



Investigation into Industrial Mining Challenges and Effects

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ABSTRACT

Mining industry is one of the most recognizable sectors worldwide due to its economic prominence and dominance. It is the ultimate and indispensable pillar for almost every country's economy. It contributes greatly to economic growth. This paper however aims at giving the panorama of challenges encountered in industrial mining sector. The sector encounters among others various adversities such as HIV/AIDS epidemic, mechanical, environmental and economic challenges. The paper instils these adversities that may discredit the reliability on this sector. It is however important to note that these adversities can contribute towards land, vegetation, water, animal, human life degradation as well as the sustainability of the sector. The paper outlines and explains each challenge in detail rather than controlling them. The compensatory measures were deferred for further study.

Keywords: *Mining Industry, Climate change, HIV/AIDS, Control challenges, Stiction & Friction*

1. INTRODUCTION

Extraction of minerals has long been practiced by many countries, dating back from earliest. As mining sectors evolved with time, more advanced, secure and efficient methods of excavating as well as extraction of minerals were realized and implemented. These methods are used widely across the world. Developed countries were however, at the forefront in adoption of these technological advancements compared to developing countries. The methods helped in excavating well-known minerals across the world - coal, silver, gold, diamond etc. Moreover, nations have different levels of resources i.e. some nations have more minerals than others therefore some nations have a comparative advantage to other nations. The methodologies implemented are subjective and dependant of the land topology as well as the economy. For instance an open - pit is less risky, cheaper to implement than shaft mine [1]. In some developing countries most of the government revenues are generated from the mining sector as a result of high taxation based on lucrative commodities. Tax revenue from mining sector has created job opportunities in other sectors such as education, health and defence hence significant improvement on the economic welfare of local people and the nation as a whole. Mining industry is one of the most decipherable sectors worldwide due to its economic prominence and dominance. It is the ultimate and indispensable pillar for almost every country's economy. It contributes greatly to economic growth. This paper was inspired by a clear determination to oust challenges discrediting the credibility of this sector.

2. CHALLENGES

2.1. Climate Change

Climate change is a stern condition of distress. Human kind contributes immensely on the climate machinations thereby a

huge nemesis to climate. In general their works have proved destructive. Where there is mankind, a great deal of adverse effect can always be expected. Damages include deforestation, water and air pollution etc. These lead to variety of effects like poor ventilation systems, water and air inter - related diseases i.e. diarrhoea, breathing or lung problems - asbestosis, silicosis and pneumoconiosis from inhalation of poisonous gases, heat stroke caused by penetration of the ultra violet rays through the ozone layer as result of global warming. Global warming continues to be a huge threat to the ecological systems. Gas emissions (i.e. carbon monoxide (CO)) from huge excavating and processing machinery form a layer on the ozone, creating a sheet that traps hot air inside the atmosphere zone equally polluting atmospheric air. This also referred to as the greenhouse effect. Thus, mines emit greenhouse gases into the atmosphere [2]. Effects of climate change have been at the heart of nations mainly because of their adversities. Formation of acid rain is one of the major effects of climate change. Acidic rain corrodes everything that comes in contact with (metals and buildings), living organism's health and marine life deteriorates.

2.2. Natural Disasters

Earth quakes used to just happen without any prior warnings - thanks to modern technologies that they can be detected and safety measures executed. In cases where they are not detected, catastrophes and mayhem are definitely witnessed. Unfortunately miners (or anyone) at that juncture may lose their life, get life threatening injuries, get trapped and so forth. There are lots of natural disasters such as floods that are very deadly and some have the surprising components like storm. Mine workers have lost their lives in the past years and this shows how risky this primary sector is in terms of safety. Some of the

most recent epic catastrophes related to mining have been witnessed bearing devastating outcomes [3]. Major natural disasters appear to have severe negative short – run economic impacts and could preclude long – term economic growth, development suppression and poverty increment. In hindsight negative impacts are inevitable.

