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Mandatory and voluntary waste management practices of selected mining firms in South Africa: a review of literature

Abstract

This paper reviews literature on the waste management practices of selected South African mining firms. Mining firms are used in this study, given the nature of their operations. Most studies on waste management have focused on the mandatory waste management practices rather than those that are voluntary. Statutory requirements have ensured full compliance with legislation. The advent of the JSE SRI has played a significant role in promoting environmental consciousness among firms. As such, the paper explores existing literature and company documents and analyzes the waste management practices of the selected firms, both mandatory and voluntary, based on the firms' market share by revenue. International frameworks, guidelines and standards are used as a yardstick of comparison. The paper finds that most mining firms have adopted voluntary waste management practices due to their concern for stakeholders and potential financial benefits, while the mandatory waste management practices are the result of strict regulations, reputation and potential financial losses. The paper recommends that mining firms adopt more voluntary waste management practices and calls for further study to add to the existing body of knowledge in this field.

Keywords: JSE SRI, market share, mining, South Africa, waste management practices.
JEL Classification: M11, M41.

Introduction

Mining firms have always been synonymous with waste production (Mineral Policy Institute, 2012). At a community and local level, mining operations constitute an environmental and ecological problem (Evangelinos and Oku, 2006; Garvin et al., 2009; and Mutti et al., 2011). To curtail the waste management problems faced by these mining firms, there is a need for mining firms to adopt waste management practices into their corporate agenda. Currently, waste management practices by South African mining firms are borne out of the need to comply with regulation. Firms are now steadily adopting voluntary waste management practices but little evidence in the form of scientific study exists to show the extent of this voluntary adoption.

This paper aims to evaluate current waste management practices in selected South African mining firms, with specific focus on mandatory and voluntary waste management practices. Using a review of literature and company documents, the paper analyzes and describes current waste management practices and offers recommendations for further study into the waste management practices of mining firms in South Africa. Therefore, this paper attempts to fill a gap in literature and stoke heightened interest for further study into this area.

1. Literature review

1.1. Waste related problems of mining firms. According to the Mineral Policy Institute (2012), waste generated by mining operations includes tailings, which cause catastrophic damage to the environment and affect multitudes of ecosystems when such disaster occurs. Other issues such as discharge of mining effluent, unrehabilitated mining sites, tailings dam failures and waste seepage from these dams pose a great long-term ecological problem (Franks, 2007; Spitz and Trudinger, 2009; Fourie, 2009; Franks et al., 2011). Hilson and Murck (2001) argued that extracting ore from the ground inevitably leads to issues such as habitat damage, erosion and sedimentation. They further added that gold mining operations, which were at the heart of their study, resulted in two critical environmental problems; acid mine drainage and cyanide contamination. Mining waste, waste from processing operations and metallurgical waste are a huge source of pollution and constitute a serious ecological problem, with far reaching consequences (BRGM, 2001; Lottermoser, 2003; Chan et al., 2008). In China, an emerging economy, the need for coal to provide energy has created environmental problems (Haibin and Zhenling, 2010). Currently, coal mining and its resultant waste have become the leading cause of pollution in China (Haibin and Zhenling, 2010). Waste problems noted by Haibin and Zhenling (2010) include coal bed methane, coal slime, coal gangue, fly-ash and coal mine drainage. Bian et al. (2010) further argue that coal mining creates environmental problems through land subsidence, mining waste disposal, damage to aquatic systems and air pollution. Another waste related problem occurs when humans come into contact with metallic pollutants, which are scattered in the atmosphere from mine sites (Ghose and Majee, 2000; Sanchez de la Campa et al., 2011). Sanchez de la Campa et al. (2011) further argue that mining activities have always been looked at as major contributors to environmental degradation and pollution by affecting natural waters and soils. In their studies, Spiegel (2009) and Spiegel and Veiga (2010) highlighted the impact of mercury pollution, which is a serious waste problem. Spiegel (2009) showed that the resultant mercury pollution was due to the processes used in artisanal and small-scale mining, which is relatively common in Sub-Saharan Africa. Moors and Dijkema (2006) showed that waste problems related to Zinc mining, which was at the heart of their study, included production of jarosite waste and the release of sulphur dioxide subsequent to the production of sulphuric acid.

