Chapter 17
Enhancing In-Service Tank Maintenance Through Industrial Internet of Things: A Case for Acoustic Emission Tank Inspection

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ABSTRACT

In the area of tank inspections across the industry, robots were introduced to replace human inspectors in selected operations. The technological gap in adoption of similar technologies by Zimbabwe's bulk fuel storage tanks operators motivated this research. The industry's current NDT practices were investigated, costs and inconveniences were identified, and improvements were explored. Operators of bulk fuel facilities and companies providing tank inspection services were engaged to establish the reasons for the gaps in technological assimilation. Emerging global technologies that enable in-service inspections were identified and their applicability to Zimbabwe's bulk fuel facilities was investigated. A combination of crawler based ultrasonic thickness tests for tank shells, and acoustic emission in-service tank bottom testing was observed to be the most convenient and relevant in-service tank inspection method for Zimbabwe's bulk fuel storage tanks industry. Internet-based remote connectivity and control was considered for data compilation, analysis, storage, and reporting.

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INTRODUCTION

Bulk petroleum storage and handling is crucial in smoothening fluctuations that may occur between supply and demand. Providing extra storage space ensures that excess supply can be warehoused when supply exceeds demand and when supply falls below consumption there is draw down from the excess stock previously built-up. The bulk fuel facilities' integrity and healthiness is very critical in ensuring the facilities' readiness to service the industry on demand. Maintenance of the facilities' critical equipment such as the tanks is important. The capacities of the tanks will result in significant environmental contamination and has the potential of catastrophic consequences should any mishap occur. Strategic maintenance management is important in ensuring the facilities are ready to serve when required. Involvement of the organisations' top management ensures management commits and partakes in making key decisions for their organisation's long-term equipment maintenance. This is needful for successful implementation and monitoring of the adopted maintenance programs. Top management commitment is important where decisions to be made involve drastic changes to the usual way of doing business, such as is the case with the adoption of the new paradigm shift in industry, the industry internet of things (IIoT).

The Industrial Internet of Things (IIoT) created several opportunities which organisations can conveniently adopt in their quest for improved operational efficiency as well as efficient equipment operation and maintenance (Muhonen, 2015). Key among the benefits to be drawn from IIoT is real-time data analytics, machine to machine communication, autonomous machine operations, and the ability to instantly alert stakeholders on equipment condition as well as prescribing possible action plans on predicted adverse equipment conditions (IBM Corporation, 2016). This is illustrated in figure 1.

BACKGROUND

An Overview of Zimbabwe's Bulk Fuel Storage Industry

Zimbabwe's bulk fuel industry has for many years been dominated by a few players that own bulk storage depots with capacities of at least 1,000 cubic metres per depot. These depots play a crucial role of creating a buffer to iron out fluctuations between supply and demand (*Gujarat is vulnerable to major manmade chemical disaster, especially in the aftermath of natural catastrophe, says GSDMA report*, n.d.). Other players making up the supply chain reach out the markets through service stations and renting bulk storages from the few depot owners. Before Zimbabwe's independence in 1980, the industry comprised of five international oil companies which operated the depots that were in major towns such as Harare, Bulawayo, Mutare, Gweru, Masvingo, Chinhoyi, Chiredzi and Beit Bridge. The five were British Petroleum (BP), Shell, Caltex, Mobil and Total. These five were also part of the industry owned joint venture that made up the Central African Petroleum Refinery (CAPREF) which ran the Feruka refinery in Mutare. In addition to the five companies, the joint venture also included American Independent Oil Company and Kuwait National Petroleum Company (Field & Interim, 2008).

Post-independence, Feruka depot was acquired by the Government of Zimbabwe, which also run depots in Harare, Bulawayo and Beitbridge through the state-owned National Oil Infrastructure Company of Zimbabwe (NOIC). BP merged with Shell to form BP & Shell Marketing Services (BPSMS) which was later disposed, together with its depots first to Masawara which later disposed the business to Zuva Petroleum. Mobil sold its depots, to Total while Caltex was sold to Engen, and lately to Vivo Energy. To