,799.67	74,754.71	1,46,383.89	3,54,165.99	4,45,703.53
EBIT	622.40	751.71	819.57	891.85	1,085.96
Finance cost	163.17	146.70	253.95	155.19	252.53
PBT	459.23	605.01	565.62	736.66	833.43
Purchases	2,817.51	2,455.23	1,520.29	1,779.92	2,785.91

CHAMBAL FERTILISERS AND CHEMICAL LTD (Rs.in Crores)					
Attributes	FY-2019-20	FY-2020-21	FY-2021-22	FY-2022-23	FY-2023-24
NET SALES	12,205.95	12,719.01	16,068.83	27,772.81	17,966.41
GROSS PROFIT	1,328.06	2,359.53	2,330.90	1,416.33	1,886.98
NET PROFIT	1,225.56	1,747.59	1,566.06	1,033.79	1,275.75
Working capital	646.97	1,622.07	2,273.56	2,486.60	2,052.54
Cost of goods sold	3,773.21	2,924.19	5,368.53	8,522.56	6,581.95
Average stock	1,229.38	962.37	1,956.18	2,248.52	1,514.25
Quick Assets	6,189.59	2,358.42	2,952.15	4,264.91	2,834.47
Current Assets	7,325.19	3,147.56	6,075.36	5,638.74	4,089.13
Current Liabilities	6,678.22	1,525.49	3,801.80	3,152.14	2,036.59
Opening stock	1,323.15	1,135.60	789.14	3,123.21	1,373.83
Closing stock	1,135.60	789.14	3,123.21	1,373.83	1,254.66
Inventories	1,135.60	789.14	3,123.21	1,373.83	1,254.66
Equity	3,431.00	5,235.00	6,386.00	7,052.00	7,258.00
Beginning assets	13,926.26	14,532.00	10,246.00	13,289.00	12,770.00
Ending assets	14,532.00	10,246.00	13,289.00	12,770.00	11,508.00
Total assets	14,229.13	12,389.00	11,767.50	13,029.50	12,139.00
Opening trade receivables	4,827.40	5,563.00	1,174.00	2,151.00	1,760.00
Closing trade receivables	5,563.00	1,174.00	2,151.00	1,760.00	191.00
Average trade receivables	5,195.20	3,368.50	1,662.50	1,955.50	975.50
Opening trade payables	988.16	541.00	389.00	1,499.00	1,211.00
Closing trade payables	541.00	389.00	1,499.00	1,211.00	793.00
Average trade payables	764.58	465.00	944.00	1,355.00	1,002.00
Debt	9,386.00	3,146.00	4,322.00	3,334.00	1,853.00
EBIT	1,830.00	2,638.00	2,335.00	1,736.00	2,059.00
Finance cost	502.00	279.00	105.00	320.00	173.00
PBT	1,328.00	2,359.00	2,230.00	1,416.00	1,886.00
Purchases	3,773.00	4,060.00	6,561.00	9,395.00	4,174.00

CHAMBAL FERTILISERS AND CHEMICAL LTD					
Ratios	FY-2014-15	FY-2015-16	FY-2016-17	FY-2017-18	FY-2018-19
Current Ratio	1.08	1.02	1.11	1.14	1.00
Quick Ratio	0.9	0.8	0.9	0.9	0.8
Inventory turnover Ratio	3.9	2.9	1.7	2.2	2.6
Gross profit ratio(%)	4.72	3.09	7.47	9.76	8.19
Net profit ratio(%)	3.03	2.05	4.74	6.57	5.75
Return on assets(%)	3.76	2.64	4.28	5.65	5.00
Return on equity(%)	13.09	9.11	17.59	20.49	21.00
Receivable turnover ratio	2.89	2.97	2.18	2.71	2.76
Payable turnover ratio	8.54	5.37	3.80	6.35	4.26
Debt equity ratio	1.69	31.53	71.72	146.46	160.02
Interest coverage ratio	3.81	5.12	3.23	5.75	4.30