A study of the environmental costs of platinum and platinum group metals (PGM) was carried out by Glaister and Mudd (2010). Supported by researchers such as Curtis (2008), Rajak (2008), Mnwana and Akpan (2009), Glaister and Mudd (2010) indicated that PGM mining allegedly resulted in negative environmental impact such as water pollution. Investigating tailings management in Gold mines, (Ritcey, 2005) mentions that tailings pose an environmental issue for mining firms. Amongst the biggest environmental threats, Ritcey (2005) brings to the fore two waste issues; solid and liquid effluents. The solid effluents may harbor sulphides which in due course, degrade into acids and subsequently, create an environmental hazard of acid discharge. Liquid effluents on the other hand, include Arsenic, Cyanide and metal-cyano complexes which are harmful toxins to the environment Ritcey (2005). Small scale gold mining in Papua New Guinea faced similar waste problems as reported in other small scale and artisanal gold mines overseas (Crispin, 2002). Crispin (2002) reported that the environmental and waste challenges posed by these small scale mines included Mercury use and its subsequent discharge and general physical environmental damage.

Salomons (1995) argues that while mining operations generally affect localized areas, their impact on the local environment can be quite huge due to waste related problems like acid mine drainage and attrition of tailings deposits and waste dumps. Macedo et al. (2003) studied environmental management in the Brazilian non-metallic small-scale mining sector. They reported that in spite of a lower degree of damage, the environmental impacts and waste from non-metallic mining firms are broader than those of conventional metal mines and fuel mining processes. Klukanová and Rapant (1999) conducted two in depth case studies on the effect of mining activities on the environment of The Slovak Republic. Independent studies of mining activities in the Banská Stiavnica – Hodruša metal ore district and the Handlová – Cígel' brown coal district revealed that waste generated by mining operations ended up contaminating the local aquatic environment through the discharge of highly toxic mineral waste stored in tailings dams and damps, which ended up in groundwater and surface water (Klukanová and Rapant, 1999).

Luis et al. (2011) examined the environmental effects of an abandoned mine, the Lousal mine in Portugal. They discovered that the waste disposed in the tailings formed acid mine drainage (AMD), which ended up being the primary pollutant of water sources in the Lousal area. Similarly, Loredo et al. (2006) also studied the effects of toxic metals and metalloids on the environment in an uninhibited Mercury mining area in Spain. They discovered that the waste resulting from mining operations accumulates and forms acids, which pose an environmental threat to surface and groundwater systems. Concas et al. (2006) investigated the movement of heavy metals from tailings to stream waters in a mining polluted site. The major waste concerns highlighted where metal contamination and acid mine drainage (AMD), which ended up polluting water sources. Feng et al. (2006) studied the effects of gold mining related mercury contamination and discovered that large-scale, long-term gold mining activities using Mercury amalgamation processes resulted in serious local environmental Mercury pollution as a result of the release of unused Mercury in to the open environment. Edinger et al. (2008) studied heavy metal pollution as a result of Gold mining in a region in Indonesia. They singled out Arsenic and Mercury as the two principle waste problems which led to contamination.

According to Dondeyne et al. (2009), artisanal mining in central Mozambique poses an environmental challenge through the release of waste and siltation of rivers and other water bodies. Waste from artisanal mining posing a threat to the environment includes Mercury, Arsenic, Cadmium, Copper, Chrome, Lead and Nickel. If released into ground and surface water, these metals pose a major health and ecological concern (Dondeyne et al., 2009). Yellishetty et al. (2009) studied the extent of metal concentrations and metal motion in Goa, India. They argued that due to the presence of heavy metals such as Iron, Manganese, Lead, Cadmium, Copper, Chrome and Nickel, the waste generated by the mining actives was susceptible to forming acids, which would in turn pollute ground and surface water systems. Huang et al. (2010) carried out an evaluation of the environmental impact of mining activities on the surface water quality in Tibet. They concluded that waste deposits containing heavy metals such as Lead, Copper and Zinc where more likely to leak and contaminate downstream water sources, as a result of erosion of particulates and seepage of waste water. Horvath and Gruiz (1996) studied the impact of metallic ore mining on the environment in region in Hungary. They observed that the water samples, waste materials, Soils and plants measured around the region where contaminated with heavy metals, proving another waste challenge as a result of mining operations.

