E Asset Tracking Report

The following report comprises of a preliminary market research that was performed with regards to the tracking systems for personnel and/or assets followed by a requirement-based analysis of the product(s). It provides an insight into the current market to help us find potential areas for innovation and the possibility of building a prototype using current tracking systems for implementation in an oil rig environment.

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**Abstract**

This paper aims to provide context into the importance of personnel safety in an an oil rig environment followed by a preliminary market research into the development of a personnel/asset tracking system. The key requirements of the system include (1) tracking asset and personnel locations, (2) assisting with evacuation or rescue protocols, and (3) monitoring worker fatigue levels. Market research has found that the personnel/asset tracking market sector is a highly saturated one. However, a requirements based approach, followed by the comparison of various commercial off-the-shelf (COTS) systems, suggests that there are areas in which existing systems could be improved in order to satisfy the clients requirements better and also ensure that the system is well-suited to an oil rig environment.

# 1 Table of Contents

2 Introduction……………………………………………………………………………………….3

3 Sensor Networks………………………………………………………………………………...5

4 Project Requirements...……………………………………………………………………....6

4.1 Competitor Analysis. 5

3.1.1 2.1.1 Progility Technologies. 5

3.1.2 Tracertrak. 5

3.1.3 2.1.3 Identec Solutions?. 7

4 Scope for Innovation. 8

5 Requirements. 8

5.1 Requirements. 8

5.1.1 Personnel Tracking. 8

5.1.2 Equipment Tracking. 8

5.1.3 Asset Location Analysis. 8

5.1.4 Emergency Notification. 9

5.1.5 Fatigue Monitoring. 9

5.1.6 Seawater Detection. 9

5.2 Pairwise Analysis. 9

6 Sensor Networks. 9

7 Conclusion. 10

8 References. 11

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# 2 Introduction

Across industry, technology is being used to improve efficiency and reduce reliance on personnel. With increasing competition from renewable energy and dwindling natural supply; this trend is particularly obvious within the mining and offshore oil oil rig industries [4]. Technology shifts also presents opportunities for improvement of work conditions for employees on such sites. One such opportunity is a system that tracks and manages on-site assets, such as personnel and equipment. Such a system could be beneficial since it allows managers to quickly identify the location and status of everyone on site, monitor the usage of key equipments, and alert workers about emergencies. Implementing this system into a mine presents a variety of challenges, such as unknown/complicated layout, poor network reception underground, and hazards such as pockets of gas. In comparison, oil rigs present a more rigid environment with clear hazardous events such as oil and gas leaks, workers falling into the ocean, and fatigue due to long shifts. Personnel safety is of essence in such an environment, where personnel interact with heavy machinery and hazardous materials on a daily basis. The complexity of site, coupled with personnel working at heights and in numerous confined spaces makes on-site safety a nightmare [1]. The need to be able to effectively track and manage personnel and assets on-site is of utmost importance to ensure the safety of both. Given the dangerous line of work they are in, if an emergency does occur, it is essential for oil rig companies to be able to manage personnel and evacuate or rescue them in the smallest possible timeframe. The implementation of a tracking system will enable the existence of a centralised unit to alert personnel of any emergency situations, determining the most efficient evacuation route and track the whereabouts of all personnel at any given time, so as to ensure that all workers are safe at any given time. The tracking of assets also ensures safety of the machinery used, their whereabouts, efficient locations to minimise time wastage etc. Injury issues and loss of machinery can cost companies a lot of money (in the form of compensation or replacement of machinery), and hence it is necessary to control the situation before things go from bad to worse (which can happen very quickly in such an environment: “When errors are made in these workplaces, the consequences can be devastating” [6].

The offshore oil rig environment serves immense amounts of risks to the people and assets present in the worksite, primarily due to the high-risk activities that tend to take place in such a workplace on a regular basis. These activities involve a range of accidental risks such as falling objects, leaks and explosions, etc [6]. Oil and gas drilling accounts for the highest critical injury incident rate in the petroleum industry [5]. Factors such as weather and low reliability rates of safety barriers significantly also add to the substantial amounts of risk that workers and loose equipment, in particular, are faced with. Since the worksite is an oil rig platform in an offshore environment, the chances of recovering assets that have fallen into the sea can get very hard to recover and costly to replace.

Workers failing to follow rules and regulations, together with emotional exhaustion and general fatigue, are also contributing factors to majority of serious incidents [6]. Offshore oil rig workers tend to be exposed to various physical stressors such as cramped physical environments, long work shifts, working in an isolated location, high noise levels, vessel motion, heavy physical work, lack of privacy, etc [7]. With such challenging work environmental conditions, it would undoubtedly be physically and mentally difficult for workers to consistently focus and be aware of their surroundings.

The conventional methods of assessing the safety of the workplace, such as fatigue levels, injuries and illness rates, are not adequate for use in an oil rig environment, considering the huge repercussions that a lapse in safety could cause [2]. An emergency can be very fatal for those on-site, and without the help of a streamlined system, it could lead to serious injuries or even fatalities. Considering the challenging environment iit is easy to lose track of personnel and assets, hence making it more essential that a tracking and monitoring system is in place. One major area of deficiency in current systems is the level of time efficiency evaluation it can perform; critically monitoring and evaluating personnel and asset movement can improve the efficiency on-site and make lives easier for the workers, giving they are already in a mentally and physically taxing line of work [3].

