Competing Through Human Capital and Technology: Zimbabwe’s Gateway to World Class Manufacturing

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COMPETING THROUGH HUMAN CAPITAL AND TECHNOLOGY: ZIMBABWE'S GATEWAY TO WORLD CLASS MANUFACTURING

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ABSTRACT
The world has become global, manufacturing companies are competing for the same market. Goods manufactured on one part of the globe are marketed across national, regional and international boundaries. Local companies are facing stiff competition from imports. Human capital is the single most critical pillar in a manufacturing environment. Without people in an organisation manufacturing becomes impossible. Even in the environment of complex machinery there is still need for human interface with the machinery. This paper investigated the prevalence of world class manufacturing techniques in Zimbabwe’s manufacturing industries with a focus on human capital traits (advanced management techniques) and advanced manufacturing technologies. The methodology used was a survey of fifty manufacturing companies. The research tool used was a closed ended questionnaire administered to engineers working in the manufacturing plant. The survey concentrated on companies in the processing, production, mining and energy sector. The research results revealed that the uptake of advanced manufacturing technologies with Robots having a prevalence of around 12%. Most equipment used by Zimbabwean companies is obsolete. Management training was found to have a prevalence of 85.7% and lean six sigma manufacturing (LSSM) is the lowest applied technique at 24.50%.

Key words: World class manufacturing advanced manufacturing, advanced management techniques, human capital.

1.0 INTRODUCTION
The world is becoming a global marketplace due to increased movement of capital, services, products, ideas and people across the countries, regional boundaries and continents. This movement has been necessitated by improved logistics, infrastructure and technology particularly Information and Communication Technologies (ICTs). Liberalisation of trade on the other hand has enabled the fast and easy movements of manufactured products across boundaries. This created stiff competition for manufacturing companies from all over the world. These competitions require organisations to reconfigure the way they do business. The manufacturing function has to be used as a competitive weapon to ward off competition. Managers should be equipped with knowledge and skills to manage the different challenges. The research focused on the implementation of WCM strategies in Zimbabwe focusing on Delta beverages Company.
Zimbabwe is situated in Southern Africa and is a land-locked country. The country is bordered by Mozambique, South Africa, Botswana, and Zambia It has a population of nearly 13 million people. Its major industries are agro-based and mining. The companies in Zimbabwe produce for local, regional and a few for International markets. It used to export processed meat products, tobacco, dairy products, fruit juice and processed timber. The exports and imports use road, railway and air to their destinations. It is connected to the over- sea markets by air and sea. The technology both equipment and strategies are imported from outside the country. Zimbabwe lost its international market share of the product due to the downward trend of the economy in the last decade and a decline in productivity due to competition from outside the country. If Zimbabwe is to restore its status of competitiveness, it has to produce products which are of higher quality and cheaper, there is a need to introduce World Class Manufacturing (WCM) technologies to become competitive. In the current global world, people are buying products, from where they are of higher quality and cheaper. Zimbabwe has abundant natural resources in the form of minerals such as gold, diamonds, and platinum, iron ore and coal to mention a few and has fertile soil to sustain agriculture (Ndhlovu et al., 2010). Mining and farming are the major drivers of Zimbabwean industry and the economy (Global Edge, 2011). Most Zimbabwean companies in the mining sector produce semi-processed products which fetch less on the world market. Despite having abundant natural resources the country is failing to compete at global level, both in terms of quality and price. Goods in the textile industry cost several times more than those produced from the Far East (Zimbabwe Independent, 2012).

2.0 METHODOLOGY

A survey of fifty manufacturing companies was carried out. The targeted respondents were engineers working in the plant, the engineers targeted were; plant engineers, plant managers, process engineers, planning engineers, production engineers and manufacturing engineers. A closed ended tool of yes or no was used to assess the prevalence of certain management techniques and
advanced manufacturing techniques which Zimbabwe manufacturing companies are using. The questionnaires were hand delivered and collected from the respondents.

3.0 HISTORICAL BACKGROUND OF MANUFACTURING IN ZIMBABWE

Zimbabwe had one of the most diversified manufacturing infrastructures in sub-Saharan Africa outside South Africa. The question is how did it all start? The first settler immigrants who came and settle in Southern Rhodesia, concentrated on the mining of minerals such as gold, coal, chrome and asbestos. Agriculture was later introduced to serve people who were working in the mining sector. Agriculture expanded with the growing of cattle, maize Virginia tobacco (Tow, 1960). Small manufacturing entities were started to support agriculture and the mines. The actual expansion of industry came after the World War II due to higher demand for commodities, manufacturing became for the first time 50% of both agriculture and mining.