1.2. Mining firms and waste in South Africa. The mining industry adds significantly to South Africa's gross domestic product (GDP) (South African government, 2012). It is therefore not surprising that the challenges faced by South African mining firms are similar with those faced by mining firms within Africa and overseas. Naicker et al. (2003) studied the effects of acid mine drainage arising from gold mining in Johannesburg, South Africa. They concluded that the mining activities in the study region did indeed affect the overall aquatic environment through altering the pH of the water, leading to a negative impact on aquatic life. Winde and Van der Walt (2004) carried out a case study of a gold mining site in South Africa with the aim of investigating the implication of groundwater – stream exchanges and shifting stream chemistry on waterborne uranium pollution of streams. They concluded upon analyzing water and sediment samples in the study region that gold and uranium slimes dams where the primary source of waterborne stream contamination as a result of the waste seeping into groundwater systems. Tutu et al. (2008) studied the chemical effects of acid mine drainage (AMD) in the Witwatersrand basin, South Africa. They indicated that pollution was mainly as a result of disused gold mine tailings dumps which eventually caused seepage into groundwater plumes, which subsequently flowed into perennial streams.

In a recent study, Durand (2012) examined the impact that gold mining on the Witwatersrand had on the rivers and karst system of Gauteng and North-West Provinces in South Africa. Durand (2012) focused on mining waste problems prevalent in the gold mining industry; problems that included acid mine drainage (AMD), sulphate discharge, metal run-off, radioactivity and Cyanide pollution.

2. International policies, frameworks and standards governing waste management

There are numerous international conventions, policies, protocols and standards with regards to waste management. This paper focuses on three frameworks, relevant to the study in question. They are the Carbon Disclosure Project (CDP), International Organization for Standardization (ISO) 14001: 2004 (Environmental Management Systems) and the Global Reporting Initiative (GRI) guidelines and framework.

2.1. Carbon Disclosure Project (CDP). The Carbon Disclosure Project (CDP) is a voluntary self-reporting project introduced to allow for companies to address the problem of climate change and investors to address the risks involved with their investments. The CDP envisages a situation of efficient resource utilisation to ensure long-term sustainable development with environmental protection at the forefront (CDP, 2013).

The CDP uses measurement and disclosure to advance the managing of environmental threats and through leveraging investors, customers and authorities, it has been able to give incentives to organizations across the largest global economies to report and measure their environmental data. The CDP holds the largest global collection of reports on climate change, forest and habitat risk and water data. This is all based on voluntary self-reports by the companies that ascribe to this initiative. This allows investors and other stakeholders to be better informed to make sound investment decisions that have a long way in providing for a sustainable world going into the future (CDP, 2013).

2.2. The Global Reporting Initiative (GRI) guidelines. The non-profit Global Reporting Initiative (GRI) was established in 1997 to help foster sustainable development and transparency in all aspects of economic, social and environmental development. The G4 guidelines are the most recent guidelines issued by the Global Reporting Initiative (GRI). These sustainability reporting guidelines are the cornerstone of the GRI's reporting framework (GRI, 2012). Organizations are expected to voluntarily use these performance indicators to measure their individual sustainability reporting areas of economic, social and environmental disclosures. This paper focuses on the environmental indicators that have a direct impact on waste management. These guidelines are EN22, EN23, EN24 and EN25 (GRI, 2012).

These guidelines relevant to waste management are in more detail in the table below.

Table 1. GRI waste management guidelines (GRI, 2012)

EN22	requires organizations to disclose their waste type and methods of disposal
EN23	calls for organizations to report their complete number and volume of any significant waste spills
EN24	encourages organizations to describe the weight of conveyed, exported, imported or treated waste that is considered hazardous and the percentage of such waste transferred internationally

Table 1 (cont.). GRI waste management guidelines (GRI, 2012)

EN25	calls for organizations to disclose the identity, scope, protected status and ecological worth of water bodies and associated environments significantly affected by the organization's expulsions of water and runoff

2.3. ISO 14001:2004. The ISO 14001 standard was drafted by an expert technical committee within the ISO. It aims to standardize environmental management systems worldwide (ISO, 2004). Within the standard, there is a request for organizations to adopt an inclusive environmental management system that permits organizations to meet progressively stiff legislation while also meeting their economic and environmental objectives (ISO, 2004).