CHAMBAL FERTILISERS AND CHEMICAL LTD					
Ratios	FY-2019-20	FY-2020-21	FY-2021-22	FY-2022-23	FY-2023-24
Current Ratio	1.10	2.06	1.60	1.79	2.01
Quick Ratio	0.9	1.5	0.8	1.4	1.4
Inventory turnover Ratio	3.1	3.0	2.7	3.8	5.0
Gross profit ratio(%)	10.88	18.55	13.88	5.10	10.50
Net profit ratio(%)	10.04	13.74	9.75	3.72	7.10
Return on assets(%)	8.61	14.11	13.31	7.93	10.51
Return on equity(%)	35.72	33.38	24.52	14.66	17.58
Receivable turnover ratio	2.35	3.78	9.67	14.20	18.42
Payable turnover ratio	4.93	8.73	6.95	6.93	4.17
Debt equity ratio	2.74	0.60	0.68	0.47	0.26
Interest coverage ratio	3.65	9.46	22.24	5.43	11.90

Table 2 10-year Average Ratios of Chambal Fertilizer and Chemical Ltd

Ratios	10 year average
Current Ratio	1.39
Quick Ratio	1.03
Inventory turnover Ratio	3.10
Gross profit ratio(%)	9.21
Net profit ratio(%)	6.65
Return on assets(%)	7.58
Return on equity(%)	20.71
Receivable turnover ratio	6.19
Payable turnover ratio	6.01
Debt equity ratio	41.62
Interest coverage ratio	7.49

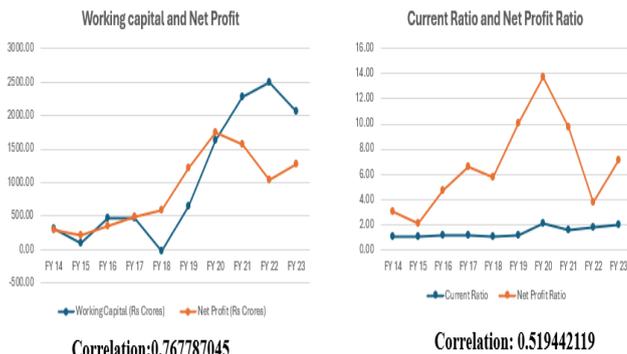


Figure 1 Correlation Analysis of Chambal Fertilizer and Chemical Ltd

A representative tabulation for one of the services sector company Apollo hospitals is follows:

Table 3 10-year financial data of Apollo Hospital

APOLLO HOSPITAL (Rs. in Crores)					
Attributes	FY-2014-15	FY-2015-16	FY-2016-17	FY-2017-18	FY-2018-19
NET SALES	5,178.45	6,085.50	7,254.90	8,243.40	9,617.40
GROSS PROFIT	455.41	416.37	222.08	171.46	373.54
NET PROFIT	325.41	316.10	131.10	59.56	200.10
Working capital	862.50	954.80	1,206.50	652.90	326.40
Cost of goods sold	1,158.00	1,211.50	1,362.70	1,460.90	1,644.80
Average stock	314.41	396.73	455.03	516.33	575.25
Quick Assets	1,588.54	1,816.90	1,719.43	1,654.30	1,697.00
Current Assets	1,938.80	2,260.10	2,186.30	2,220.10	2,281.70
Current Liabilities	1,076.30	1,305.30	979.80	1,567.20	1,955.30
Opening stock	278.55	350.26	443.20	466.87	565.80
Closing stock	350.26	443.20	466.87	565.80	584.70
Inventories	350.26	443.20	466.87	565.80	584.70
Equity	3,317.30	3,543.60	3,887.70	3,383.90	3,468.90
Beginning assets	5,372.40	6,479.40	7,687.10	8,116.50	8,612.80
Ending assets	6,479.40	7,687.10	8,116.50	8,612.80	9,183.00
Total assets	5,925.90	7,083.25	7,901.80	8,364.65	8,897.90
Opening trade receivables	519.70	609.20	701.90	748.20	884.60
Closing trade receivables	609.20	701.90	748.20	884.60	1,023.10
Average trade receivables	564.45	655.55	725.05	816.40	953.85
Opening trade payables	325.00	419.10	503.70	500.40	588.80
Closing trade payables	419.10	503.70	500.40	588.80	713.10
Average trade payables	372.05	461.40	502.05	544.60	650.95
Debt	1,813.70	2,477.60	3,048.70	3,302.90	3,450.20
EBIT	573.20	584.70	479.30	466.40	700.50
Finance cost	117.80	168.40	257.30	295.00	327.00
PBT	455.40	416.30	222.00	171.40	373.50
Purchases	1,404.10	1,845.20	2,280.00	2,649.80	3,087.50