The following report discusses the need of a tracking device for personnel and asset in an oil rig environment. The report:

* Gives context to:
  + The existing problem, and
  + The offshore oil rig environment.
* Conducts a requirements-based analysis to establish the main requirements of the client,
* Provides insight into sensor networks,
* Does a market analysis and comparison of existing commercial off-the-shelf (COTS) systems,
* Scopes any space for innovation to build upon current tracking systems in order to better suit them for the needs of the client and for use on an offshore oil rig environment.

Preliminary market research revealed that the market for tracking systems is well saturated with companies such as Wavetrend specializing in rugged tracking tags designed for construction and mining operations [13]. There appeared to be less saturation for a system specialized for use on an oil rig, so the focus was shifted from a general system to one optimized for the oil rig.

Since the development of a completely new system may not be the most efficient way of moving- forward, two ways of potential action with the project were concluded:

1. Implementing existing solution into new environment
2. Adding functionality to existing product

# 3 Sensor Networks

With a tracking system likely to involve the use of a wireless sensor network (WSN) this brief section will aim to outline some of the key concepts and considerations when implementing these networks. The key concept of WSN’s is to have sensor nodes scattered in an environment. These sensors could be of a number of different types such as audio sensors, (microphones), RF antennas and thermometers. The key challenges in using these networks are:

· Accurate Source localisation

· Power Constraints

· Wireless Bandwidth Constraints

· Network Latency

Source localisation is quite relevant to the context of this problem. There are numerous approaches to estimating the location. These include algorithms such as maximum- likelihood estimators (MLE) or by using deep neural networks (DNN). There is a tradeoff when designing the algorithms used by these networks to reduce the computational complexity while still determining the correct solution.

The motivation for the reduced computational complexity stems from the inherent hardware constraints. Often the nodes are powered by battery which leads to limited transmit power. These sensors can often feature a small amount of processing power in the form of a microprocessor however these are not conducive to large amounts of data handling.

A key design consideration is whether to process the data in a centralised or decentralised fashion. By using the small amount of processing power in each sensor the network can locate sources using a decentralised algorithm. The opposite approach is to compute the data centrally which can lead to more accurate algorithms at the cost of network latency.

# 4 Project Requirements

Based on the project brief the key project requirements are outlined below. These requirements are high level and can be broken down further into sub requirements. This will be done as part of the design process once the market analysis has been complete. For the purpose of the market analysis, these requirements will be considered:

## **4.1 System Requirements**

### **4.1.1 Personnel Tracking**

The most critical component of the system is that it needs to be able to track and monitor the location of personnel. The location should be accessible in real time by relevant site supervisors for safety purposes.

### **4.1.2 Equipment Tracking**

The system should also be attachable to larger pieces of equipment and should be able to track the location of these assets. This can lead to improved efficiency and management of an oil rig.

### **4.1.3 Asset Location Analysis**

The system needs to provide analysis tools for the data collected by the system. For example, the system should be able to provide information on patterns detected for activities such as:

· Worker movement

· Equipment Movement

· Safety Hazards

This information could then be used to improve efficiency and safety in an oil rig.

### **4.1.4 Emergency Notification**

Workers should be notified of an emergency via the system.

### **4.1.5 Fatigue Monitoring**

The system will monitor workers fatigue levels as an added level of safety.

### **4.1.6 Seawater Detection**

The system should be able to detect if a worker has fallen off the oil rig into the ocean.