3. Policies, legislation and frameworks governing waste management in South Africa

There are many policies, legislative and strategic frameworks governing waste management in South Africa (Enviropaedia, 2012). According to Enviropaedia (2012), South Africa has numerous Acts that affect waste management and related issues. Some of these Acts in question include:

- The Hazardous Substances Act (Act 5 of 1973).
- The Occupational Health and Safety Act (Act 85 of 1993).
- The South African Constitution (Act 108 of 1996).
- The Municipal Structures Act (Act 117 of 1998).
- The National Environmental Management Act (Act 107 of 1998).
- The National Water Act (Act 36 of 1998).
- The Municipal Systems Act (Act 32 of 2000).
- The Mineral and Petroleum Resources Development Act (Act 28 of 2002).
- The Health Act (Act 63 of 2003).
- The Air Quality Act (Act 39 of 2004).
- The National Environmental Management: Waste Act, 2008 (Act 59 of 2008).

Other appropriate frameworks include the Draft White Paper on Integrated pollution and Waste Management for South Africa issued in 1998. Of relevance to this paper are the South African Constitution (Act 108 of 1996), Draft White Paper on Integrated Pollution and Waste Management for South Africa (1998), National Environmental Management Act (Act 107 of 1998), Mineral and Petroleum Resources Development Act (Act 28 of 2002), Air Quality Act (Act 39 of 2004) and the National Environmental Management Waste Act 59 of 2008 and the National Waste Management Strategy (2011).

3.1. The South African Constitution (Act 108 of 1996). The supreme law of South Africa, the constitution sets out under the Bill of Rights in subsection 24 that South Africans have a right to an environment that is not detrimental to their health and well-being and that this environment ought to be preserved for current and future generations through legislation and other means.

3.2. The Draft White Paper on Integrated Pollution and Waste Management for South Africa (1998). Developed as a guideline policy for public and private implementation, the Draft White Paper on Integrated Pollution and Waste Management for South Africa (1998) set out to help South Africa develop a comprehensive policy regarding pollution and waste management. According to the South African government (1998), their aims through this white paper are to:

- promote the prevention and minimization of waste generation and hence pollution at source;
- promote the management and minimization of the impact of unavoidable waste from its generation to its final disposal;
- ensure the integrity and sustained "fitness for use" of all environmental media, i.e. air, water and land;
- ensure the remediation of any pollution of the environment by holding the responsible parties accountable;
- ensure environmental justice by integrating environmental considerations with the social, political and development needs and rights of all sectors, communities and individuals.

This draft white paper has been updated and merged into the National Waste Management Strategy (2011).

3.3. The National Environmental Management Act (Act 107 of 1998). Under this Act, The national environmental management principles stipulate in Sec 2 subsection (2) that environmental management must put people and their needs at the forefront of its concerns and further calls for all measures of development to be undertaken in a sustainable, economical and environmental manner (sec 2 ss [3]). Crucially in Section 4 (ss 1, 2, 3 and 4), the Act stipulates that pollution and degradation of the environment, disturbance of heritage sites and landscapes and waste are avoided or minimized and remedied if possible. This act has since been replaced with the National Environmental Management Waste Act 59 of 2008.

3.4. The Minerals and Petroleum Resources Development Act (act No. 28 of 2002) [as amended]. Of relevance to this research is the Minerals and Petroleum Resources Development Act (South Africa, 2002). Under chapter 2, part III of this act, sections 51 and 52 call for mining firms to have an environmental management program and environmental management plan respectively. A key area under these sections is the need for mining firms to provide for financial costs to rehabilitate the environment after cessation of mining operations as well as providing for costs to mitigate environmental disasters should they occur. Section 54 stipulates the quantum for financial provisions and has stipulated that the following costs need to be provided for, subject to the Department's revision from time to time:

- premature closure costs;
- decommissioning and final closure costs;
- post closure management of residual and latent environmental impacts.

3.5. The Air Quality Act (Act 39 of 2004). The objective of this Act is to ensure that the environment in protected by providing rational measures for the deterrence of air pollution and environmental degradation, the protection and enhancement of air quality in South Africa and fortifying environmentally sustainable development while fostering economical and social development. Hence, waste management practices by mining firms ought to fall in line with the requirements of this Act.