APOLLO HOSPITAL (Rs. in Crores)					
Attributes	FY-2019-20	FY-2020-21	FY-2021-22	FY-2022-23	FY-2023-24
NET SALES	11,246.80	10,560.00	14,662.60	16,612.50	19,059.20
GROSS PROFIT	434.90	1,036.00	1,578.10	1,143.70	1,362.50
NET PROFIT	431.70	136.80	1,108.40	844.30	935.00
Working capital	309.60	1,603.50	1,738.30	1,012.10	615.20
Cost of goods sold	1,809.20	1,623.30	2,685.50	2,283.80	2,454.10
Average stock	661.30	493.65	340.70	411.00	424.95
Quick Assets	1,909.10	3,391.80	3,689.70	3,946.90	4,819.90
Current Assets	2,646.90	3,641.30	4,121.60	4,337.00	5,279.70
Current Liabilities	2,337.30	2,037.80	2,383.30	3,324.90	4,664.50
Opening stock	584.80	737.80	249.50	431.90	390.10
Closing stock	737.80	249.50	431.90	390.10	459.80
Inventories	737.80	249.50	431.90	390.10	459.80
Equity	3,469.80	4,802.40	5,877.70	6,531.30	7,320.50
Beginning assets	9,183.00	11,338.40	11,416.70	13,192.40	14,427.80
Ending assets	11,338.40	11,416.70	13,192.40	14,427.80	16,753.10
Total assets	10,260.70	11,377.55	12,304.55	13,810.10	15,590.45
Opening trade receivables	1,023.10	1,027.20	1,331.10	1,767.60	2,234.20
Closing trade receivables	1,027.20	1,331.10	1,767.60	2,234.20	2,514.90
Average trade receivables	1,025.15	1,179.15	1,549.35	2,000.90	2,374.55
Opening trade payables	713.10	908.80	1,331.10	1,631.80	1,915.60
Closing trade payables	908.80	1,331.10	1,631.80	1,915.60	2,368.60
Average trade payables	810.95	1,119.95	1,481.45	1,773.70	2,142.10
Debt	3,349.50	2,494.60	2,635.70	2,710.30	3,161.90
EBIT	1,192.80	669.90	1,956.70	1,524.50	1,811.90
Finance cost	532.80	449.20	378.60	380.80	449.40
PBT	660.00	220.70	1,578.10	1,143.70	1,362.50
Purchases	3,796.70	4,186.10	4,961.30	6,315.00	7,384.90

APOLLO HOSPITAL					
Ratios	FY-2014-15	FY-2015-16	FY-2016-17	FY-2017-18	FY-2018-19
Current Ratio	1.80	1.73	2.23	1.42	1.17
Quick Ratio	1.48	1.39	1.75	1.06	0.87
Inventory turnover Ratio	3.68	3.05	2.99	2.83	2.86
Gross profit ratio(%)	8.79	6.84	3.06	2.08	3.88
Net profit ratio(%)	6.28	5.19	1.81	0.72	2.08
Return on assets(%)	5.49	4.46	1.66	0.71	2.25
Return on equity(%)	9.81	8.92	3.37	1.76	5.77
receivable turnover ratio	9.17	9.28	10.01	10.10	10.08
Payable turnover ratio	3.77	4.00	4.54	4.87	4.74
Debt equity ratio	0.55	0.70	0.78	0.98	0.99
Interest coverage ratio	4.87	3.47	1.86	1.58	2.14

