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Industrial sustainability in a challenged economy: the Zimbabwe steel industry

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Abstract

The economy of Zimbabwe has deteriorated over the years with hyperinflation. In the years 2006 to 2008 the conditions worsened and in 2009 a multicurrency system including the US dollar was introduced, however investment in the industry did not strengthen and a number of challenges are still faced by the industry. A main feature of the Industry in Zimbabwe had been the steel and steel related manufacturing industry which was key for both domestic and foreign markets. The motivation for this study was to investigate and propose strategies for enhancing sustainability of steel making companies in Zimbabwe. The aim of this research was to undertake a requirements analysis from the steel companies and identify the main challenges from the point of view of steel production. From these challenges the paper aimed to help co-define some of the possible solutions the companies could consider. Sharing the findings could help companies pick up best practice and inform policy makers in developing new frameworks for improving industrial sustainability.

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1. Introduction

The United Nations Report of the World Commission on Environment and Development defined sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs [2]. Altwegg and others [1] reported that the impacts on the environment, economy and society are three pillars of sustainability. The idea behind the three pillars is that for the full sustainability to occur all three pillars of sustainability must be achieved. Environmental sustainability looks at maintaining renewable resources, pollution at minimum and reduction in the use of non-renewable resources. Economic sustainability is being able to sustain a specific level of economic production. Social sustainability of a country is being able to function at a specific level of social well-being of its people. Social sustainability is

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affected by the Economic sustainability and Environmental sustainability. The growth in Economy is limited by the society and the growth of the society depends on natural resources available. In Zimbabwe, economic instability has affected sustainability as a whole. Once companies are struggling economically then environmental and social sustainability become the least of their worries. A key industry for Zimbabwe has been steel production.

1.1. Production of Steel in Zimbabwe

There are two main ways in which steel is produced in Zimbabwe, namely from ore and from scrap. Steel making process involves the conversion of pig iron or scrap material into steel. This is done by reducing the quantities of carbon, silicon, manganese, sulphur and phosphorus. This reduction is done using the oxidation process. One of the main sources of steel comes from ZISCO, a major company that produces steel. At the time of the study, ZISCO had suspended operations due to economic issues. The resuscitation of this company introduction other alternative large scale producers would be a big step towards economic sustainability. All the other steel making companies that are still operating in Zimbabwe depend on recycling scrap steel materials. This is made possible by the fact that steel can be recycled multiple times and reproduced into new products while maintaining its original quality [3]. Therefore, steel has been considered as a cradle-to-cradle material.

1.2. Research Motivation

The aim of this research was to find out from the actual steel companies what the main challenges in the country are from the point of view of steel production. Then what the possible solutions are especially what the companies are able to do amid the country's economic instability. With results shared, each company can pick new insights and strategies.

2. Research Methods

This industrial sustainability study was based on an oral interview of companies to define the parameters of the study, the main issues to be instigated and a follow up questionnaire to study a wider set of companies based on the initial parameters. Information was collected from thirteen of the steel companies that are still operational in Zimbabwe. The rationale for picking the steel industry was due to its significant impact on the Zimbabwe economy and potential for export. Additionally, its high energy intensity was of significant relevance to environmental sustainability and industrial emissions. The study explored raw materials and energy usage, type of energy used, and more importantly possible ways of working towards greener manufacturing.

For this study the Delphi approach was used. Experts from the required steel industry were first identified and asked to participate in the inquiry. Fifteen companies agreed to participate in the study and agreed to the first round of the Delphi approach which was the oral interview. Fourteen of the companies were dealing with sourcing of scrap metals and producing steel products and one company deals with non-ferrous metals. This indeed was a homogenous sample and fifteen respondents were sufficient.

The initial contact of the nominated companies was done on the phone. Companies were told about the research and kindly invited to participate first, in an oral interview. They were assured of anonymity in the sense that none of their statements were to be attributed to them by name. Individuals, the experts, were then identified to represent each company in the oral interviews. Appointments were set at their convenience and the researcher went in with open ended questions. The theme was on what challenges the companies are facing and how financial and environmental sustainability may be achieved. Open ended questions allowed the researcher to get even more relevant information. These experts representing each company included technical representatives from the different Steel/Metal companies who all have engineering backgrounds such as foundry forepersons, managers, and workshop and plant managers. In some cases, however, the actual individuals were not the technical people, they were accountants or marketing personnel, but when it came to the technical questions they referred to the technical individuals in the company and allowed access to the researcher into their foundries to see how the work was done and meet the technical people on the ground. To preserve anonymity, pictures were not taken in the foundries.

