Developing Country Studies
ISSN 2224-607X (Paper) ISSN 2225-0565 (Online)
Vol.4, No.5, 2014

An Evaluation of the Accuracy of Aggregate Performance Indicators Used in the Measurement of the Performance of Zimbabwe's Manufacturing Sector.

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ABSTRACT
Developing viable industrial policies and operational strategies depends on the availability of accurate information. A number of aggregate performance indicators are currently in use to measure the aggregate performance of Zimbabwe's manufacturing sector; supplying information for decision making. The continued poor performance of the manufacturing sector despite the adoption of a succession of industrial and economic policies to promote the development of the sector brings into question the informational base used to develop, monitor and evaluate these policies. This research evaluated the accuracy of aggregate performance indicators used to measure the performance of Zimbabwe's manufacturing sector, namely capacity utilisation, employment statistics and the contribution of manufacturing to Gross Domestic Product .The research finds that the metrics used to measure the performance of Zimbabwe's manufacturing sector are not representative of the performance of the manufacturing sector in Zimbabwe.
Key words: Zimbabwe, Manufacturing, Aggregate Performance Measurement, Capacity Utilisation, Gross Domestic Product, Employment statistics

1 Background

Zimbabwe's manufacturing sector's contribution to the country's economy has declined over the years, with recent statistics indicating a decline in the contribution of the manufacturing sector to Gross Domestic Product, GDP, from 28.4% in 2006 to 15.1% in 2011 (African Development Bank, Organisation for Economic Cooperation and Development, United Nations Development Program, United Nations Economic Council for Africa, 2012). During the same period the economic outlook of the country became increasingly negative, with Gross National Income per capita declining to US$460.00 in 2011 (The International Bank for Reconstruction and Development, 2012), with Gross Domestic Product at market prices at US$8,865,427,917 for 2011 (Zimbabwe National Statistics Agency, 2012).

While the contribution of manufacturing to GDP showed a marked decline in the period from 2006 to 2011, corresponding capacity utilisation figures for the manufacturing sector relating to the same period suggested improved performance of the manufacturing sector; capacity utilisation decreasing from 33.8% in 2006 (Mudzonga, 2009) to 10% in 2008 then increasing to 57.2% in 2011 (African Development Bank, Organisation for Economic Cooperation and Development, United Nations Development Program, United Nations Economic Council for Africa, 2012).

In contrast to the latter statistics, unemployment levels rose sharply since 2004, when the last official data prior to 2011 on unemployment was gathered, going from 9.3% (African Development Bank, Organisation for Economic Cooperation and Development, United Nations Development Program, United Nations Economic Council for Africa, 2012) to 10.7% in 2011 (Zimbabwe National Statistics Agency, 2012). This rise in unemployment suggested deterioration in the performance of the economy, not least the manufacturing sector.

Between 2006 and 2011, the relative proportions of Zimbabwean manufactured goods and imports retailed in Zimbabwe changed in favour of locally manufactured goods. From 2006 to 2009 the volume of locally manufactured goods in stores declined significantly owing to unfavourable business conditions. From 2009, after the introduction of the multi-currency monetary system, manufacturing activity in Zimbabwe increased and the volume of Zimbabwean goods in stores increased. This increase was not however attributed to the opening of a corresponding number of new manufacturing facilities or expansion of existing operations, as such, cannot be considered as real growth in the manufacturing sector.

The summary of metrics given above creates more confusion than it does answer the question of Zimbabwe's manufacturing sector's performance in the period under consideration.

The following hypotheses have been proffered to summarise the accuracy of the metrics used in the measurement of Zimbabwe's manufacturing economy's performance.

> **H_0** – The aggregate performance indicators used to measure the performance of the manufacturing sector in Zimbabwe are accurate.

Alternatively:

> **H_1** – The aggregate performance indicators used to measure the performance of the manufacturing sector in Zimbabwe are inaccurate.

The findings of this research are based on the performance of Zimbabwe's manufacturing sector between 2006 and 2011, for which period a large volume of statistical data relating to the sector's performance is available. It should be noted that the systems for collating and analysing data do generate the aggregate performance indicators had not changed significantly between 2011 and the date of publication of the present work in 2013. As such, by the time of publication of this work, the determination of the hypothesis test still held true.

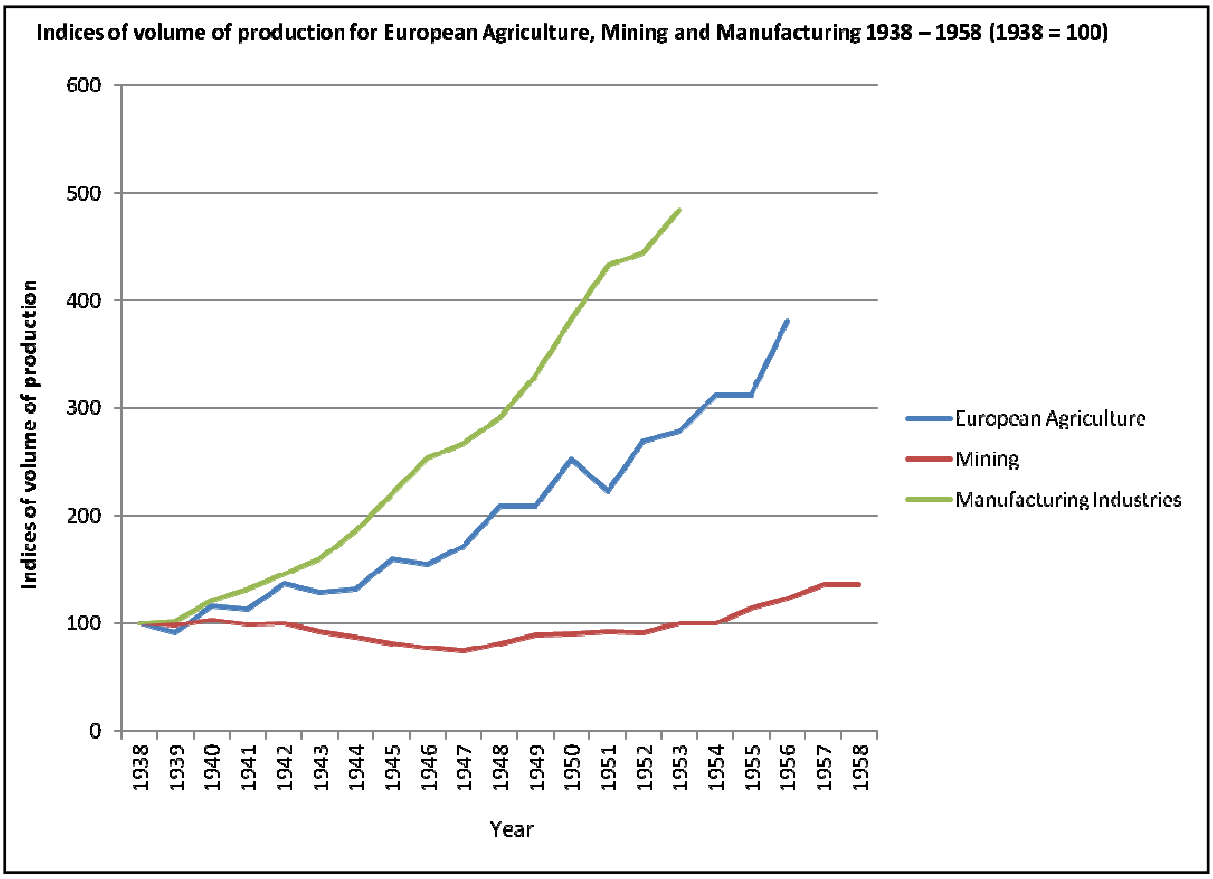
2 Measurement of the Performance of Manufacturing in Zimbabwe