3.6. The National Environmental Management Waste Act 59 of 2008 (the Waste Act). The Act is primarily responsible for governing the management of waste and other waste related aspects. In quoting from the Act, the objectives of this Act include:

"to protect health, well-being and the environment by providing reasonable measures for:

- minimizing the consumption of natural resources;
- avoiding and minimizing the generation of waste;
- reducing, reusing, recycling and recovering waste;
- treating and safely disposing of waste as a last resort;
- preventing pollution and ecological degradation;
- securing ecologically sustainable development while promoting justifiable economic and social development;
- promoting and ensuring the effective delivery of waste services;
- remediating land where contamination presents, or may present, a significant risk of harm to health or the environment;
- achieving integrated waste management reporting and planning;
- to ensure that people are aware of the impact of waste on their health, well-being and the environment".

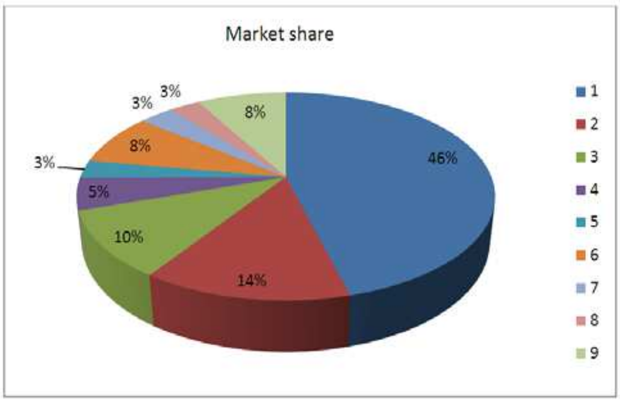
3.7. National Waste Management Strategy (2011). As one of the requirements of the National Environmental Management Waste Act 59 of 2008, the strategy calls for all sections of South African society to embrace a comprehensive and contemporary approach towards waste management, mining firms included. The strategy has laid out a series of goals and objectives as well as mechanisms necessary for the implementation of the strategy (Department of Environmental Affairs, 2011). South African mining firms, which fall under the private sector, are expected to take responsibility for any waste generated by their operations by adopting proactive and comprehensive mechanisms.

4. Methodology

The study used a review of literature and company documents as a method of analyzing South African mining firms' adherence to international waste management practices and guidelines vis-à-vis CDP, GRI guidelines and ISO 14001. This paper places specific focus on selected Johannesburg Securities Exchange (JSE) listed mining firms, all of which are ranked highly on the JSE's Socially Responsible Investment (SRI) index. These firms have been selected due to their reputation with regards to environmental responsibility and the relative ease of accessing their environmental data. They have consistently produced environmental reports, using mandatory legislation and the voluntary guidelines as a basis for their reporting.

Nine mining firms were used in the study, representing the entire mining firms in the SRI of 2011. Pseudonyms were adopted instead of real names for commercial confidence reasons. The mining firms were: ABC Ltd, DEF Ltd, GHI Ltd, JKL Ltd, MNO Ltd, PQR Ltd, STU Ltd, VWX Ltd, YZ Ltd.

The mining firms are involved in various extractive actives ranging from Gold mining to coal and iron ore extraction. Their size based on market share is depicted in the figure below.



Source: Author.

Fig. 1. Market Share of the firms

The study places emphasis on the market share of firms in the study to depict firm size. Market share is an important measure. According to Hall (1987), a firm that expands its market share sees an increase in profitability as well. O'Regan (2002) contends that market share is a gauge of not only financial success, but also a crucial institutional goal. Our market share in the study was based on the revenue market share, calculated as: revenue/total market revenue*100% (Boundless, 2014).

The current waste management practices of South African mining firms are shown in Table 2 below. These waste management practices were compiled from the various company annual, integrated and sustainability reports over a five year period from 2007-2011. These reports were reviewed based on the company disclosures on their waste management practices.

Table 2. Current waste management practices in selected South African mining firms

Current waste management practices
Mineral and non-mineral waste disposal
Mineral residue control
Dust control
Cyanide control
Acid Mine Drainage (AMD) control
Hazardous waste control
Air quality monitoring and control
Waste recycling
Cleaner production
Landfilling

These waste management practices are borne out of both mandatory and voluntary regulation. The table below shows the compliance with selected international frameworks and guidelines, legislation, financial motives and voluntary stakeholder concern.