Using the information and key factors suggested during the oral interviews the questions were then refined by the researcher and the study pursued through a questionnaire into the second round. At this point 3 companies did not complete the questionnaire so the sample size reduced to 12 in the second round. The reasons were mainly individuals feeling that they had done enough in the oral interviews so they did not have to take more time out of their busy schedules to do the questionnaires.

In the questionnaire, participants were asked to briefly describe the profile of their companies and then the following information was requested:

1. Their highest qualification
2. To select the level of his or her position in the company from the three levels provided
3. Identify the number of employees in the company
4. Identify the main raw materials used and how they are acquired
5. In US\$ specify how much is spent on energy (electricity, gas or coal) and water at full capacity and at current capacity.
6. Specify the main products/s and the target market
7. The current capacity that the company is functioning at
8. State the company monthly turnover in US\$ at full capacity and at current capacity

9. Based on the oral interviews a list of eight challenges facing the industry was generated, participants were then requested to show to what degree each has affected their company. Space was provided for each to add any other challenges not specified already.
10. Also basing on the oral interviews five possible solutions to make the Zimbabwe steel/metal industry do well in the long term were presented and participants had to indicate to what level each of the possible solutions would actually assist their company's sustainability.
11. Identify the number of pollution control mechanisms in place.
12. Coming from the oral interviews thirteen factors that influence environmental sustainability were stated and participants had to indicate to what level each of the factors is being applied.
13. Lastly, space was provided for participants to add a process flow diagram/s for their companies especially indicating strategies or devices in place for pollution control.

3. Results and Discussions

This section presents and discusses the responses from the 12 companies. The first and second question indicated the highest qualification and position in the organisation of the respondent representing each company. The result showed an almost equal distribution on the levels of the highest qualifications and position in an organisation of the specific respondents. This however did not affect the results because all respondents ideally consulted with different relevant departments in filling in the questionnaire. The specific individual used by each organisation to fill in the questionnaire largely depended on the size of the company. Generally, in small companies people in the top management filled in the questionnaires, in big companies middle management was used to fill up the questionnaires and in 1 case an operational employee filled in the questionnaire. The general sizes of the companies were measured by the number of employees.

The raw material that is common to all the companies is scrap metal. These are mostly purchased from local vendors and mines. Other main raw materials include ferro-alloys, pulverised coal and gases and are all purchased locally. With the current state of the country's economy all the companies are not functioning to their individual full capacity. So a question was asked for the companies to state at what capacity they are currently functioning at. Three companies (labelled 4, 5 and 6) were not at liberty to disclose monetary details hence it was not possible to clearly determine at what capacity they are functioning at currently. Figure 1 shows the individual current capacity and the average capacity the steel industry is currently operating at. The average capacity for the industry for the participating companies was 31%. The notation *a* to *i* has been used since this graph shows a reduce list of companies compared to the full set.

To put this into context, capacity utilization in the United Kingdom was 84.70% in 2017 and 83.60 % for the European Union [4]. This clearly shows that the Zimbabwe steel industry is currently operating at very low capacity and this presents a challenge for financial sustainability. This is even lower compared to 81.5% industry utilisation for South Africa and even lower than the 48.5% utilisation in Nigeria [4]. Data on continuously-cast steel output for the years 2013 to 2015 for three countries in Europe and two top African countries were acquired from the World Steel Association [5]. This served as an indication on the capacities at which other steel industries in the world are operating at. Table 1 shows the data. The other steel industries in the identified countries are all operating at nearly 100% capacity while the Zimbabwean industry is struggling at about 31%. This shows how important it is to look at sustainability if the industry is to survive.

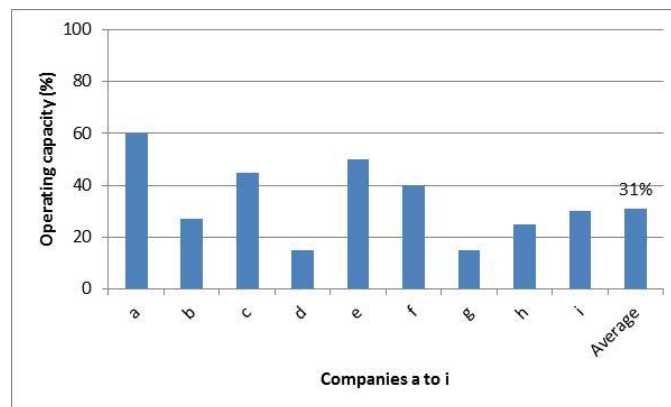


Fig. 1. Zimbabwe steel industry average current functioning capacity

Table 1. Average functioning capacity of other steel industries in the world (WSA 2016)