![Figure 1: The contribution of manufacturing in %GDP to economy of Zimbabwe: (Arrighi, 1966; Mzumara, 2012).](image)

The situation before 1938 was that manufacturing was only two thirds of mining alone. Figure 2 shows that contribution of manufacturing to the national income rose from 9% in the early 1930s to over 15% in the early 1950s and to 18% in the early 1960s (Arrighi, 1966). At the same time, industry moved from small family business shops to large corporate, industrial mechanised big institutions (Arrighi, 1966). Stoneman (1990) stated that the contribution of manufacturing to GDP rose from 10% before the World War II to 20% in 1965 and in 1974 it reached 25% due Rhodesia’s policy of Import substitution. At independence in 1980 there was no significant change in the manufacturing policy the growth continued until 1986 to 30% of the GDP. The UNDP report of 2008 shows that on average the contribution of manufacturing to GDP has been going down from 1980 -1990. The sector was the largest contributor to GDP at 24% from 1980 to 1990 ahead of agriculture which was at 14%. It once contributed 27% at its peak (CZI). There was a notable decline in contribution of manufacturing to GDP from 24% to 16% in 2007 (Mzumara, 2012). The contribution of manufacturing to GDP went down to 13% in 2010.
The problems facing the companies are deindustrialisation leading to closure of the companies, due to imports from countries with low priced products (Gadzikwa, 2012). The key contributor to the lack of competitiveness is due to; non availability of capital, high cost of capital leading to lack of investment in plant and machinery, unreliable electricity and water bills leads to high cost of production, high cost of labour and the decline in agriculture which is the main feeder to the manufacturing (Msipa, 2013). Msipa acknowledged that the manufacturing sector is in a crisis since it has been declining from 25% in the 1990s to 15% currently in 2013. The economy is still facing challenges such as infrastructure deficiency, a large external debt of government and limited formal employment (Katsande, 2013). The challenges which affect the businesses in Zimbabwe are many, Katsande (2013) has outlined the following as some of the challenges that are facing Zimbabwe today; non availability of funds, the cost of money itself does not encourage businesses to borrow, economic policy instability, high labour costs and non-flexible labour laws.

4.0 WORLD CLASS MANUFACTURING

Several authors have defined world class in different ways in this paper is has been summarised: it is about improving customer satisfaction and overall business efficiency through quality improvement, flexibility of manufacturing, streamlining the supply chain, worker participation and elimination of all forms of waste.

4.1 Principles of world class manufacturing

The Business dictionary (2015) has defined principles as fundamental norms, rules, or values that represent what is desirable and positive for a person, group, organization, or community, and help it in determining the rightfulness or wrongfulness of its actions. Likewise world class manufacturing has got principles which are accepted as desirable and valued by manufacturing engineering scholars.

Waldron (1999) has summarised the best practices that can be adopted by an organisation trying to become world class in Table 2.

**Table 2: The best practices in manufacturing adapted from Waldron (1999)**

<table>
<thead>
<tr>
<th>Automatic storage and retrieval systems</th>
<th>Materials requirement planning</th>
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<tbody>
<tr>
<td>Cellular manufacturing</td>
<td>Modular design and construction</td>
</tr>
<tr>
<td>Computer aided design</td>
<td>Quality circles</td>
</tr>
<tr>
<td>Computer-aided manufacturing</td>
<td>Robotics</td>
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<tr>
<td>Computer integrated manufacturing</td>
<td>Statistical process control/quality control</td>
</tr>
<tr>
<td>Concurrent engineering/design for manufacturability</td>
<td>Synchronous manufacturing/balanced loading</td>
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<td>Flexible manufacturing systems</td>
<td>Target pricing/costing</td>
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<tr>
<td>Just in time systems(delivery, inventory control, manufacturing)</td>
<td>Total preventive maintenance</td>
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<tr>
<td>Kanban system</td>
<td>Total quality control</td>
</tr>
<tr>
<td></td>
<td>Manufacturing rationalisation</td>
</tr>
</tbody>
</table>

Companies pursuing world class status may choose one or more out of the four dominant principles of manufacturing strategy which are Just in Time (JIT), Total Quality Control (TQC), Total Preventive Maintenance (TPM) and Computer Integrated Manufacturing (CIM) (Swinehart et al, 2000). Whilst other authors have identified JIT, TQM, TPM and CIM as principles, Mahadevan (1998) has identified them as characteristics of the world class manufacturing, he has also added employee involvement
and simplicity to these characteristics. A JIT organisation aims to reduce all types of waste such as time, equipment, material, space and the worker’s time in order to add value to the product. In TQC everyone participates in the business of the organisation or towards producing a quality product.