APOLLO HOSPITAL					
Ratios	FY-2019-20	FY-2020-21	FY-2021-22	FY-2022-23	FY-2023-24
Current Ratio	1.13	1.79	1.73	1.30	1.13
Quick Ratio	0.82	1.66	1.55	1.19	1.03
Inventory turnover Ratio	2.74	3.29	7.88	5.56	5.78
Gross profit ratio(%)	3.87	9.81	10.76	6.88	7.15
Net profit ratio(%)	3.84	1.30	7.56	5.08	4.91
Return on assets(%)	4.21	1.20	9.01	6.11	6.00
Return on equity(%)	12.44	2.85	18.86	12.93	12.77
receivable turnover ratio	10.97	8.96	9.46	8.30	8.03
Payable turnover ratio	4.68	3.74	3.35	3.56	3.45
Debt equity ratio	0.97	0.52	0.45	0.41	0.43
Interest coverage ratio	2.24	1.49	5.17	4.00	4.03

Table 4 10-Year Average Ratios of Apollo Hospital

Ratios	10 year average
Current Ratio	1.54
Quick Ratio	1.28
Inventory turnover Ratio	4.07
Gross profit ratio(%)	6.31
Net profit ratio(%)	3.88
Return on assets(%)	4.11
Return on equity(%)	8.95
Receivable turnover ratio	9.44
Payable turnover ratio	4.07
Debt equity ratio	0.68
Interest coverage ratio	3.09

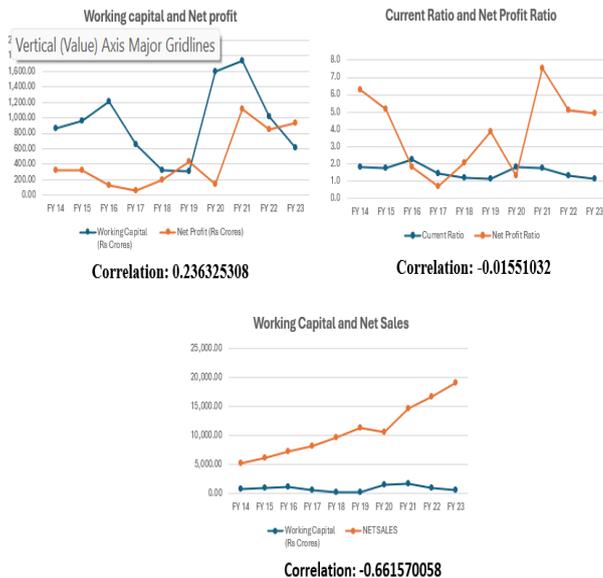


Figure 2 Correlation Analysis of Chambal Fertilizer and Chemical Ltd

Similar tabulations were performed for rest of the eight companies, and the analysis was performed. The correlation analysis revealed that manufacturing companies demonstrated stronger positive relationships between working capital and profitability indicators, such as net sales and net profit. For example, Ratnamani Metals showed a correlation coefficient of 0.949 for working capital vs. net profit. In contrast, service sector firms did not show significant correlations, likely due to differences in how the working capital is consumed in services sector.

Two sample Z-test on current ratio

Current ratio is tabulated calculated for manufacturing and services sector in a sector-wise manner. Five company's data for ten years results in fifty data points as below.

Table 5 Manufacturing Sector Current Ratio Table

Company name	FY 14	FY 15	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23
Chambal Fertilizers	1.08	1.02	1.11	1.14	1.00	1.10	2.06	1.60	1.79	2.01
Cipla	2.7	0.9	2.6	2.8	3.3	2.7	2.9	3.0	3.3	3.7
Force motors	1.7	1.7	1.7	1.6	1.7	1.1	1.0	0.8	1.0	1.3
Ratnamani metals	2.8	3.8	5.1	3.1	2.9	2.7	3.9	3.5	2.9	4.4
Wellspun Living	1.1	1.2	1.4	1.4	1.3	1.2	1.3	1.4	1.7	1.7

The Mean or Average is calculated as follows:

$$\bar{X} = (x_1 + x_2 + x_3 + \dots + x_n) / n$$

The Standard Deviation (SD) is calculated as follows:

$$\sigma = \sqrt{\frac{1}{N} \sum_{i=1}^N (X_i - \mu)^2}$$

The mean and standard deviation is calculated using MS Excel functions "AVERAGE" and "STDEV.S" respectively. N =50.