	2013	2014	2015	Average
Belgium	100.0	100.0	100.0	100.0
Italy	95.0	94.2	94.3	94.5
Spain	97.8	97.8	98.2	97.9
Egypt	100.0	100.0	100.0	100.0
South Africa	99.7	99.5	99.4	99.5

Data on how much is spent on energy and water bills was collected as well. The main sources of energy for the companies are electricity, coal and gas. Figure 2 shows the normalised data comparing the expenses at current capacity with 100% corresponding to the largest resource electricity consumption cost reported at \$70,000 per annum. Taking into account an energy cost of approximately \$0.08/kWh of electricity this is equivalent to 875,000 kWh consumption per annum. Companies 4, 5 and 6 did not supply data. Companies 3, 8, 9, 10, 11 and 12 do not have water bills because they have boreholes at their properties which are used to supply water for their work. This is a good and important development for companies operating in a demanding economic environment. Company 11 uses gas in addition to electricity. Only two companies reported the use of coal as a source of energy too. Figure 2 shows that electricity use dominates the identified resource costs for the companies.

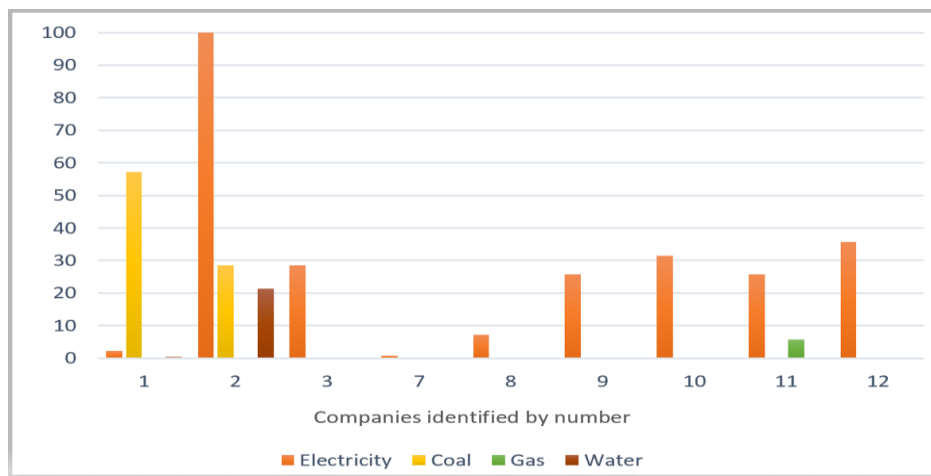


Fig. 2. Normalised resource expenditure of energy, water, coal and gas at current capacity

The next section in the questionnaire looked at the challenges that the whole industry is facing and the possible solutions. The initial interviews generated eight challenges and five possible solutions that were revealed in the questionnaire. The respondents were presented with this list of challenges from the pilot study and then asked to indicate the extent to which each of the factors has affected their organisation. The results are shown in Figure 3. Cash shortage and import and export policies proved to be the biggest challenges for all the companies. However, lack of foreign investment, loss of local and foreign markets and advance payment of taxes are affecting business too since the lowest percentage to agreeing that a challenge is affecting each company is 80%. The respondents had to also indicate to what extent they agree with possible solutions. The results are shown in Figure 4.

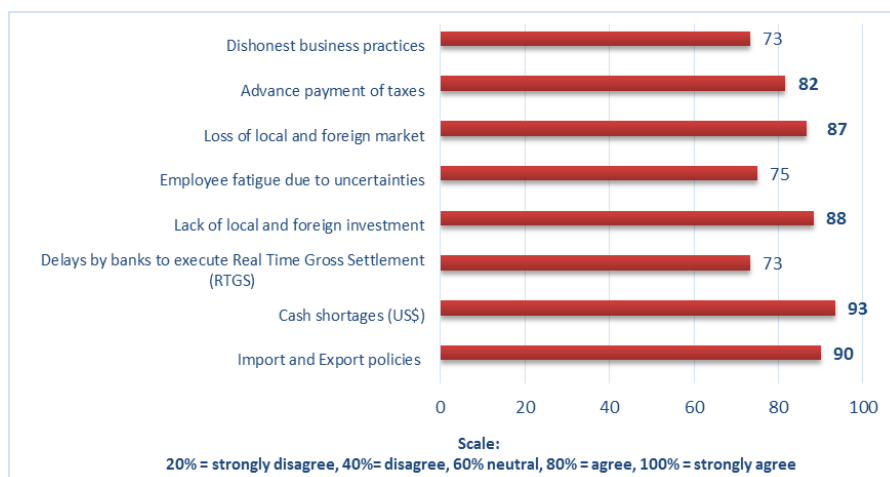


Fig. 3. To what extent does each of these factors are affect the organization?