2.1 Manufacturing Performance from 1938 to 1964

Between 1938 and 1965 a census conducted by the Central African Statistical Office was one of the methods used to measure and report on the performance of the manufacturing sector. In addition a great deal of information relating to manufacturing was collected on a monthly basis through the Monthly Digest of Statistics which was also produced by the Central African Statistical Office.

The performance of the manufacturing sector was measured by means of indices of volume of production among other things. The indices of volume of production were constructed by linking annual percentage changes between individual years back to 1938 (Tow, 1960). Measuring annual changes and linking them estimated the major effects of any fundamental alterations in the structure of each of the respective sectors which might have taken place over an extended period (Tow, 1960).

Figure 2.1 provides a graphic representation of the performance of three sectors of economy Rhodesian economy between 1938 and 1958.

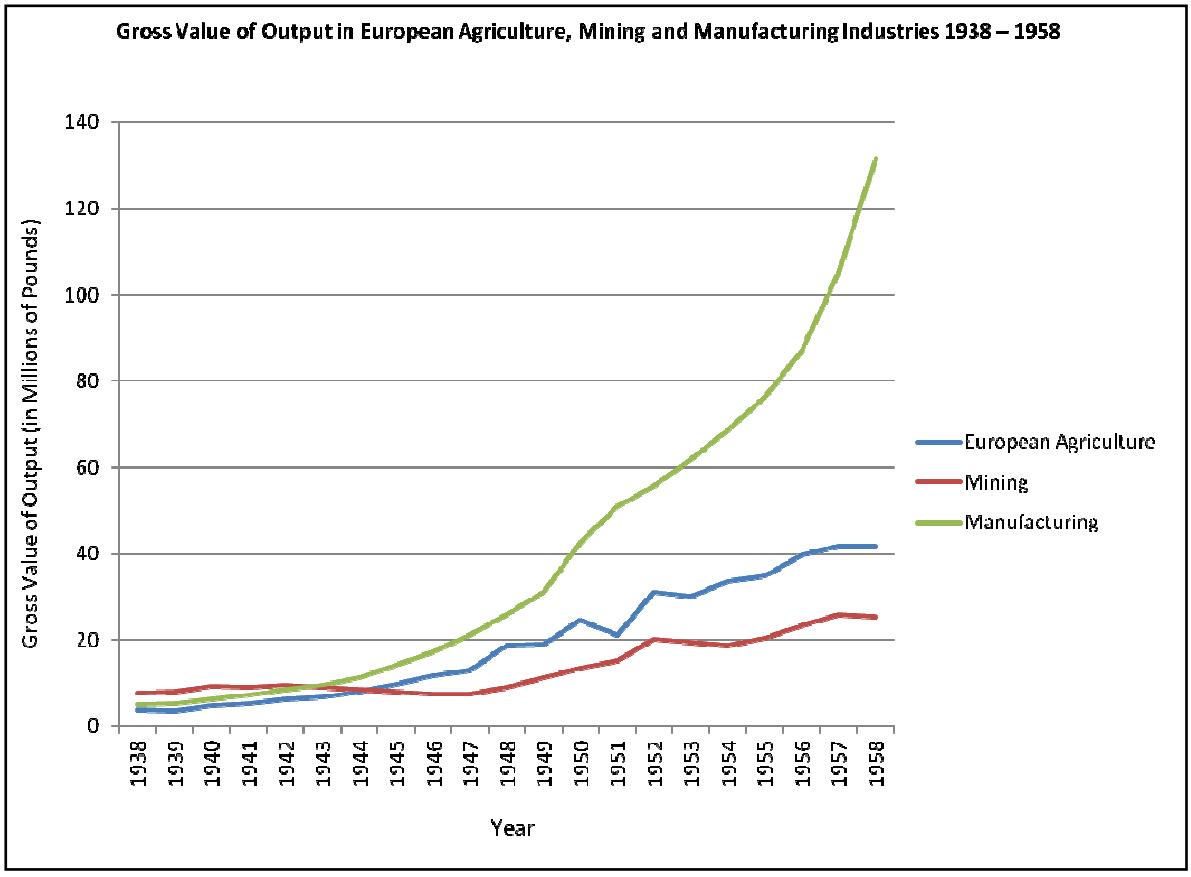


Source: Adapted from Tow (1960)

Figure 2.1: Indices Of Volume Of Production, 1938 – 1958 (1938 = 100)

One point of particular note with the data presented above is the consistency with which it was collected; this is in contrast to current trends, where large gaps exist in economic data. Corroborating the performance of manufacturing during this period under consideration, Figure 2.2 presents graphs that show the gross value of output from the manufacturing, European agriculture and mining sectors between 1938 and 1958.

The graphs in Figure 2.2 are considerably similar to those in Figure 2.1. This is consistent with expectation as the value of output is expected to closely follow the volume of production except to the effect that price changes and inflation may reduce the correlation between the two measures over an extended period of time.



Source: Adapted from Tow (1960)