Manufacturing Sector: Current Ratio: Mean = 2.10 and SD = 1.05

Table 6 Service Sector Ratio Current Table

Company name	FY 14	FY 15	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23
Apollo Hospitals	1.80	1.73	2.23	1.42	1.17	1.13	1.79	1.73	1.30	1.13
Bluedart Express	1.7	1.5	1.2	1.2	1.1	0.8	0.8	0.8	1.0	0.9
Patel Engineering	1.2	1.3	1.2	1.3	1.3	1.2	1.5	1.4	1.4	1.4
Shriram Finance	1.6	1.0	1.0	1.0	3.7	27.1	65.1	100.3	55.5	47.9
Zee Entertainment	3.6	3.4	4.6	3.7	3.3	4.0	4.2	5.0	4.3	5.0

Shriram Finance FY 19 to FY23 has an unusually high current ratio due to increase in current assets resulting in issue of equity (equity infusion). The values are shaded in the table above. These values will be ignored in the mean and standard deviation calculations as this is more of extreme values. Hence N=45.

Services sector: Current Ratio: Mean = 2.0 and SD = 1.26

Hypothesis Formulation:

Null Hypothesis: Manufacturing and Service sector means are same for current ratio.

$$H_0: \mu_1 = \mu_2$$

Alternate Hypothesis: Manufacturing and Service sector means are different for current ratio.

$$H_a: \mu_1 \neq \mu_2$$

Z calculated is computed as per the below formula and the data is approximately normally distributed.

where N1 = 50, N2 = 45

$$z_{cal} = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

Z Calculated = - 0.519

For 5% (0.05) significance and two tailed Z-Test with probability < 0.025, Z Critical = ± 1.96. Since the calculation as per Z Test resulted in Z Calculated < Z Critical, the null hypothesis is validated.

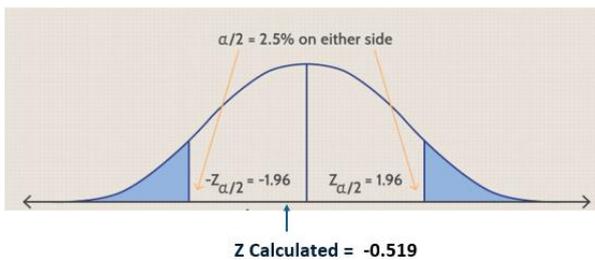


Figure 3 Two Sample z-Test Results for Current Ratio

The results concluded the means of the current ratio for manufacturing and services sectors are similar in nature and within the standard range between 1.5 and 3. Similarly net profit ratio was also analysed, and the means were found to be similar in nature. The mean values of both the sectors are within the standard range between 5% to 15%.

Two sample Z-test on net profit ratio

The data for both manufacturing and services sector is as follows.

Table 7 Manufacturing Sector Net Profit Ratio Table

Company name	FY 14	FY 15	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23
Chambal Fertilizers	3.03	2.05	4.74	6.57	5.75	10.04	13.74	9.75	3.72	7.10
Cipla	10.3	11.0	7.2	9.6	9.3	9.0	12.6	11.8	12.6	16.3
Force motors	4.3	5.9	5.2	4.2	3.9	1.6	-6.2	-2.8	3.0	5.6
Ratnamani metals	10.3	9.5	9.8	8.5	9.2	11.9	12.0	10.3	11.4	12.4
Wellspan Living	1.0	11.8	6.3	6.6	3.5	7.8	7.5	6.5	2.5	7.0

Manufacturing Sector: Net Profit Ratio: Mean = 7.33 and SD = 4.3

Table 8 Services Sector Net Profit Ratio Table

Company name	FY 14	FY 15	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23
Apollo Hospitals	6.28	5.19	1.81	0.72	2.08	3.84	1.30	7.56	5.08	4.91
Bluedart Express	5.5	7.4	5.2	5.2	2.8	-1.3	3.1	8.7	7.2	5.7
Patel Engineering	0.2	-4.6	-1.5	4.3	6.3	1.0	-17.8	1.7	38.7	61.9
Shriram Finance	11.2	11.5	11.6	12.7	16.6	15.2	14.3	14.1	19.8	20.3
Zee Entertainment	20.0	17.5	34.5	22.1	19.8	6.5	10.3	11.7	0.6	1.6

