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Original Article

Intelligent IT Infrastructure in the Gas and Oil Industry

Ahmad Fahad Alotaibi[1], Khalid Hamed Hajri[2], Humoud Hudiban Rashidi[3]

[1,2,3]*Saudi Aramco, Area Information Technology Department, Abqaiq, Saudi Arabia*

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Abstract *- Intelligent information technology infrastructure is considered one of the enablers to enhance digital transformation in the gas and oil fields to optimize IT infrastructure reliability by supporting operations and maintenance in a safe and secure method to optimize resources. Smart IT buildings, communication rooms and shelters with intelligent technologies can strengthen the performance and profitability of gas and oil companies by ensuring business continuity. This paper describes the advantages of deploying intelligent IT infrastructure in the oil and gas industry by illustrating its positive impacts on some development aspects, for instance, operations, maintenance, safety, security and resource optimization. Moreover, it highlights the challenges and difficulties of providing smart IT services in a remote area and proposes solutions to overcome such difficulties.*

Keywords *- Intelligent, Infrastructure, Remote area, Shelter, Smart.*

I. Introduction

The global demand for intelligent IT infrastructure in the gas and oil industry recently increased. Since it can add great value to remotely manage and monitor IT infrastructure and equipment through reliable network management systems, it raises productivity and profitability by optimizing operations and maintenance efficiently to enhance employee safety, network security and resource utilization. This article presents some applications to capitalize on deploying smart IT infrastructure to support operations, maintenance, safety, security and resource optimization in the gas and oil fields. After that, the article explains some challenges and solutions to overcome these difficulties that energy companies might face because of utilizing intelligent IT infrastructure in remote areas lacking fibre strands and cooling intelligent equipment.

2. Development Aspects of Deploying Intelligent IT Infrastructure in the Gas and Oil Industry

Gas and oil companies mainly focus on drilling workover, extracting and refining oil, operating and maintaining plants and refineries, shipping and reserving oil barrels and managing production pipelines. IT plays a crucial part in these processes by constructing smart IT buildings, communication
rooms and shelters with recent technologies in urban and remote areas to enhance the below development aspects:

2.1. Operations

Achieving five-nines (99.999%) network availability is the goal for every gas and oil company to ensure sustainable and reliable operations. Most of the gas and oil companies cover a huge area containing gas and oil plants scattered in deserts, which means operating and maintaining fibre cables between these plants. In the case of fibre, cutting is a difficult task which may result in having the network down for plants for a couple of hours since technicians must travel hours to the plant to repair the issue.

IT infrastructure is provided to resolve this matter with intelligent patch panels that enable remote managing and monitoring of fibre cables between plants and data centres controlled by the Network Operations Centre (NOC) through a special Network Management System (NMS). As a result, this solution enhances the real-time network visibility, which assists in finding alternative healthy fibre strands to reroute the traffic in a few minutes rather than hours in case of a fibre cut, which leads to reduced Mean Time To Recover (MTTR). In addition, this technology supports being proactive since it detects network slowness that results from CRC errors or dB loss [1].

2.2. Maintenance

Several gas and oil industry entities have to implement regular Preventive Maintenance (PM) for production pipelines under the water. These PMs assist in protecting the aquatic ecosystem from any oil spill under the water in order to take immediate actions to fix the leaks. Unmanned Underwater Vehicle (UUV) is the optimal technology that helps detect leaks from underwater pipelines at early stages [2]. Therefore, this solution significantly assists in decreasing water pollution in an efficient and quick method. These UUVs are controlled remotely by IT communication towers in intelligent IT shelters and communication rooms over offshore oil platforms [4].

2.3. Safety

According to the British Petroleum Company, the top 4 oil producing countries in 2021 have a common factor which is that they cover a very large area, as presented in Table 1 [5].

Table 1. Oil Production Countries [5]

Country	Area (km^2)	Oil Production (b/d)
United States	9.83	11,184,870
Russia	17.11	10,111,830
Saudi Arabia	2.15	9,313,145
Canada	9.99	4,459,455

This large area is an indicator that these countries have some gas and oil wells in remote areas, such as the Empty Quarter Desert in Saudi Arabia and the Chihuahuan Desert in the United States. As a result, employees might get lost in a desert when they travel hundreds of kms to support drilling in rigs. Therefore, the company's vehicles are equipped with a smart SOS alert system linked to the 911 centre using Automatic Vehicle Location (AVL). The SOS alert system has a button that can be pushed by the employee, which sends electrical signals to the nearest communication tower in any IT intelligent shelter and then to the 911 centre through the IT network. After that, the 911 centre dispatches a rescue team to the exact location, which leads to a decrease in rescue time from hours to minutes. Moreover, this system is equipped with a speaker and audio to enable the 911 centre to communicate with the employee to check his health [6].