2.3. Spread of HIV/AIDS

In addition, mining areas tend to be associated with the spread of well – known epidemic HIV/AIDS disease. These areas / sites are usually far away from residential places. Thus, miners leave their families to live in places nearer to the site. Mostly men participation rate at mining sites is relatively higher than their female counterparts. Consequently, as time pass – by, they fornicate, become adulterous – cheating on their partners and spouses respectively. These behaviours often prompted by monotony are common in such areas; typical miners are well known for it. Sexual networks form a chain hence allowing the spread of diseases as indicated by the following statement, “The boom-and-bust lifestyle in mining areas has also been blamed for the spread of HIV/AIDS. A transitory work force plus a thriving sex trade in many mining areas or around mining areas, often leads to the spread of sexually transmitted diseases,” adopted from literature [4] include the effects.

2.4. Level of Skills and Knowledge

In the past, to be a miner, significant qualification were not required to be hired i.e. extreme cases one had no need to go to school to secure a place in the mining fields except for management. Hard labour was the key to excavating. Mental effort and assimilation were rather not important. However, in recent times, demand for skill, knowledgeable labour i.e. specialists, engineers and implementation of latest technological advancement is crucial to the sector. Skill and knowledge as a requirement from mine recruiters carry a special component of Experience. Most people got the knowledge without experience which creates problems on marketing and recruitment sectors to provide workforce. There are still more challenges concerning the subject matter.

For instance, mines train candidates for available and future positions before getting into the field of work. What happens in the short run? Production costs increase but in the long run the target goal is achieved i.e. productivity plus skilled staff. After training staff members the most integral part is how far can the mines keep their workers? It is indeed a contentious issue which needs close attention as well. With technology at the tip of our fingers, intelligent and quality equipment complement qualified competent professionals.

2.5. Working Capital

These could inevitably mean shortfalls incurred by the sector posing a huge problem on future development prospects. High operation costs – high labour costs and higher energy costs. More so, mining sectors are prone to economic recession as well as other various sectors and have since then from

commencement of mineral extraction and production have suffered and survived calamities. The economic downturns can or have threatened this sector to a point of closure. With perseverance and determination of the sector they somehow manage to surpass the hurdle.

2.6. Mechanical Systems

A wide range of equipment’s are used to facilitate mineral excavation, extraction and maximize quality production flow lines within the industry. Machinery include stone crushing machinery, transportation systems, drilling, boring systems, rock blasting equipment, digging machinery, measuring equipment’s, hydraulic machines and electro – hydraulic servo systems. These machineries mostly incorporate automation capabilities to perform their designated tasks. To achieve automation efficiency precise and effective optimal control algorithms are implemented to ascertain desired performance of such equipment’s. There has been a gradual growth for this sector driven by high demands of natural commodity. The proportion of growth for the sector is directly correlated to consumption around the world henceforth machinery automation. The intelligent machinery brought forth accuracy, timely deliverables and consistency in product quality. Note, intelligent machines are not there to replace men but rather aid or complement in performing a tasks. These machineries however present various mechanical hardware wear - tear and software control complexities i.e. high complexity brings greater challenges in control and understanding, as well as design. The following section focuses on the following aspects; identify mechanical control challenges, which are a major problem for the industry.

3. CONTROL CHALLENGES IN MECHANICAL SYSTEMS

The range of application for mechanical systems is diverse with inherent degree of nonlinearities. Generally all physical systems possess some nonlinearities and this has led to an increase in research on how to control adversities. There are a number of well-known issues affecting mechanical systems and the following sub – section will discuss the issues explicitly. It’s given; all nonlinearities possess a significant amount of threat and are difficult to contend with.

3.1. Backlash

The use of mechanical systems such as power trains, gears, robotic manipulator and mechanical linkages has become a widely acceptable norm on our everyday lives. More research papers and text indicate the importance of having such mechanisms. For instance, gears and power trains used for driving vehicles (gearbox transmission), converting high speeds low torque to low speeds high torques and the converse is true. Mechanical linkages provide numerous advantages including scissor lifts, ladders etc. However, gears, power trains and mechanical linkages are more vulnerable to backlash. A clearance gap between gear teeth and linkage constitutes backlash phenomenon on mechanical systems. Power

machinery affected by backlash phenomenon includes transportation vehicles, hydraulic actuation (i.e. lifts) and conveyor drive systems. Figure 1, represent the backlash

phenomenon. The region labelled indeterminate region has some hidden state of system and, it introduces the time delay between the input and output.