Figure 2.2: Gross Value Of Output, 1938 – 1958

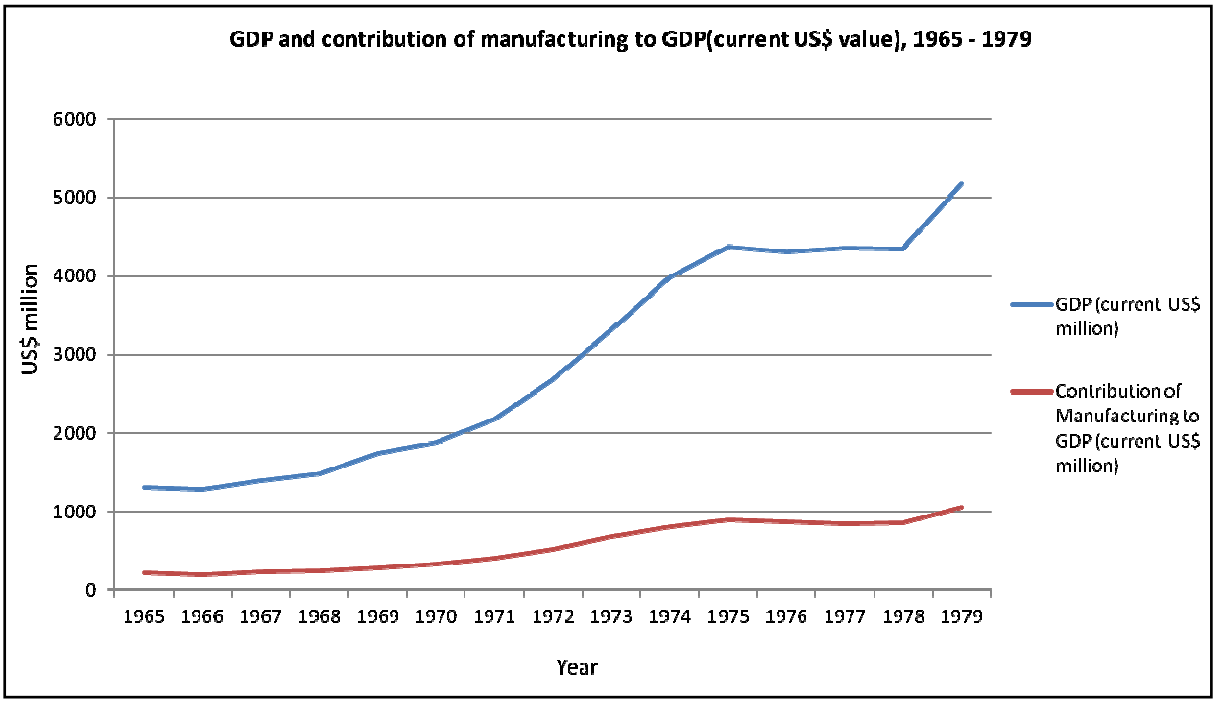
During this period, the contribution of manufacturing to Gross Domestic Product and employment statistics were not readily available.

Between 1954 and 1964 the economy grow substantially, with GDP at factor cost growing at a rate of 99% from 324 million Rhodesian Dollars in 1954 to 646 million Rhodesia Dollars in 1964 (Hurungo, 2010). The contribution of manufacturing to GDP between 1954 and 1965 increased marginally to 17% (Hurungo, 2010).

The growth trend in manufacturing which persisted from 1938 to 1964 continued through the period from 1965 to 1979, during which time the country was under sanctions.

2.2 Manufacturing Performance from 1965 to 1979

While details of the performance of the manufacturing sector went unpublished for the better part of the period of UDI, concise records of the country's GDP were maintained and indications of the contribution of the manufacturing sector to GDP were readily available. Figure 2.3 shows GDP and the contribution of manufacturing to GDP from 1965 to 1979.



Source: Adapted from (World Bank, 2013)

Figure 2.3: GDP and Contribution of Manufacturing to GDP, 1965 – 1979

Figure 2.3 shows growth in GDP and the contribution of manufacturing to GDP during the period from 1965 to 1979. The figure shows that the contribution of manufacturing to GDP closely followed GDP itself. The correlation between GDP and the contribution of manufacturing to GDP during the period from 1965 to 1979 is represented by a Correlation Coefficient of 0.9986 meaning that GDP was a good indicator of the performance of the manufacturing sector.

In the absence of other comprehensive data relating to the performance of the manufacturing sector, GDP was the most viable indicator.

2.3 Manufacturing Performance from 1980 to 2013

Throughout the period, GDP and the contribution of manufacturing to GDP were measured consistently. Figure 2.4 shows GDP and contribution of manufacturing to GDP from 1980 to 2011.

Source: Adapted from World Bank (2013)

Figure 2.4: GDP and Contribution of Manufacturing to GDP, 1980 to 2011

The performance of manufacturing mirrored the performance of the entire economy less than it did in the preceding period. The correlation between GDP and contribution of manufacturing to GDP is represented by a Correlation Coefficient of 0.7973. While this is a positive correlation, it represents weak correlation.

As a result of the inability to accurately tell the performance of the manufacturing sector from GDP and the contribution of manufacturing to GDP, the period required other indicators to give an accurate indication of the performance of the manufacturing sector.

3 Aggregate Industrial Performance Measurement

Performance measurement is the activity of measuring and assessing the various aspects of a process or whole operation's performance (Slack et al., 2010).

Performance can be measured for a single organisation or it can be measured for a group of organisations.

Without performance measurement, it would be impossible to exert any control over an operation on an ongoing basis (Slack et al., 2010). Likewise, in the case of aggregated operations, performance measurement is essential to be able to exercise control over a collective of operations.

When a number of operations are assessed as a collective the resources used may often differ. In such instances, input and output indicators need to be converted into common-sized metrics which allow for assessment of the aggregated operations with a single common indicator.

Throughout Zimbabwe's history a series of economic policies have been used to promote economic growth. The vision of the Industrial Development Policy covering the period from 2011 to 2015 was to transform Zimbabwe from a producer of primary goods into a producer of processed, value-added goods for both the domestic and export market (Government of Zimbabwe [1], 2011). Some of the most important developments mentioned in the Policy are articulated in terms of capacity utilisation, GDP and employment statistics, setting out these indicators as a basis for the measurement of the performance of the manufacturing sector.

3.1 Capacity and Capacity Utilisation

Capacity utilisation is commonly used for the measurement of the performance of manufacturing. In Zimbabwe, since 2001, the Confederation of Zimbabwe Industries, CZI, has conducted an annual survey of the state of the manufacturing sector producing statistics on capacity utilisation as one of the results. Confederation of Zimbabwe Industries (2012) reported that the Manufacturing Sector Survey is so significant that policy makers, International Monetary Fund, World Bank, and the United Nations Development Program among others always anticipate it and make use of it.

Capacity is defined as the maximum rate of output for a process, measured in units of output per unit of time (Hill, 2012). Capacity utilisation is the level to which the productive capacity of a plant or firm is being used in the generation of goods (Confederation of Zimbabwe Industries, 2012).

Coelli et al. (2000) define capacity of a plant as the maximum output that can be produced using the given technology and the fixed input vector when the variable input vector may take any non-negative value. They go on to define Capacity utilisation for a single facility, Θ_i, as being equal to the ratio of observed output, y, to the capacity of the plant, y_c. That is,

$$\Theta_i = \frac{y}{y_c} \qquad \text{…Equation 3.1}$$

These definitions differ from some functional definitions used in other parts of the world. In the United States of America the Census Bureau and the Federal Reserve have adopted an economic definition of capacity that assumes the full employment of all variable factors of production and the use of only the equipment in place and ready to operate (Morin & Stevens, 2004).