2.4. Security

Securing restricted areas, for example, plants, refineries, data centres and IT buildings, is one of the major concerns in the gas and oil field. Nowadays, these concerns are mitigated by applying a smart facial recognition system where this system can match a human face from a video or an image by retrieving information in the active directory server. In addition, the system is equipped with multiple sensors to measure all face dimensions to authenticate employees. This process takes only a few seconds since the system is connected wirelessly through access points which transfer data to switches and then to routers until terminating in the active directory server [8].

2.5. Resource Optimization

One of the major concerns for all companies in different fields is managing and monitoring power consumption in IT facilities, especially if distributed among huge remote areas, as in the gas and oil companies. The recent development in artificial intelligence to manage power systems produced some significant capabilities that supported technicians to remotely manage and monitor power consumption for IT devices through a special Network Management System (NMS) by connecting power systems to the IT network. Moreover, it helped IT infrastructure design engineers to optimize IT power resources by relocating batteries and generators from low-power consumption sites to high-power consumption sites. As a result, this maximizes profitability by achieving millions of cost avoidance in the IT power field [9].

3. Overcoming Challenges Related to Deploying Intelligent it Infrastructure in the Gas and Oil Industry

Every new technology or solution comes with its difficulties and challenges. The best practice to overcome these challenges is utilizing and integrating different technologies together. This paper sheds light on challenges and solutions that generate from applying intelligent technologies in the gas and oil fields in IT shelters within remote areas, for instance, lack of fibre strands and cooling IT systems.

3.1. Unavailability of Fibre Strands in Remote Areas

IT shelters are very important sites for energy companies since they provide multiple critical IT services in remote areas and rigs, such as radio and SOS alert systems, by providing a wireless network connection for these services [11].

The significant issue is connecting these IT shelters to the corporate network since laying fibre hundreds of kms in trenches all over the desert is extremely costly. In addition to the cost issue, lying fibre negatively affects the mobility of IT shelters since it impacts the nature of these IT sites, which is adjusting location frequently based on business needs and the location of rigs and drilling.

The optimal solution to resolve this matter is utilizing a satellite network through a third party to secure and ensure high network availability in desert sites and rigs [12]. Furthermore, a satellite network enhances shelter mobility since it can be easily relocated whenever needed. As a result, this solution ensures having 24/7 availability of intelligent IT services in rigs, for example, an SOS alert system over AVL [7].

3.2. Cooling Intelligent Equipment in Shelters

IT smart devices process and perform a lot of algorithms, scripts and codes, leading to generating heat from the devices themselves. This is considered a matter in IT shelters since it is too expensive to install an Air Condition (AC) system in each site to maintain an intake temperature below 25° C (77° F). The failure to maintain the ideal intake temperature (25(C) affects the equipment's efficiency by impacting the lifespan. Also, a high ambient temperature affects the charging and discharging process for Uninterruptible Power Supply (UPS) batteries, which might cause a power shutdown and lead to an IT service interruption in rigs and desert sites.

To fix the issue, passive cooling shelters are deployed instead of traditional shelters. These shelters focus on heat dissipation to reduce the indoor temperature with no energy consumption by preventing outside heat from entering the site and removing inside heat from the site. This is achieved by designing the site using heat sinks and wind to decrease the inside temperature [13].

4. Conclusion

In summary, this paper presented how intelligent IT infrastructure automated a lot of significant activities in the gas and oil area. These activities maximize the benefits by ensuring sustainable operations, efficient maintenance, reliable safety, high-security level and great resource optimization. Furthermore, examples were highlighted for every development aspect to illustrate how intelligent IT infrastructure support and utilizes recent technologies in the gas and oil field. Moreover, challenges and solutions were provided for deploying smart technologies in the desert area. Gas and oil companies could utilize global conferences perfectly to share success stories for applying new technologies and to benchmark what fulfils their needs. Finally, IT is developing rapidly and producing multiple promising technologies supported by a smart IT infrastructure to develop every gas and oil field aspect.

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