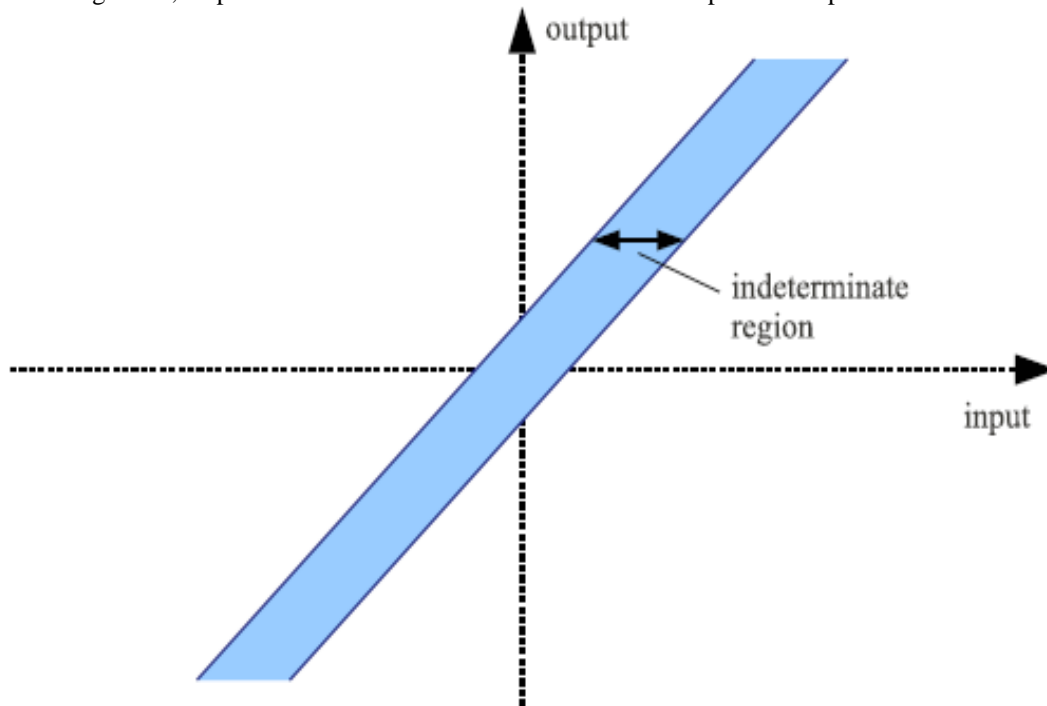


Figure 1: Input/output Position courtesy of Wescott Design Services [5]

Therefore, the ‘indeterminate region’ illustrates the relationship between the input and output of a system. It is a point of no contact between two or more interconnected components. For instance, when the running clearance is traversed by drive shaft of the DC motor, no torque is transmitted on the system [6]. At the point of contact between the traversing shaft and stationary counterpart of the system, results in a collision causing a surge response. The collision can make the system difficult to be controlled and limit cycles are inevitable. Multiple collisions in any drive system do cause jerkiness and jittery motion. The backlash effect has a negative impact on the overall system performance such as abrupt velocities, position inaccuracies and system life deteriorates faster than it normally could assume backlash free - cause a considerable amount of damage to gear teeth and linkages if remain uncontrolled.

Effects of Backlash

Backlash effects are diverse, depending on the magnitude of the lash and maximum force produced by the drive can damage and degrade the system performance. Consequently, banging or colliding of mechanical mating components leading to the following severe damages; meshed, cracked and broken gear teeth, lose and unstable joints on mechanical linkages, reduced accuracy on robot manipulators and overall system dilapidation.

3.2. Machinery Noise

Machine noise is a hazardous issue in underground mining and it imposes major health complications to miners. Miners lose

their sense of hearing. Controlling this hazard still remains a challenge in underground mining more especially where compartments are very small. Drilling and cutting processes are the main sources of noise. It is well known fact that underground areas are confined, ranging from small to large compartments. Therefore, the smaller the compartment the higher the sound level, hence controlling the impact of noise in a confined area is problematic. Earplugs are also used to lessen the impact and innovative engineering control includes replacing old with new damped machinery, mufflers and regular maintenance. These control strategies are quite expensive.