While the Zimbabwean context evidently looks at the current levels of employment and the productive output thereof, the approach adopted in the USA assumes full employment of all input factors. The effect is to overstate capacity utilisation in Zimbabwe's context when compared to the American scenario owing to the fact that a reduction in resource employment levels in the Zimbabwean context will be read as a reduction in capacity and a corresponding drop in production will not necessarily be recorded as a drop in capacity utilisation. As a result, capacity utilisation in the Zimbabwean context only takes into consideration the capacity that is currently in use, 'productive capacity', completely ignoring industrial capacity that is not currently in service.

The effect of this approach is that while manufacturing facilities may close or stop production completely or partially, capacity utilisation statistics will not reflect this. In the case of the period from 2008 to 2011, capacity utilisation increased despite the fact that the same period witnessed the closure of several manufacturing facilities.

A further point of divergence between the Zimbabwean approach and the approach adopted in the USA is the definition of terms which form the basis of the measurement of the performance of the manufacturing sector. In the 2002 Survey of Plant Capacity form, the instructions to plant managers for estimating full production capability were to consider Full Production Capability as the maximum level of production that the establishment could reasonably expect to attain under normal and realistic operating conditions fully utilising the machinery and equipment in place. (Morin & Stevens, 2004):

The goal of measuring capacity utilisation is to inform decision making that helps attain and maintain a level of capacity utilisation that minimises economic costs, being the sum of the capacity and waiting costs (Hill, 2012). The CZI however implies that full 'productive' capacity utilisation is the ideal to which the manufacturing sector should strive. This is implied by the measurement of the proportion of firms operating at full capacity in the manufacturing sector to those operating below full capacity.

In any industry and economy, the desirable level of capacity utilisation is often a predetermined level which is decided at the design phase of a manufacturing facility or by analysis of economic factors from time to time. The reason for operating at a level below full capacity, which also is a cost-optimum level of capacity utilisation, is to allow sufficient flexibility of the manufacturing facility to absorb short-run increases in demand as well as to accommodate stoppages for maintenance and unforeseen incidences.

In practice any increase in capacity utilisation beyond full utilisation requires capital investment; for a facility operating at full capacity to increase its production volume, an expansion of the operation is required having the

effect of reducing the utilisation of its total capacity. Also, such a facility will not be in a position to take on any new business until such a time as it has increased its capacity. For any business that seeks to grow, operating at full capacity is an indication that the firm is incapable of growth.

3.1.1 Measurement of Capacity Utilisation in Zimbabwe

Confederation of Zimbabwe Industries (2012) reported aggregate capacity utilisation for the manufacturing sector for 2012 as 44.9%. The report states that from the respondents, 46.5% recorded capacity utilisation of above 50%, with a total of 4 firms recording capacity utilisation of 100%.

Zimbabwe National Statistics Agency (2010) makes use of the CZI's capacity utilisation statistics to determine business tendency in Zimbabwe. Table 3.1 is a reproduction of the data presented in the Business Tendency Survey of 2006 - 2009 (Zimbabwe National Statistics Agency, 2010). The table shows that in the period from 2006 to 2009 the number of firms in the manufacturing sector that were operating at full capacity reduced from 27 to 5. This statistic however does not lead to any conclusive assessment, implying on one hand that the firms reported in 2006 as operating at full capacity increased their capacity over the period, or on the other hand that the operating conditions became increasingly undesirable and some of the firms that had previously reported operating at full capacity were no longer operating at full capacity. This analysis assumes the absence of new companies in the various sectors, as well as the closure of businesses in the same period.

Table 3.1: Percentage Of Establishments Working At Full Capacity, 2006-2009

Sub-Sectors	**2006**	**2007**	**2008**	**2009**
Foodstuffs	29	7	0	7
Drinks & Tobacco	18	9	0	8
Textiles	38	25	13	14
Leather & Footwear	29	14	14	0
Wood & Furniture	14	14	0	0
Paper & Printing	36	18	0	0
Chemicals	25	10	5	0
Non-Metallic Minerals	50	0	0	0
Metals & Metallic Products	18	14	10	4
Transport Equipment	33	22	0	0
Other Manufacturing	14	14	13	29
All Manufacturing	27	13	5	5
Mining	14	0	0	0

Source: Zimbabwe National Statistics Agency (2010)

80% capacity utilisation is generally accepted as an ideal level of operation, allowing sufficient capacity to accommodate unforeseen stoppages as well as accommodating short-run increases in demand. It is generally believed that when utilisation reaches 85%, price inflation is expected. Similarly, when utilisation rates fall below 75% for an industry as a whole, it is in a recession (Acclaro Growth Partners, 2011). For the purpose of economic development, the objective would be to optimise costs as opposed to maximising capacity utilisation, a view held by Hill (2012) who states that the goal of capacity management is to minimize the sum of two relevant costs: the cost of the capacity and the cost of waiting.

Capacity and waiting lines will differ between firms. As a result different levels of capacity utilisation will yield optimum performance across industries. With this in mind, the aggregation of capacity utilisation across the entire manufacturing sector should take into consideration the different capacity utilisations that optimise the running of each industry. This may be done by means of rationalisation, whereby capacity utilisation for individual firms is converted into an index which represents performance of the firm subject to the optimum level of capacity utilisation for the industry in which it operates. When aggregated, the indices would represent the relative performance of the entire manufacturing sector.

This could be achieved by use of the arithmetic computation:

$$\Theta = \sum_{i=1}^{n} \frac{(\Theta_i w_i)}{n} \qquad \text{…Equation 3.2}$$

Where:

Θ - Aggregate capacity utilisation,

Θ_i - Capacity utilisation for a single facility.

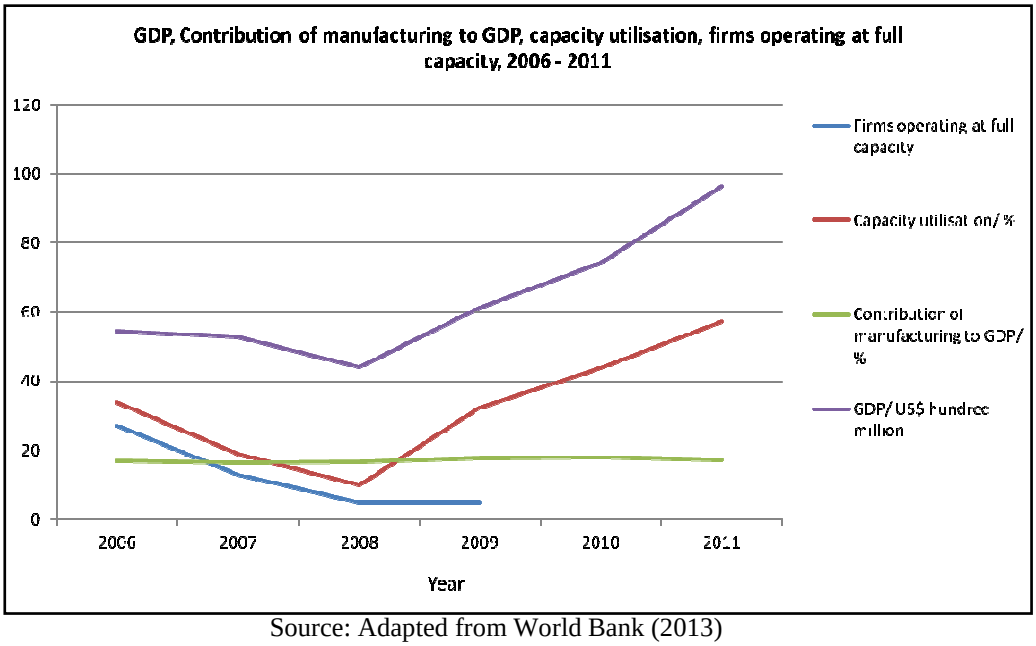
w_i - Weighting / conversion factor to industry standard.

n - Number of facilities.