This section will briefly review some of the manufacturing technologies that can be used as part of world class manufacturing strategy. These are Group Technology (GT), Direct Numerical Control (DNC), Computer Numerical Control (CNC), Computer Aided Design (CAD), Computer Aided Engineering (CAE), Computer Aided Process Planning (CAPP), Flexible Manufacturing Systems (FMS), Automated Material Handling (AMH), Cellular Manufacturing (CM), Robotics and Concurrent Engineering (CE).

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4.2 Advanced manufacturing technology for world class manufacturing

The previous section 2.4 looked largely into the management of people and this section will concentrate on the management of technology. Hayes and Wheelwright (1984) had pointed out the importance of the manufacturing equipment upgrade in their fifth practice which they termed, rebuilding manufacturing engineering. They emphasised the internal development of equipment with unique characteristics and difficult to copy which employees are able to maintain (Flynn et al., 1999). The importance of equipment in a manufacturing environment has been quoted later by Schonberger (1986) in his Principle 14 and 15. In principle 14 he emphasised the improvement of current equipment and human work before considering new equipment and automation. In principle 15 Schonberger (1986) advocated for selection of simple, flexible, movable, low cost and readily available machines (Flynn et al., 1999). Fredendall et al. (1997) advocated for an investment strategy that continually enhance technology throughout the entire organisation with a clear and focused vision for future competition in mind. Their second point on technology was a careful plan for technological upgrades which is consistent and in tandem with infrastructural upgrades (Flynn et al., 1999). Voss (1995) emphasized the need to choose appropriate technology when competing through manufacturing to achieve desired capabilities. Today’s economic challenges, advocate for the establishment of a technology enabled businesses in order to outpace competition through acting faster and quicker than the competitors.

Advanced manufacturing systems (AMS) comprise of production systems and associated services, processes, plants and equipment, including automation, robotics, measurement systems, cognitive information processing, signal processing and production control by high speed information and communication systems. It involves manufacturing systems that create high tech products using innovative techniques in manufacturing and invention of new processes and technologies for future manufacturing (European Union Commission, 2010). The adoption of advanced manufacturing technology is a must for any company which intends to increase its manufacturing competitiveness. Adopting AMT is an essential part of an organisation’s capability building (Liu & Dutta, 1999). Advanced manufacturing technologies reduce cost of production, improve quality of product and provide quick delivery of customised products. For a company to achieve potential benefits from
AMT there is need to spruce managerial capabilities in the area of understanding technology, skills in planning and innovativeness, organisational structure and training the composition of workers, type of training they received and level of education influences the implementation of AMT. The composition of workers should increase the number of engineers for AMT to be successful (Yussuf et al., 2005).

4.3 Advanced management systems
Total quality management (TQM) is the management philosophy and company wide practices that aims to harness the human and material resources of an organisation in the most effective way to achieve the objectives of the organisation. These objectives are customer satisfaction, business growth, profit, market position or provision of service to the community. TQM is a way of managing to improve the effectiveness, efficiency, flexibility and competitiveness of the business as a whole. It is concerned with the change of behaviour, attitudes and skills so that the culture of the organisation becomes one of preventing failure first time (Dale and Auckland, 1994).

JIT talks about the management of resources in relation to time in the manufacturing environment, so that the customer gets the product in time. The theoretical wish for a company in a manufacturing environment is to have zero inventories, either as raw material, work in progress and finished products. Just in time manufacturing is a way of managing manufacturing systems that could reduce waste, and lower cost, thus increasing profit. In its basic sense, it means that products or raw material arrives in time and there is no need for holding stock at the premises (Frazier, 2004).

Vankatesh (2009) has defined TPM, a maintenance programme, as a concept of maintaining plants and equipment, with the goal of increasing production, while at the same time increasing employee morale and job satisfaction. It is considered as the medical science of machinery.

The Business Dictionary (2015e) has defined empowerment as a management practice of sharing information, rewards and power with employees so that they can take initiatives and make decisions to solve problems and improve services and performance. Employees that are empowered have the capacity to reach higher productivity levels; they feel they are in control of their jobs. Lean production combines the advantages of both craft and mass production, while avoiding the high cost of craft and the rigidity of mass production. Lean manufacturers employ teams of multi-skilled workers at all levels of an organisation and they use highly flexible, increasingly automated machines to produce volumes of products of different varieties.