3.3. Stiction and Friction

Stiction refers to the force precluding static objects from being set to motion. Friction and stiction are inter – related as they all act on mating interfaces. Fiction is a valuable quantity in mechanical system because it makes braking cars, conveyor belts, hydraulic lifts feasible and most importantly it’s needed for walking robots (and people). Although, essential for everyday lifestyles, it possess undesirable nonlinear effects on mechanical system. It induces limit cycles to the system response, inconsistency in accuracy, performance and system degradation, and increases power consumption. For example, Figure 2 illustrates the behaviour of a system under friction / stiction phenomena. The oscillations means that the system is unstable and response signal suggests its movement is jittery or jerkiness.

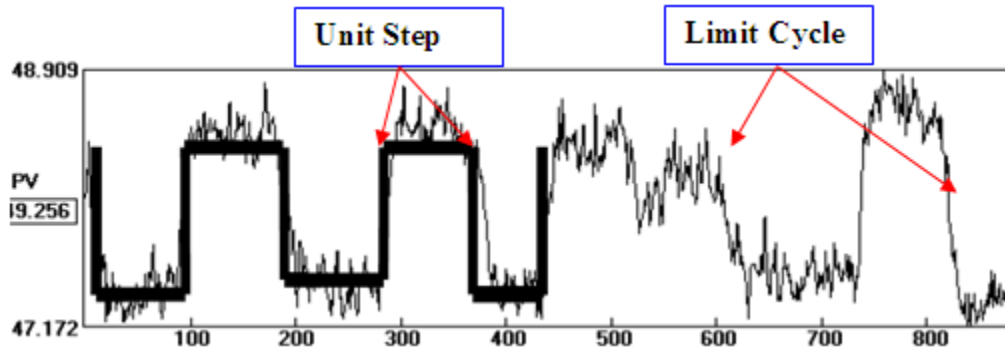


Figure 2: Response for a system with friction / stiction [7]

Friction phenomenon's have been and are still a continuous problem in all mechanical systems. The impact can be minimized by compensation using different control strategies to predict friction irregularities. In order to compensate friction, it has to be understood as a result empirical models have been

used for clarity [8, 9]. Therefore, friction phenomena can be categorized into two model groups a) static friction models and b) dynamic friction models. Unlike dynamic models small forces induce certain amount of displacement on the system. Relationship of static models is in Figure 3.

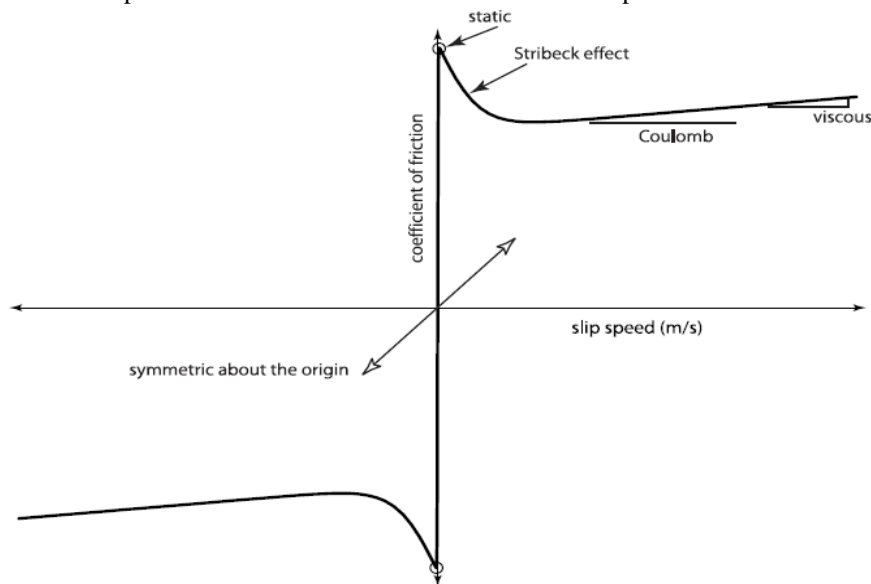


Figure 3: Characteristic of Static Friction Mode [9]

4. CONCLUSION

Mining has a firm prominence for developing and developed countries. However, they are still a number of challenging issues affecting the sector. This paper has explored and examined various issues relating to the mining industries. These examinations were the domain of this paper giving a stern backbone and coherent framework. There are still outstanding challenges for mechanical system such as sensor faults, communication faults, and other anomalies (not discussed). The most important things in the paper are; we have looked at different problems affecting or discrediting the credibility of the mining sector.

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