This method will however not factor in the effect of company closures and new players in the sector.

The use of capacity utilisation to measure industrial performance gives an inaccurate indication of growth or decline in a turbulent economy in so far as the aggregate capacity of such economies continues to reduce at a rapid pace owing to the closure or downsizing of manufacturing operations.

The viability of capacity utilisation as a metric for the measurement of aggregate performance of the manufacturing sector is determined by means of a comparison of the trend in capacity utilisation against GDP and the contribution of manufacturing to GDP. Figure 3.1 shows the contribution of manufacturing to GDP, the number of firms operating at full capacity in manufacturing, and the capacity utilisation of the manufacturing sector for the period from 2006 to 2011.



Source: Adapted from World Bank (2013)

Figure 3.1: GDP, Manufacturing Contribution to GDP, Capacity Utilisation, Firms Operating at Full Capacity, 2006 – 2011

Figure 3.1 indicates that the contribution of manufacturing to GDP remained relatively constant throughout the period from 2006 to 2011. During this period however, capacity utilisation and GDP initially fell then increased sharply. There was a strong positive correlation between GDP and capacity utilisation during the period expressed by a Correlation Coefficient of 0.9435. This indicates that GDP was a good indicator of capacity utilisation in manufacturing during the period. The significance of the correlation between GDP and Capacity Utilisation is however uncertain owing to the fact that the contribution of manufacturing to GDP should ideally be more closely related to capacity utilisation than GDP is to capacity utilisation. Also, due to the fact that the contribution of manufacturing to GDP remained steady throughout the period, the validity of the data is questionable as it suggests that at least one of the metrics in the comparison is inaccurate.

The state of the economy from 2008 to 2013 was such that the contribution of manufacturing to GDP was declining owing to increased output from mining and growth in tourism, against a drop in manufacturing output. Table 3.2 shows the real GDP growth by sector between 2008 and 2011. The growth rate of manufacturing which is far lower than that of real GDP, agriculture, hunting and fishing, and mining and quarrying in 2010, suggests that the contribution of manufacturing to GDP was decreasing and beyond 2010 the contribution of manufacturing would cease to be 15% of GDP.

Table 3.2: GDP Growth By Sector, 2008 - 2010

Sector	**GDP Growth/ %**		
	2008	**2009**	**2010 (Estimate)**
Real GDP	-14.8	5.7	8.1
Agriculture, hunting and fishing	-39.3	14.9	33.9
Mining and quarrying	-33.4	8.5	47.0
Manufacturing	-17.1	10.2	2.7
Electricity and water	-13.6	1.9	1.5
Construction	-8.5	2.1	1.5
Finance and insurance	-27.9	4.5	0.5
Real estate	-36.4	2.0	0.9
Distribution, hotels and restaurants	2.8	6.5	0.5
Transport and communication	5.4	2.2	0.1

Source: Government of Zimbabwe [2], (2011)

In 2010 the State of the Manufacturing Sector Survey gave aggregate capacity utilisation for the manufacturing sector for 2010 as 43.7%, which was a significant increase from 2009 levels of 32.3% (Confederation of Zimbabwe Industries, 2010).

In 2012 the State of the Manufacturing Sector Survey the aggregate level of capacity utilisation was 44.2%, a decrease from the 2011 level of 57.2%.

3.2 Employment Statistics

The number of people employed in various sectors of the economy has been used in Zimbabwe to determine the performance of the economy (Zimbabwe National Statistics Agency, 2012).

Tow (1960) sites employment statistics for the manufacturing sector for the period between 1938 and 1958, comparing these figures against the estimated population.

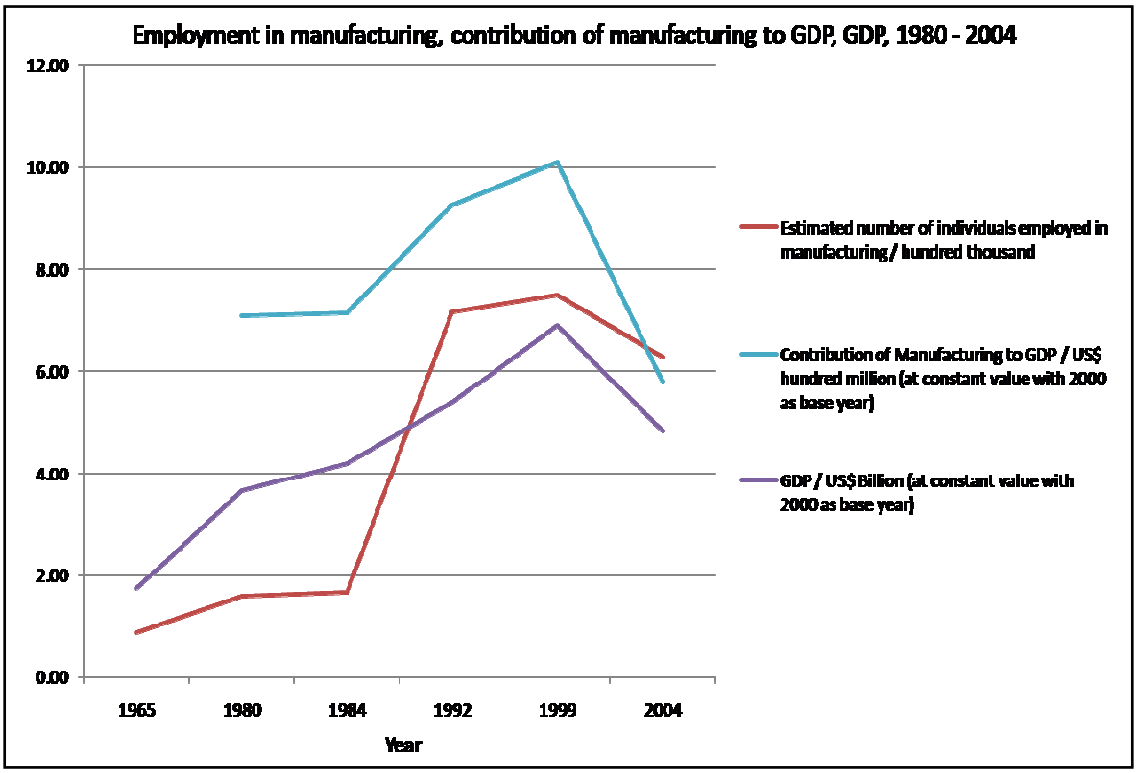
Employment statistics are sparsely published, being less frequently published than capacity utilisation and Gross Domestic Product. Roussos (1988) presents employment statistics relating to the period from 1980 to 1984, and World Bank (2013) presents statistics relating to employment in manufacturing for 1999 and 2004. A summary of the employment demographics relating to manufacturing from 1956 to 2004 has been presented in Table 3.3.