4.4 Advanced manufacturing prevalence in Zimbabwe
This section analysed the frequency of advanced manufacturing technology prevalence in Zimbabwe. The analysis used bar charts with the technology type on the X-axis and the percentage or frequency on the Y axis.
Figure 3: Frequency of advanced manufacturing technologies use in Zimbabwe

Figure 3 shows a generally low level of uptake of advanced manufacturing technologies in Zimbabwe with the use of robots being implemented by only 12.2% of the surveyed companies and 87.8% not implementing, followed by direct numerical control and computer numerical control at 22.40% prevalence. The other technologies which are poorly implemented in Zimbabwe are concurrent engineering at 26.50%, Flexible manufacturing and group technology tying at 30.6% prevalence, the top three performers though below 50% prevalence are computer aided design at 42.9%, followed by computer aided process planning at 34.7% followed by computer aided engineering and cellular manufacturing sharing at 32.7% prevalence. There is need for technological upgrade if Zimbabwean companies are to compete at global level.

Figure 4: Frequency of Information technologies uses in Zimbabwe

Yes

No

Percentage

ERP

MRP

MaRP

EDI

XML

WEB

INT

Yes

No

67.30%

59.20%

59.20%

20.40%

18.40%

20.40%

48.90%

32.70%

40.80%

79.60%

81.60%

79.60%

51.10%
In Figure 4, Enterprise resource planning (ERP) showed a prevalence of 67.3%, material requirements planning (MRP) at 65.30%, and manufacturing resource planning (MRP11) (MaRP) at 59.20%. The three IT technologies are showing a fair prevalence in most Zimbabwean companies. The other four technologies are less used in Zimbabwean companies, which are EDI at 20.4%, WEB-based technologies at 20.4%, internet 48.9%, and XML web-based showing the lowest at 18.4%. The last four IT systems show the capacity of the organisation to communicate with the outside world. Generally, Zimbabwean companies are not doing business in terms of buying and selling on the Internet. The concept of hiding products in a showroom is still prevalent. Companies need to sell and advertise on the net to be globally visible. Failure to do business on the net reduces the customers who have access to the product.

4.5 Advanced management techniques

Figure 5 shows that Management training (MT) has the highest prevalence at 85.7%, followed by customer relations at 75.5% and then worker involvement at 71.4% prevalence. LSSM is the lowest applied technique at 24.50% and LM at 49% which shows that most companies are not implementing waste management techniques. It should be noted that there are a lot of losses which contribute to the production cost of the product. This could be one contributor to the high prices charged by Zimbabwean companies. JIT is the next in line with 28.6% prevalence showing that most companies are not practising time management in their operations. In today’s global world, it is critical for organisations to reduce the lead times of the products. The synchronization of the supply chain increases operational and business efficiency of the system.
Figure 5 shows that TQM is at 69.4% prevalence and TPM is at 55.10% prevalence which is quite low for any country which aspire to be a world class manufacturer.

5. RECOMMENDATION AND CONCLUSION

The recommendations are as follows:

- Employers must equip their workers with technical skills that match their duties. The machines which Zimbabwean companies are using are mainly imported from outside the country; it is needed to match the operational skills and maintenance skills of the worker to technological dictates of the machines.

- All workers in the organisation should be IT literate and they should continually update their IT skills. The world economy has become IT driven and most manufacturing companies are using IT as a competitive advantage to compress transaction time. Communication within the organisation and outside becomes faster. It facilitates quick interface between workers and machines.

- Companies should introduce TPM maintain their machines. When organisations buy new equipment there is a need to put in place a maintenance program to ensure that machines are fit to perform their duties. Proper maintenance gives long life to machinery and it also ensures that quality products are produced.

Research has shown that manufacturing’s contribution to GDP has been going up from 1938 to 1986 and has been going down since then to the current day. The research has revealed a generally low level of uptake of advanced manufacturing technology in Zimbabwe with the use of robots being the lowest at 12%, with Computer aided design having the highest prevalence at 42.9%. There is a generally low prevalence of IT systems such as XML, WEB, EDI and internet which enhance trade and communication with the outside world. Advanced management techniques are fairly implemented in Zimbabwe with LSSM being the lowest applied technique at 24.50% and LM at 49% prevalence, which shows that most companies are not implementing waste management techniques. Zimbabwean companies that aspire to be world class manufacturers need to upgrade their manufacturing technology and equip their human capital with the required technical and management skills.

REFERENCES