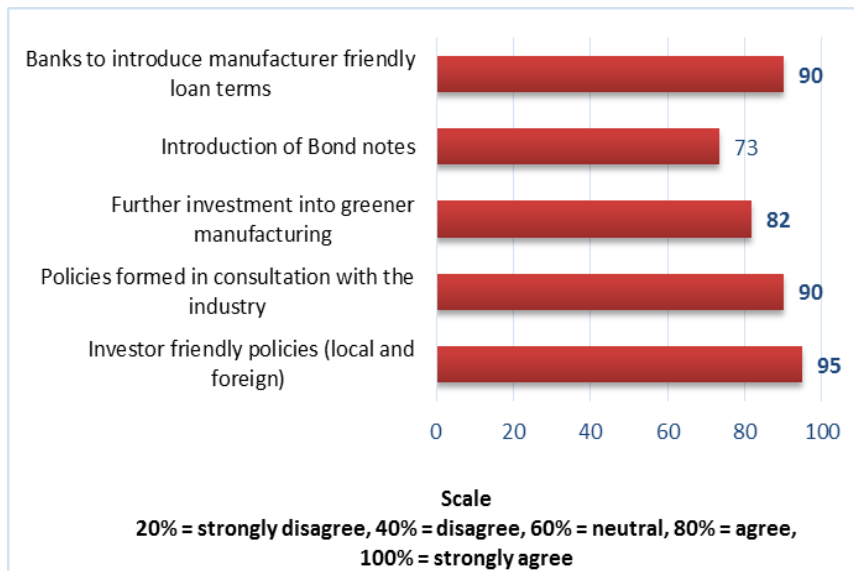


Fig. 4. To what extent would each of these help sustainability?

The results show that almost all companies agree unanimously that improvement of both local and foreign investor policies, policies formed in consultation with the industry, investor friendly loans and investment into green manufacturing would increase chances of industry sustainability. The lowest agreement percentage is for introduction of bond notes at 73% in this case too, indicating that the other four proposals are perceived to help the industry. These results point to the fact that most companies agree with the suggestions that came out of the initial interviews. There is one company that strongly disagreed with the introduction of bond notes as a possible solution. This is because the company mainly deals with international business so the introduction of bond notes that are only used locally will not alleviate their problems. But holistically, presented here are the main challenges facing the Zimbabwean industry as a whole and the five possible solutions that would assist in economic sustainability of the industry which will in turn encourage companies to improve the environmental and social aspects of sustainability.

Four additional points were stated as possible solutions. Looking at them closely shows that they are supported by policies that are formed in consultation with the industry. The four points are.

- Resuscitation of the biggest parastatal that produces steel from pig iron. It could be assumed that this will be made possible by the introduction of investor friendly policies, local and foreign.
- Add foundry products on controlled imports
- Adjust electricity charges on companies with induction furnaces
- Encourages use of other foreign currencies in addition to the US dollar

Of great importance as well is the environmental sustainability. So respondents were asked to state how many pollution control strategies they have in place. Table 2 shows the results.

Table 2. How many pollution control strategies/devises do you have in place?

Number of pollution control strategies	1	2	3	4	5 or more
Number of Companies	5	4	1	1	1

It is encouraging that even in a harsh economic environment the companies have at least one mechanism in place to care for the environment. This number really depends on the process of each company. They were also requested to draw a process outline of their company highlighting the areas where these mechanisms are in place. Six companies drew this and one only highlighted the mechanisms for caring for the environment in place. The other five did not, but such will encourage them to look into the matter and do more about it. From the interviews thirteen factors that may influence the environmental sustainability were identified. In the questionnaire the companies were asked to point out the ones that are being applied in their companies by strongly agreeing or strongly disagreeing. In as much as the question was looking at the current mechanisms in place for environmental sustenance the companies also identified other mechanisms that may be applicable to them. The results are in Figure 5. The main common mechanisms include improving processes to use less energy (this is expected since energy costs dominate inputs), environmentally friendly machinery and operating foundries at levels to minimise emissions. The other sustainability solutions identified in literature are not yet realised in the companies. Publicising these solutions will help inform the companies so that they can have many options and tools at their disposal. From the study the companies are showing their willingness to apply different other environmentally friendly mechanisms in addition to what they may already have in place. This shows that there is great potential for environmental sustainability.