## **4.2 Pairwise Analysis**

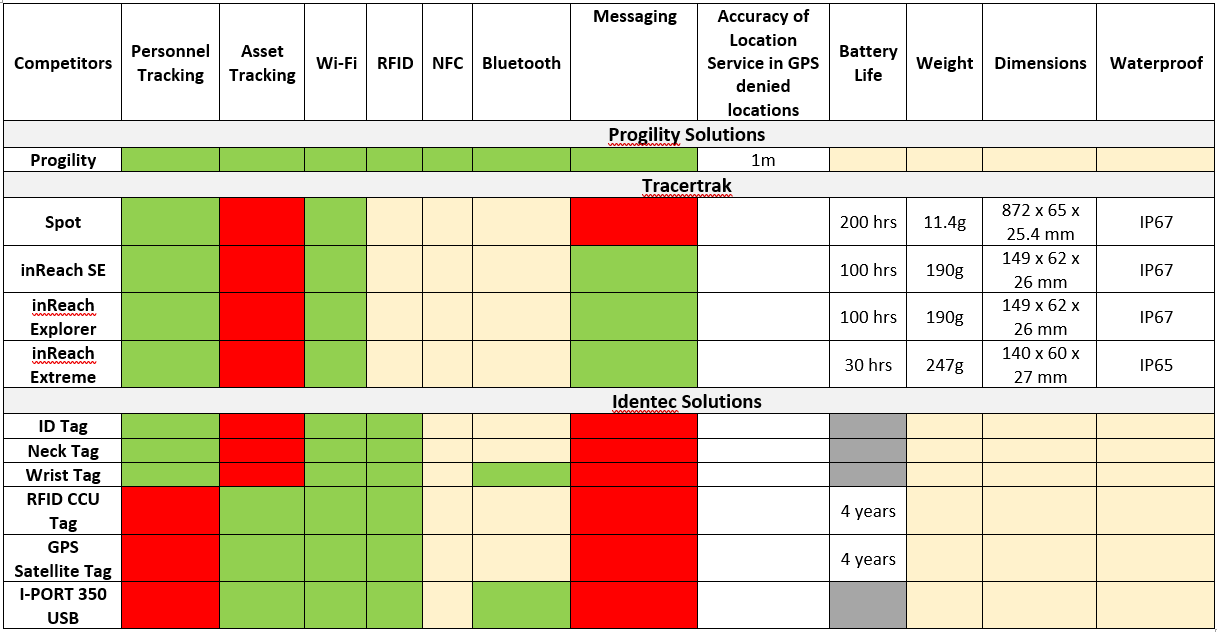
|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Personnel Tracking | Equipment Tracking | Asset Location Analysis | Emergency Notification | Fatigue Monitoring | Seawater Detection | Sum | Rank |
| Personnel Tracking |  | 1 | 1 | 1 | 1 | 1 | 5 | 1 |
| Equipment Tracking | 0 |  | 1 | 0 | 1 | 1 | 3 | 3 |
| Asset Location Analysis | 0 | 0 |  | 0 | 0 | 1 | 1 | 5 |
| Emergency Notification | 0 | 1 | 1 |  | 1 | 1 | 4 | 2 |
| Fatigue Monitoring | 0 | 0 | 1 | 0 |  | 1 | 2 | 4 |
| Seawater Detection | 0 | 0 | 0 | 0 | 0 |  | 0 | 6 |

Figure 1: \*label figure\*

## 

## **4.3 House Of Quality**

* *We need to add this to the report*



*Green - Function is available*

*Red - Function is not available*

*Yellow - Information unknown*

# 

# **5 Tracking Devices**

There are many different types of sensor devices that can connect to wireless sensor networks. These devices are each made for different working environments. Some of these are made for industrial environments, meanwhile others are for office environments. The devices which are currently available on the market include:

· *Hardhats with sensors*

· *Smart glasses*

· *Wi-Fi Tags*

· *Backpack*

· *Wearable computers*

· *Watches*

· *Bracelets*

· *GPS Locators*

Each specific device has its own environments where they would be useful in. For example, GPS Locators would not be useful to tracking personnel in mines or oil rigs as the employees will often be inside/underground. Due to the harsh environment of an oil rigs, some devices which are currently on the market are not feasible to use. [8] [10]

## 5.1 Competitor Analysis

## **5.1.1** **Progility Technologies [14]**

· Provide Personnel and Asset Tracking

o Wifi systems

o RFID

o NFC

o Bluetooth

· Location based services in GPS denied locations

o CA-TAP system-accuracy of approximately 1m

o CA-TAP HD system-accuracy of approximately 55mm

· Underground mining and proximity detection

o Distance between two points through hard rock

o Custom alert system

### **5.1.2** **Tracertrak [11]**

#### **5.1.2.1** **Spot**

· Tracking

· Emergency Alerts

· Worker Check in

#### **5.1.2.2** **inReach SE**

* Tracking
* Emergency Alerts
* Worker Check in
* Send and receive message
* Message Delivery Confirmation

#### **5.1.2.3** **inReach Explorer**

* Tracking
* Emergency Alerts
* Worker Check in
* Send and receive message
* Message Delivery Confirmation
* Waypoint Saving

#### **5.1.2.4** **Iridium Extreme**

* Tracking
* Emergency Alerts
* Worker Check in
* Send and receive message
* eDelivery Confirmation
* Voice Communications

**5.1.3** **Identec Solutions [14]**

WATCHER**PERSONNEL** System:

· Personnel registration system

· Automated mustering system

· Mobile mustering

· Access control system

· Certification logging

· Integration with DaWinci personnel logistics system

· Custom reporting

· Active and passive monitoring

IDENTEC SOLUTION Mobile Mustering increases security and improves efficiency during an emergency through:

· Automated headcount per mustering zone

· Manual mustering of personnel without a tag

· Flexible lifeboat allocation

· Simple relocation of mustering points

· Real-time identification of missing personnel

Offline mode to mitigate network connectivity issues

# **6 Scope for Innovation**

* Implementing existing solution into new environment
  + Environmental challenges for COTS products, do they work well on an oil rig with exposure to salt water spray
* Adding functionality to existing product
  + Accelerometers for identifying man overboard
  + Warning signals
  + Shift length tracking

GAPS IN THE MARKET

*Need to do this section*

# 

# **7 Conclusion**

· *What our solution to the problem will be*

· *also draw few prototypes*

# 

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