Table 3.3: Employment in Manufacturing, 1956 - 2004

Year	Estimated Total Population	Estimated number of individuals employed in manufacturing	Estimated percentage of total population
1965	2,611,200	682,838	3.4%
1980	Not available	159,400	Not available
1984	Not available	166,700	Not available
1992	11,005,690	714,992	6.50
1999	12,405,236	749,140	6.04%
2004	12,597,877	627,517	4.98%

Source: Adapted from Tow (1960), Roussos (1988), Keogh (2001) and World Bank (2013)

Comparison of the contribution of manufacturing to GDP and the estimated number of people employed in manufacturing shows weak correlation between the number of people employed in manufacturing and the contribution of manufacturing to GDP. Graphic representation of the metrics between 1980 and 2004 is presented in Figure 3.2.



Source: Adapted from World Bank (2013), Roussous (1988),and Keogh (2001).

Figure 3.2: Employment in Manufacturing, Contribution Of Manufacturing To GDP, GDP, 1980 - 2004

The Central Statistics Office reported that unemployment decreased, from 22% in 1992 to as low as 6% in 1999 (Keogh, 2001). The disparity in employment statistics is attributed to the definition of unemployment which is such that unemployment rates seemingly decrease as poverty increases simply because those without regular employment often do not actively looking for work because there is little hope of finding it (Keogh, 2001). This being the case, a large proportion of the population is not classified as unemployed, being omitted from the definition of employable individuals (Keogh, 2001)

3.2.1 Definitions Of Employment

Unemployment statistics are based on the number of people in a household aged 15 years and falling into the five classes (Keogh, 2001):

a. paid employee,

b. employer,

c. own account worker, including peasant farmers,

d. unpaid family worker, and

e. unemployed / looking for work.

The Zimbabwe National Statistics Agency (2012) reports that in 2011 the population aged 15 years and above accounted for about 58% of the population; 87% were economically active. Using the broad definition of unemployment, 13% of the population was unemployed.

Zimbabwe National Statistics Agency (2012) defines unemployment in two ways:

1. As a strict definition, unemployed persons are persons aged 15 years and above who, during the reference period, for example seven 7 days, were:

a. Without work. Were not in paid employment or self-employment.

b. Currently available for work and actively seeking employment, that is, had taken specific steps such as registered or checked at any employment agency, applied to employers, responded or placed advertisements, enquired at farms or worksites or asked friends or relatives about work in a specified recent period to seek paid employment or self-employment.

2. As a broad definition, unemployed persons are persons aged 15 years and above who, during the reference period were without work and currently available for work.

Unemployment rate is defined as the percentage of unemployed persons in the economically active population (Zimbabwe National Statistics Agency, 2012).

The Keogh (2001) definition is likely to report lower levels of unemployment than Zimbabwe National Statistics Agency (2012).

Zimbabwe National Statistics Agency (2012) states that a person aged 15 years and above was considered to be currently economically active if they were either employed for at least one hour during the last 7 days preceding the interview, or usually works but was temporarily absent from work, or was without work and available for work. This means that attaining the age of 15 years does not in itself qualify an individual as part of the labour force. This compounds the definition of unemployment.

Table 3.4 gives details of employment across various sectors of the economy in 2011.

The proportion of the employed population in 2011 attributed to manufacturing, 5%, corresponds to 2.28% of the total estimated population, a drop of 2.7 percentage points from 2004 figures. This is however not supported by a corresponding decline in the contribution of manufacturing to GDP, which, in 2011 was up 2 percentage points from 15% in 2004. This suggests that the manufacturing sector became more efficient or more mechanised between 2004 and 2011 so as to sustain output, making employment an inaccurate indicator of the performance of the manufacturing sector.

3.3 Gross Domestic Product

GDP can be calculated in three different ways: using the nations' output, adding up the rewards to the factors of production, or calculating the total expenditure on both produced and consumer goods (Roussos, 1988). For the purposes of determining real growth or decline in performance, constant price GDP is most favoured; it allows comparison of GDP over an extended period of time, exchange rates and other factors against those of a base year or specific reference period.

The strength of this measure of performance is in its ability to compare the performance of difference sectors of the economy, the economies of different countries, and the performance of the same economy over a period of time. GDP provides the most distinguishable aggregate measure of business performance; financial performance.

However, GDP is subject to gross distortion as highlighted by Nathan Associates Inc. (2007) who mentioned how hyperinflation contributed towards making GDP based performance indicators inaccurate.

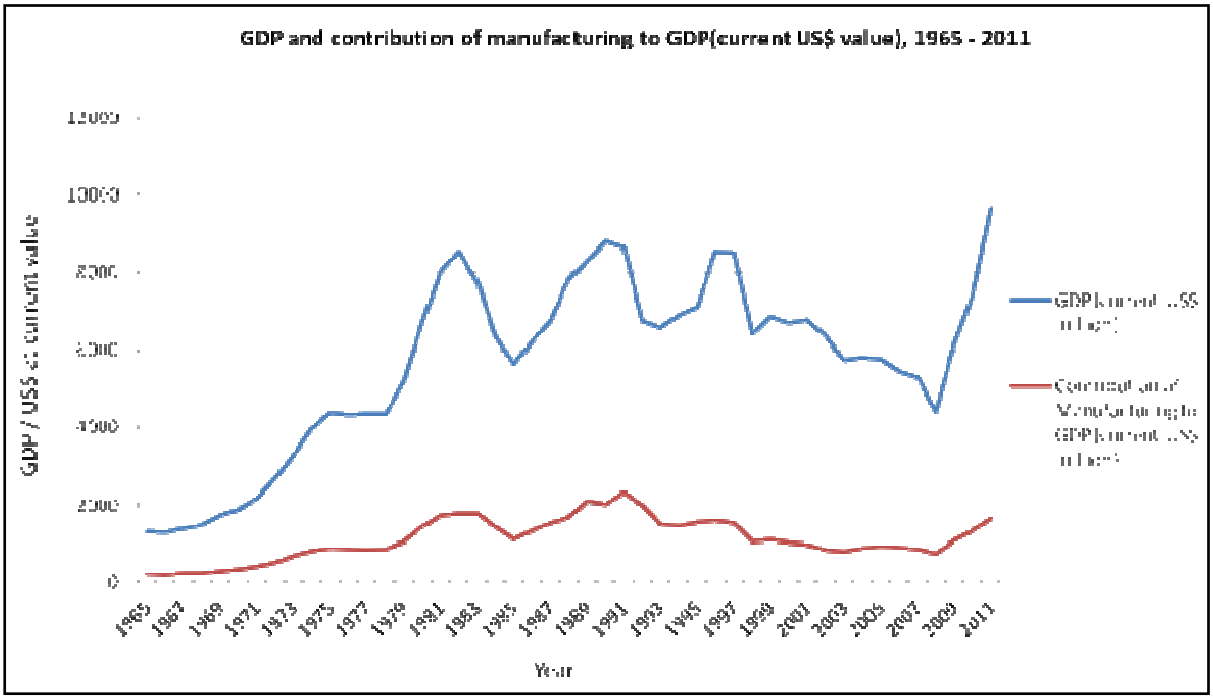
GDP has been used consistently since 1965 to measure the performance of the Zimbabwean economy. In addition a number of other indicators have been derived from GDP, some of which relate specifically to the manufacturing sector.