Table 3. Compliance with mandatory legislation and voluntary waste management guidelines

Company	GRI guidelines	IS0 14001	Carbon disclosure project	Legislation	Voluntary stakeholder concern	Financial motives
ABC	YES	YES	YES	YES	YES	YES
DEF	YES	YES	NO	YES	YES	YES
GHI	YES	NO	NO	YES	YES	YES
JKL	YES	YES	YES	YES	YES	YES
MNO	YES	YES	YES	YES	YES	YES
PQR	YES	YES	YES	YES	YES	YES
STU	YES	YES	NO	YES	YES	YES
VWX	YES	YES	YES	YES	YES	YES
YZ	YES	YES	YES	YES	YES	YES

5. Discussion

At first glance, the selected South African mining firms tend to have similar waste management practices as shown in Table 2. This is due to legislation and pressure from stakeholders. These waste management practices are well disclosed in the company integrated or sustainability reports. These international guidelines are voluntary in nature and the selected mining firms are taking the lead in adopting these guidelines. As shown in Table 3, 100% of the mining firms in the study reported in line with GRI guidelines.

89% of the companies mentioned the ISO 14001 standard in their waste management practices. 67% complied with the reporting standards from the CDP. All firms were in line with the legislation. Interestingly, out of concern for all stakeholders, the mining firms adopted some voluntary waste management practices. They also felt that there were potential financial implications out of adopting sound waste management practices hence all the firms complied with waste management legislation. Conventional waste management legislation has focused on issues such as AMD and landfilling but voluntary waste management practices has allowed the mining firms to initiate waste management practices such as recycling. From the above, it can be said that South African mining firms are striving to adhere to voluntary waste management practices.

The review of literature above clearly shows that these mining firms are taking the lead in adopting voluntary guidelines and self-regulatory frameworks that enhance their waste management practices and disclosure thereof. There are potential environmental and other implications as a result of non-compliance with the guidelines. For instance, non-adherence to the GRI EN22 can result in reduced confidence in organizational legitimacy by local communities. Non-adherence to EN23 can result in loss of goodwill from communities, lack of investor confidence and pressure from authorities. Aside from this, degradation of local ecosystems can occur as well. With regards to EN24, non-compliance can result in probable litigation to the responsible organization as well as damage to the environment through the hazardous waste. A lack of compliance with EN25 has potentially serious implications with regards to waste water runoff contaminating local ground and surface water, also resulting in potential litigation and loss of trust and goodwill amongst stakeholders.

The relationship between the firms' market share and their compliance has shown interesting results. Previous studies such as (PWC, 2011) have shown that this relationship forms an important part of investor relations. An increase in market share results in an increase in profitability, which is a target for all investors. However, increasing scrutiny by authorities and various environmental watchdogs, coupled with the global downward economic trend from 2008 meant that the costs of voluntary and mandatory compliance have gradually increased across the years. In the study all the firms representing 100% had disclosed in their integrated and sustainability reports that they complied with mandatory and voluntary regulations due to financial motives, hence indicating that their market share had some impact on their mandatory and voluntary regulations.

Limitations

This study reviewed existing literature on waste management practices and adds some insight into studies related to this field. It was based on secondary, existing literature. The firms used were only a fraction of the entire mining firms listed and unlisted on the JSE. As such, the findings based on the review of the literature and company reports cannot be generalized across the entire South African mining industry.

Contributions to knowledge

This paper reviewed literature on waste management practices in selected South African mining firms. There has been no previous study that has embarked on determining whether South African JSE SRI listed mining firms have been adopting both mandatory and voluntary waste management practices. Further study is needed to provide more insight into what drives the waste management practices of mining firms across South Africa and other emerging economies. Quantitative study is needed to show if the waste management practices of these mining firms have any impact on firm performance, which could be a potential driver.

Conclusion

Concerted efforts are needed by firms and other stakeholders to reduce the negative impact of waste on our fragile environment. Although voluntary at this stage, the CDP, GRI guidelines and ISO 14001 should be encouraged and adopted by all organizations regardless of sector, as they provide a sustainable approach to waste management and this can only result in potential economical, environmental and social benefits for organizations in the long-run.

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