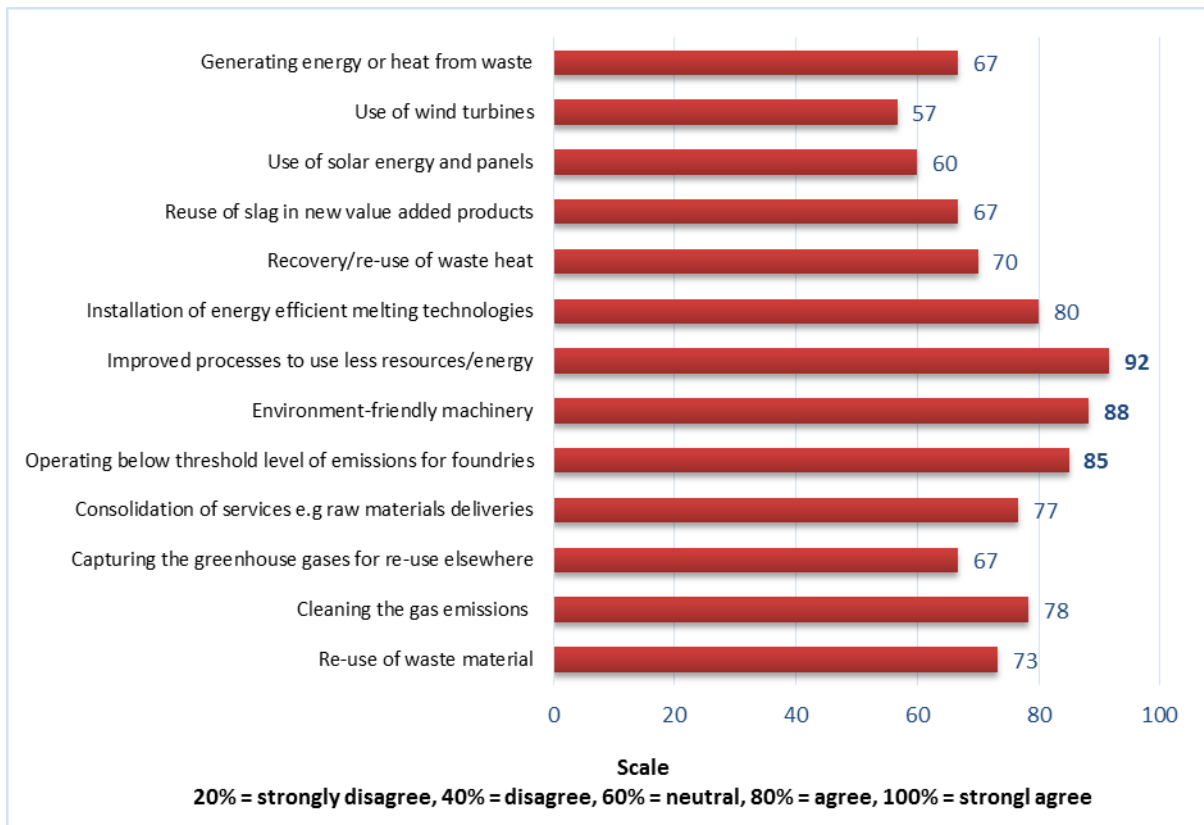


Fig. 5. To what extent would each of these help sustainability?

4. Conclusions

This work investigated the steel related industry in Zimbabwe in a period of economic challenges, the following emerged.

- The steel industry in Zimbabwe is operating at a very low capacity when compared to international company utilisation or the operating capacity of steel production in other countries.
- The cost of electricity is a dominant input cost of the companies. National effort to reduce electricity cost or development of local electricity generation capacity could help economic sustainability.
- A significant number of the companies are addressing the challenges of reliable supply of water by harnessing ground water through borehole facilities.
- A number of methods to improve the environmental sustainability of steel making operations were reviewed and it is noted that there are still a lot of potential for companies to apply the range of green technologies.
- There is a strong indication that a preferred option is involving industry stakeholders in solving the problems facing the industry.

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