Services Sector: Net Profit Ratio: Mean = 9.41 and SD = 12.08

Hypothesis Formulation:

Null Hypothesis: Manufacturing and Service sector means are same for net profit ratio.

$$H_0: \mu_1 = \mu_2$$

Alternate Hypothesis: Manufacturing and Service sector means are different for net profit ratio.

$$H_a: \mu_1 \neq \mu_2$$

Z calculated is computed as per the below formula and the data is approximately normally distributed.

$$z_{cal} = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

where N1 = 50, N2 = 50

Z Calculated = 1.146

For 5% (0.05) significance and two tailed Z-Test with probability < 0.025, Z Critical = ± 1.96. Since the calculation as per Z Test resulted in Z Calculated < Z Critical, the null hypothesis is validated.

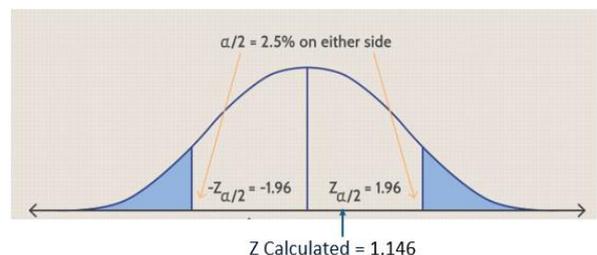


Figure 4 Two Sample z-Test Results for Net Profit Ratio.

It can be concluded that both the manufacturing and services sectors have similar net profit ratio and the financial metrics of both are similar in nature. The



mean values of both the sectors are within the standard range between 5% to 15%.

Conclusions and Future Work

Insights from correlation analysis: The Pearson correlation analysis revealed that Sales vs Working Capital as well as Net Profit vs Working Capital showed a positive correlation among 4 out of 5 manufacturing companies under the scope of the study. Such a relationship was not found in the services sector. This suggests that sales, net profit, and working capital all have a positive association in manufacturing industries, which illustrates the close relationship between these businesses' financial management procedures and production processes. The absence of a comparable correlation in the service industry points to a radically different operational model that prioritizes cash flow management and service delivery dynamics over conventional inventory and production issues. To improve overall performance and profitability, it is essential to comprehend these differences and create customized financial plans for each industry.

Financial Ratios Analysis: When ratios like the net profit and current ratios were evaluated, the findings showed that both industries kept their ratios within the standard ranges. However, compared to service organizations, manufacturing firms demonstrated a greater association between working capital and profitability indicators, underscoring the importance of inventory management and its direct influence on operational success.

Impact of COVID-19: The COVID-19 pandemic which started in late part of FY20, and FY 21 has impacted different sectors in different ways. Under the manufacturing sector while Chambal Fertilizers was not affected due to the core nature of agriculture business, the sales of automobiles in Force motors significantly decreased. CPILA and Apollo hospitals saw an increase in sales due to demand for pharmaceutical products and healthcare services. This has emphasized the necessity for robust working capital management practices [7,8] to navigate unforeseen crises effectively.

Insights from Inferential Statistical Analysis: The two-sample Z-test conducted for the current and net profit ratios confirmed that both sectors operate

within similar average ranges for these financial metrics though the nature of the working capital requirements differ between these two sectors. Manufacturing firms focus primarily on production efficiency and inventory turnover, whereas service firms rely more on service delivery effectiveness and customer satisfaction.

Key takeaways as follows:

- Manufacturing firms benefit from inventory and production efficiency.
- Service firms rely more on cash flow and receivables management.
- Proposed Future Work is as below:
- Include a broader range of industries and SMEs to increase generalizability.
- Employ machine learning models to predict profitability based on WCM metrics.
- Investigate post-pandemic changes in WCM strategies and their long-term impact.

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