Figure 3.3 shows GDP as well as the contribution of manufacturing to GDP between 1965 and 2011.

Table 3.4: Employment Statistics by Industrial Sector, 2011

Industrial Sector	Male / %	Female / %	Total / %
Agriculture, forestry and fishing	59.9	71.6	65.8
Mining and quarrying	3.6	0.3	2.0
Manufacturing	7.7	2.3	5.0
Electricity, gas, steam and air conditioning	0.3	0.0	0.2
Water supply; sewerage, waste management and remediation activities	0.1	0.0	0.1
Construction	3.4	0.4	1.9
Wholesale and retail trade; repair of motor vehicles and motorcycles	8.2	10.7	9.5
Transportation and storage	3.1	0.2	1.7
Accommodation and food service activities	0.5	0.6	0.6
Information and communication	0.5	0.1	0.3
Financial and insurance activities	0.5	0.3	0.4
Real estate activities	0.1	0.1	0.1
Professional, scientific and technical activities	0.4	0.3	0.4
Administrative and support service activities	2.5	0.8	1.6
Public administration and defence; compulsory social security	2.1	0.5	1.3
Education	2.8	3.4	3.1
Human health and social work activities	0.9	1.6	1.2
Arts, entertainment and recreation	0.5	0.2	0.4
Other service activities	2.3	3.6	2.9
Activities of households as employers	0.4	2.7	1.5
Activities of extraterritorial organizations and bodies	0.0	0.1	0.1
Not Stated	0.1	0.2	0.1
Total Percent	**100**	**100**	**100**
Total Number	**2 704 060**	**2 726 967**	**5 431 026**

Source: Zimbabwe National Statistics Agency (2012)



Source: Adapted from World Bank (2013)

Figure 3.3: GDP and Contribution of Manufacturing to GDP, 1965 – 2011

Figure 3.3 shows that the contribution of manufacturing to GDP, for the most part, followed the trend in GDP. The correlation between GDP and the contribution of manufacturing to GDP indicates a strong positive correlation between the two. Table 3.5 gives the correlation coefficients representing the relationship between GDP and the contribution of manufacturing to GDP over the period from 1965 to 2011.

Table 3.5: Correlation between GDP and Manufacturing Contribution to GDP

Period	**Correlation coefficient**
1965 – 2011	0.9144
1965 – 1979	0.9986
1980 – 1989	0.9223
1990 – 1999	0.5959
2000 – 2005	0.6769
2006 – 2011	0.9949

Source: Primary Data

The correlation Coefficients given in Table 3.5 suggests that the contribution of manufacturing to GDP could easily be determined from GDP within acceptable limits of accuracy from 1965 to 1979 and 2006 to 2011.

Interpretation of the corresponding Correlation Coefficients indicates that during the period from 1990 to 2005, the contribution of manufacturing to GDP could not be determined accurately from GDP.

It should be noted that macroeconomic factors such as inflation and currency fluctuations are likely to have had greater or lesser effect on the manufacturing sector than on the entire economy given the dependence of manufacturing on international trade. As such it would be expected that there would be weaker correlation

between GDP and the contribution of manufacturing to GDP during periods when there was hyperinflation and currency fluctuations.

4 Methodology

4.1 Data collection

Supporting the evidence provided above, a survey of suppliers and users of aggregate performance indicators relating to manufacturing was used to gather primary data. The data was analysed statistics to test the hypotheses. The research population consisted of firms engaged in manufacturing operations, policy makers, industry representative organisation and economics consultants.

Qualitative data was collected by means of interviews and focus group discussions. Purposive sampling was used for the identification of the sample elements; basing on the experience and continued involvement of the members of the population in manufacturing in Zimbabwe.

4.2 Data Analysis

Inductive tools were used to analyse qualitative nature, and deductive tools were used to analyse quantitative data.

The Hypotheses were tested using modal analysis at 95% confidence intervals with a 5% margin of error.

5 Findings

5.1 Quantitative analysis

26.4% of the respondents' organisations and 41.6% or the respondents had supplied data in surveys used to determine the aggregate performance of manufacturing. These organisations and individuals were possibly likely to have had better appreciation of the meaning, appropriate use of, and relevance of aggregate performance indicators than those who lacked such experience.

64.7% of respondents indicated that capacity utilisation was a good indicator of the performance of the manufacturing sector. 55.9% indicated that employment statistics were not representative of the performance of the manufacturing sector. The findings were indecisive on the contribution of manufacturing to GDP as a good indicator of the performance of manufacturing. 36.3% of the population believed that the metric was a good indicator, 40.2% were unsure, and 23.5% believed the metric not to be representative of manufacturing performance.

49% of respondents believed that the raw information used to determine aggregate performance indicators in question was accurate. 30.4% were unsure, and 20.6% believed otherwise.

44.1% of respondents indicated that the concurrent use of contribution of manufacturing to GDP, employment statistics, and capacity utilisation resulted in ambiguity interpreting the performance of the manufacturing sector. 38.2% of respondents were undecided and 17.6% believed the metrics gave a true impression of the sector's performance.

35.3% of respondents believed that some manipulation of data occurred in the collation of aggregate performance data relating to the manufacturing sector, biasing the data. In contrast, 17.6% of respondents were undecided while 48% believed that there was no distortion of data.

5.1.1 Hypothesis Test

The findings were subjected to statistical analysis to tests the hypotheses:

> **H_0** – The aggregate performance indicators used to measure the performance of the manufacturing sector in Zimbabwe are accurate and adequate.

Alternatively, it was hypothesised that:

H_1 – The aggregate performance indicators used to measure the performance of the manufacturing sector in Zimbabwe are inaccurate and inadequate.

