Opportunities in Application of IOT In Asset Management for Third World Countries

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Abstract
Industry 4.0 revolution landscape is constantly changing the asset management landscape globally. Industries and companies worldwide are undertaking business process re-engineering to automate processes that were initially manual. This has seen emergence of various asset management solutions aimed at locating assets, monitoring their conditions and providing insights and predictive information that can be used to make informed decisions. Automation of asset management has brought on board internet of things (IOT) where sensors, software and other devises are integrated for exchange of information with different gadgets and systems over the internet protocol.

In a nutshell asset management has evolved through the different phases as follows: -

1. Basic asset tracking with paper, pen and whiteboards
2. Asset tracking spreadsheets
3. Cloud based asset management software
4. Machine learning and artificial intelligence.

The benefits of IOT for asset management are summarised.

- Real time information of the asset is available
- We have decrease human involvement on the assets
- Optimization of the asset is realized
- Asset cost tracking is maintained and monitors
- Enhanced maintenance monitoring is realized with availability of large data on the asset for decision making.

The above benefits can be harnessed in transportation, manufacturing, agriculture and hospitality industries. Arising from these improvements in asset management, new operating and business models can be developed, risks can be managed, and customer service needs addressed in a manner that has not been achieved before.

This paper evaluates the opportunities available for absorption of technological advancements arising from industry 4.0 development in third world countries for Asset Management.

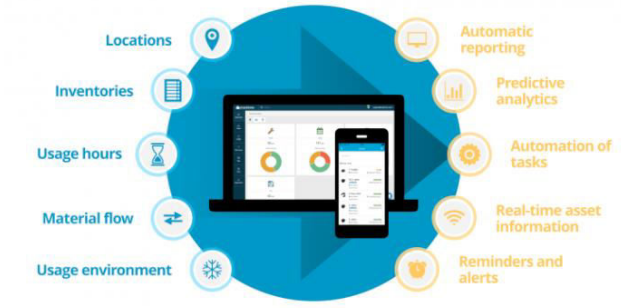
Keyword's

Internet of Things (IOT), Artificial Intelligence (AI), Asset Management (AM)

Introduction

Asset management is simply a system that helps companies to keep track of all their assets such as vehicles, equipment, and investments. Internet of things (IOT) refers to a connection of devices that communicate to each other and humans through an internet platform. Industrial Internet of Things (IIOT) focuses on non-consumer IoT devices intended for industrial applications. In this framework, instruments and sensors detect actual conditions, connectivity provides an environment for data transfer at certain frequencies whereas cloud based digital tools or cloud computing provides the storage for analysis and interpretation of the massive data IoT devices collect. As a result of this actionable insights for decision-making tools, predictive analytics and automatic reporting will be realized. IOT enabled asset management solutions basically integrate these IOT sensors attached to assets for collecting and tracking information about those specific assets without human involvement. For the realization of simplicity, improvement, automation and process control. These technological advancements have seen concepts including smart cities, smart homes, smart health, smart transportation and mobility, smart water, smart agriculture, smart security and emergency.

The figure below demonstrates the basic information flow and application of IOT



IIOT Devices

In the year 2021, we have an approximate 36 billion IoT devices that will increase to 76 billion by the year 2025 (Alam, 2018). Internet of things constitute identifiers, sensors, communications, services and semantics (Kadge *et* al., 2016). The table 1 below explains the types and applications of some of the IoT sensors.

Table 1- IoT Sensors

No.	IoT Sensor	Purpose
1.	Physical sensor	length, temperature pressure, electricity, weight, sound, etc. Examples include Radio-frequency identification (RFID) , acceleration sensors
2.	Chemical sensors	Industries for process control
3.	Bio sensor	Analytical devises that respond to concentrations or activity of a chemical process. It could be a physical or chemical sensor in a biological process or a product of living things for measurement.
4.	Temperature sensor	Heat or temperature measurement
5.	Proximity Sensor	Detection of any movement
6.	Pressure Sensor	Instrument consisting of a pressure sensitive element to determine the actual pressure of a pipeline or vessel
7.	Optical Sensor	Detect electromagnetic energy using photoelectric effect concept where a plate is negatively charged when a light sensitive material is hit by a photo beam generating an electron flow as a signal.
8.	Humidity sensor	Used in industrial processes, agriculture, human life control system and domestic appliances used to determine water vapour in the air
9	Micro sensor	Small sensors that that relay environment information measuring biological thermal chemical and other forms of processing
10	Oduor detection sensor	These are gas, bio-, gas thermography and hybrid systems

Radio Frequency Identification (RFID)

RFID refers to technology where digital data is encoded using electromagnetic fields to automatically identify and track tags attached to objects. With RFID the following tasks can be carried out:

- Inventory management
- Asset tracking
- Personnel tracking
- Controlling access to restricted areas
- ID Badging
- Supply chain management
- Counterfeit prevention (e.g. in the pharmaceutical industry)

Intelligent Asset Maintenance Platforms (IAMP)

The scope of asset management for deployment of IOT systems comprises of physical assets, financial assets, information assets, human assets and intangible assets such as goodwill, brand recognition and intellectual property (Karmakar *et* al., 2020). The focus of this paper is the physical tangible assets with economic commercial value or existence. There is therefore need to explore the opportunities available in the other four asset types.