The basis of accepting the null hypothesis was an absolute majority of responses affirming the accuracy of the aggregate performance indicators. An absolute majority was constituted of at least 51% of the sample. A single-tail test was used to test the hypotheses with a test alpha of 0.05.

The critical value used to designate the rejection region was Z = 1.96 as shown in Figure 5.1.

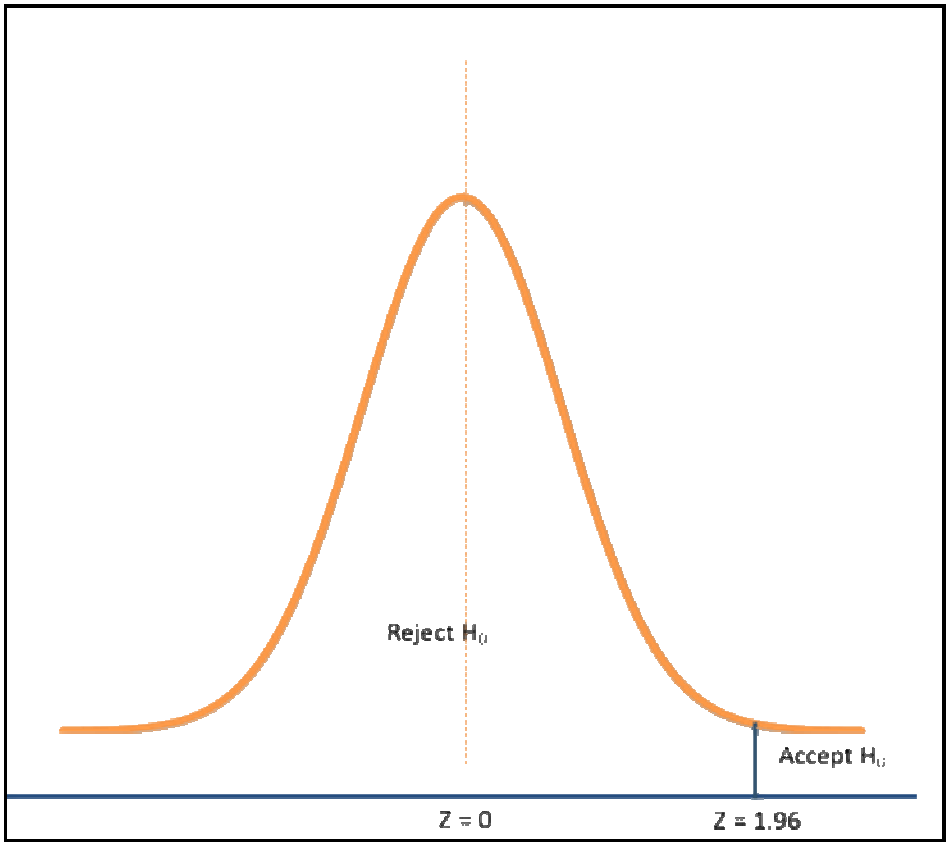


Figure 5.1: Hypothesis Acceptance and Rejection Regions

The test statistic value, Z_{calc}, for the survey findings was given by the equation below.

$$Z_{calc} = \frac{p-\pi}{\sqrt{\frac{pq}{n}}} \qquad \textbf{…Equation 5.1}$$

Where:

Z_{calc} – Test Statistic

p – Sample proportion or proportion of desired outcome

q – Proportion of undesired outcome

n – Sample size

π – Hypothesised population proportion

The sample statistics, Z_{calc}, for the population under consideration are given in Table 5.1.

Table 5.1: Sample Statistic and Null Hypothesis Decision for Various Metrics

Metric	**Capacity Utilisation (CU)**	**Contribution of manufacturing to GDP (M%GDP)**	**Employment Statistics (Emp)**	**Combination of CU, M%GDP and Emp**
$\mathbf{Z_{calc}}$	1.53	-2.40	-1.12	-0.98
Null Hypothesis Decision	Reject	Reject	Reject	Reject

Source: Primary Data

Given that $Z_{calc} < 1.96$, the result falls outside the acceptance region. As such, the null hypothesis, H_0, is refuted and the alternative hypothesis, H_1, is accepted.

5.2 Qualitative Analysis

The qualitative data collected revealed that the indicators used for the measurement of the performance of the manufacturing sector in Zimbabwe were inaccurate.

The metrics were deemed inaccurate owing to their inability to take into consideration issues of operational efficiency. Factors such as labour productivity, labour turnover, energy efficiency, energy and water consumption, and the reliability of plant and machinery were not reflected hence giving a distorted perception of manufacturing performance.

Cost of production and plant and equipment reliability are affected by the age of such plant and equipment. A considerable proportion of the equipment being run by manufacturing firms is old; operational efficiency is therefore a major consideration when measuring the performance of manufacturing.

Owing to the fact that the aggregate performance indicators did not factor in a comparative analysis, the performance of the manufacturing sector is taken in the context of a closed system, wherein the performance of trade partners is deemed not to affect the performance of the Zimbabwean manufacturing economy. On this account the accuracy of the indicators was refuted.

The metrics did not consider the effect of international trade on the manufacturing sector. For this reason the metrics were regarded as being inaccurate. Measurement of the imports consumed by the manufacturing sector compared to the exports by the sector was suggested as a more reliable indicator of the performance of the sector; this would give an indication of the sustainability of the sector.

Capacity Utilisation, Contribution of manufacturing to GDP, and employment statistics in manufacturing were deemed inaccurate owing to the fact that they did not factor in an analysis of the technology that is used in the manufacturing sector.

Technology was seen to affect manufacturing processes, communications, links in supply chains, and risk associated with manufacturing. Failure to factor these risks into an assessment of the performance of the manufacturing sector made the metrics inaccurate.

6 Summary of Findings, Recommendations and Conclusions

6.1 Summary of findings

The research arrived at the following:

- The metrics used to measure the performance of the manufacturing sector in Zimbabwe, particularly capacity utilisation, the contribution of manufacturing to GDP, and employment statistics were not representative of the performance of the manufacturing sector.

- Alternative metrics which give a better indication of the performance of the manufacturing sector are required for the purpose of providing accurate information about the aggregate performance of the manufacturing sector in Zimbabwe.

6.2 Recommendations

Based on the findings, it was recommended that:

- A new set of metrics be used to measure the aggregate performance of the manufacturing sector, and

- Further research is conducted to determine the treatment of peripheral matters relating to the measurement of the performance of the manufacturing sector.

6.3 Conclusions

The policies and strategies implemented to promote growth in Zimbabwe's manufacturing economy are subject to failure owing to the use of inaccurate data in crafting these policies and strategies.

While it is appreciated that numerous other factors contribute toward the success of industrial policy, the underlying concept of Garbage-In Garbage-Out is highly applicable to the case of manufacturing in Zimbabwe.

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