There is a general shift in organizations to manage their assets from computerized maintenance management systems (CMMS) environment to asset management utilizing multiple input data sets including:

- Historical, planning and maintenance costs
- Real time status of the equipment or asset.
- Predictions derived from reliability studies

Power generation, water distribution, road networks, oil and gas pipelines are examples of organizations with assets distributed in remote locations. IAMP can therefore be deployed to collect data from these assets for analysis into a common location. Leak detection systems for monitoring oil or gas leaks from pipelines will require IOT devices fitted along a pipeline that communicate to cloud computing where all data captured from the devises are processed. Water companies lose millions of litres of water through leakages and pipe bursts caused by different reasons that can be detected by IOT devices. IOT solutions therefore presents opportunity for management and elimination of these losses including reporting of the actual status, location operating conditions utilizing IOT devices described in table 1, RFID for identification including providing visibility through global positioning systems (GPS). Three basic scenarios' for IAMP exist (Marquez *et al*., 2020).

1. Getting developed solutions from asset providers
2. Development of tailor-made solutions internally
3. Development supported by bug data intelligent solutions configured over cloud IT solutions.

Comparison of results before and after implementation of IOT

According to Sanam *et al.* (2016), the following results were obtained at various points regarding asset management based on comparison before and after implementation of IOT.

Table 1. Analysis of different points before and after IoT implementation

No	Analysis Points	Before IoT	After IoT	Remarks /Observations
1	Manpower	436-unit hrs/Month	109-unit hrs per month	Reduced by 75%
2	Down time	20 hrs per month	15 hrs per month	Reduced by 20 to 30%
3	Preventable failures	18 hrs per month	2 hrs per month	Reduced by 90%
4	Maintenance backlog time	50 hrs per month	20 hrs per month	Reduced by 60%
5	Inventory carry cost	INR 5,00,000 per month	INR 4,60, 000 per month	
6	Work capacity	50 hrs/week	58 hrs per week	Increased by 10 to 20%
7	Labour productivity	50,624 units	75, 302 units	Increase by 60%
8	Idle time and overtime	12hrs/week	7hrs/week	Reduced by 42-58%
9	Rework	35hrs/week	28hrs/week	Reduced by 15 to 20

From the above analysis as carried out, it's evident that organizations embracing IoT in asset management stand to benefit in productivity by leveraging on efficiencies realized vide real time data analytics, reduced human interaction and predictions to reduce downtime losses.

Opportunities available for IOT investment

Industry 4.0 presents a lot of opportunities for Engineers, IT professionals and organizations to explore

1. **Knowledge management/training opportunities**
   Opportunities exist for curriculum review and training of technicians and workers in Industry 4.0 competencies. These competencies include Big Data, Cloud Computing, Internet of Things, 3D printing, Augmented Reality, Simulation, etc. Academic curriculum for higher education falls short in this specialization specialized in Information and Communication Technologies (ICT) seem to be far from what 4.0 claims (Delgado *et* al., 2017).
2. **Manufacturing**
   In the year 2020, technological experts envisioned a market volume of 200 billion euros to be spend in the next 10 years for design of factory modules, crash tests and digital mock-up as well as development of machine-user communication and interfaces (Wehle, 2016). Government can lobby through cooperation agreements for these investments to be made in third world countries considering that most of the raw materials is mined from Africa.
3. **Consultancy services**
   Consultancy opportunities in the development of solutions for asset tracking, asset health/condition monitoring, deployment of comprehensive asset life cycle management solution, workflow automation solutions, predictive asset maintenance including analytics to advise organizations on utilization of large volumes of data collected from IIOT devises.

4. **Job Creation/Implementation opportunities**
   Job creation opportunities arise for developments relating to infrastructure development. Industry 4.0 investment in Kenya and any other third world count will come along with job creation in construction industry. Employment opportunities will therefore be created with Industry 4.0 investments.
5. **Career opportunities**

Some of the new career and job opportunities that will emerge with the adoption and implementation of industry 4.0 asset management include data analytics, network experts, hardware and devices experts, user Interface experts, Sensors and Actuator Professionals, Embedded Programs Engineers and Artificial Intelligence experts.

Conclusion

African countries and more so Kenya should not be left behind in the emerging industrial revolution. Application of IoT in the industry for asset management comprise physical assets, financial assets, information assets, human assets and intangible assets. This paper has discussed only the opportunities available for physical assets. There are numerous opportunities in the other asset categories. Vision 2030 for Kenya has spelt out a roadmap of development agenda for industrialization. There is therefore need to embrace the opportunities discussed in this paper into the government papers and programs for Kenya and the larger Africa industrialization agenda.

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