FOREWARNING APPLICATIONS USING INTUITION TECHNOLOGY

INTUITION TECHNOLOGY

Senslytics has built an advanced AI software Sixth Sense Suite using its patented "Intuition Technology", that bridges the IoT, Machine Learning and Expert Interpretation and Forewarns complex state changes in chemical, biological and natural systems. Intuition Technology can be applied where Deep Learning does not produce good results. The innovation around Intuition Technology has resulted into 8 US Patents, 5 of which are already issued by USPTO (Patent # 10,061,833 and 10,073,724, 10,443,966, 10,445,163, 10,816,292) and the rest are pending. The uniqueness of Intuition Technology lies in its capability of processing simultaneously the real time data of situational changes and surrounding dynamics using its proprietary Pattern Bit generation technique and hypotheses iteration that can together combine the Expert's ballpark qualitative knowledge with machine learning quantitative intelligence.

VERTICALS

Sixth Sense Suite can be configured to real-time Forewarn hard-to-detect state changes in complex industry systems and help curb emergencies or optimize operations and thus save tens of millions of $. Below is a list of applications where Intuition Technology can make a difference.

O&G & CLEANTECH

1. **Contamination and Fluid State Forewarning in O&G Upstream Operations**
2. **Flow Assurance Forewarning in O&G Operations**
3. **Wind Energy Generation Forewarning for Changing Wind Pattern**

AGTECH

1. **Pest Infestation Forewarning in Stored Grains**
2. **Soil Moisture Forewarning for Changing Weather**
3. **Detecting Male Chick to maximize Eggs Production in Poultry**

SUSTAINABILITY

1. **Forewarn Fill Status of Surgical Recycle Bins for Hospitals**

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ENERGY USE CASES

I. Contamination and Fluid State Forewarning for O&G Upstream Operation

Samples collected using Wireline Formation Testing (WFT) provide vital information throughout the lifetime of the reservoir. Highly contaminated samples can lead to erroneous fluid analysis results with potentially huge economic consequences. On the other hand, sampling durations need to be optimized without compromising the quality of the collected fluid samples. Shell Corporation joined hands with Senslytics to build WFT Contamination Forewarning Application using Senslytics novel "Intuition Technology" to optimize the collection process of wireline formation fluid sampling and assist field engineers and formation testing experts by improving the accuracy and reliability of real time interpretations. The worldwide market for WFT Contamination Forewarning application is estimated to be $2 BN+.

METHODOLOGY

Fluid data collected by wireline test probe from deep down, e.g., optical density, acoustic data, physical density are fed into the Sixth Sense Suite hosted in cloud, either as batch files or real time ingestion which are processed to generate Forewarning of the fluid contamination state along with recommendation to Field Engineers for optimizing the fluid sample collection process. The system also can use situational information of the well, to compound the time series

intelligence. The WFT contamination forewarning application is flexible of accepting different number of time series variables (that could range from 22-55) and is also capable of accepting expert opinion as well as their qualitative experience in improving both situational modeling as well as inference generation. The output screen shown beside shows real time plots along with plot dots giving real time forewarning of contamination state along with recommendations to Field Engineers.
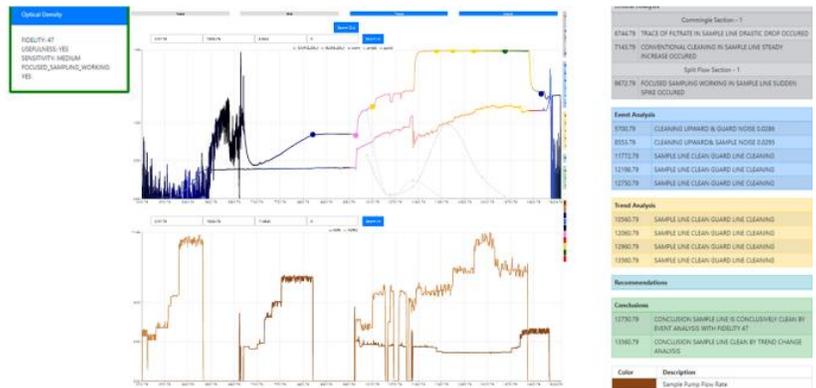
STATE OF APPLICATION

Ready to commercialize. After successful field trial, Shell Corporation and Senslytics are jointly commercializing the application to the Shell partner network. Senslytics is also working with Halliburton, Nippon Oil and creating additional channels to market. Senslytics is interested in talking to other E&P companies around the world.

II.   Flow Assurance Forewarning for O&G Operation

Understanding the Flow Assurance problem and the factors affecting it is of great importance to the oil industry because the costs associated with production loss and remediation activities, such as solvent wash and removal of deposits are extremely large. Though a precise size of Flow Assurance Management market is not available, the growing market size of the chemical inhibitors used for asphaltene deposition prevention is reaching about $1.73BN this year, gives us an indication of the Asphaltene deposition market. Flow Assurance issues are much bigger than asphaltene alone and can be contributed by any of the following factors shown on the Figure beside e.g., Asphaltene, Wax buildup, Hydrate formation, Emulsions, Slugging, Scale formation or Corrosion of the well tubulars or in the pipelines. Often more than one problem coexists creating the hindrance of the flow. Rough estimate of the comprehensive worldwide market for Flow Assurance, is $10BN.
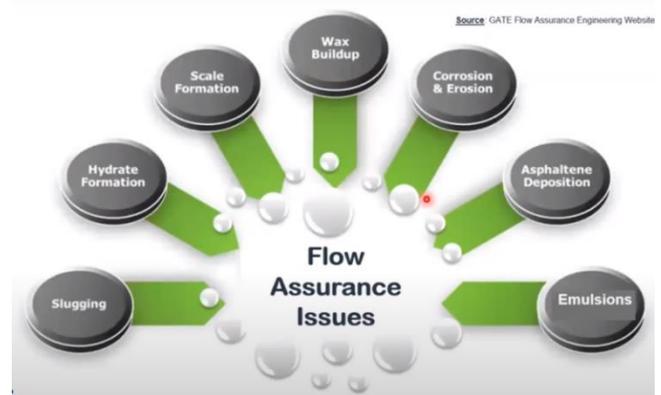

METHODOLOGY

Senslytics uses Intuition Framework to integrate diverse intelligence elements coming from different data spheres to create the Intuition Model for the Flow Assurance failure. Once historical data are ingested the model can identify the well deterioration point and seeding conditions from proprietary pattern bit analysis and then can Forewarn upcoming flow assurance issues for mitigation and optimizing uptime. The figure beside shows the different stages of out processing from raw data, interim parameter generation and inference derivation.

Three data spheres have been identified from the past studies:

- PI Historian: Time series sensor data indicating the changes in well tubular surroundings
- LIMS Data: laboratory analysis data indicating changes the fluid composition
- Maintenance/Inspection Record of Well tubulars: Qualitative data and expert interpretations giving the health and maintenance history of well tubular maintenance as well as well shut off times

STATE OF APPLICATION

Ready to pilot. Senslytics worked with Hess data and obtained promising results and is currently in talks with PDO, Shell and Hess for a field trial. Colorado School of Mines is in collaboration with Senslytics for this complex work, esp., for hydrate formation forewarning.
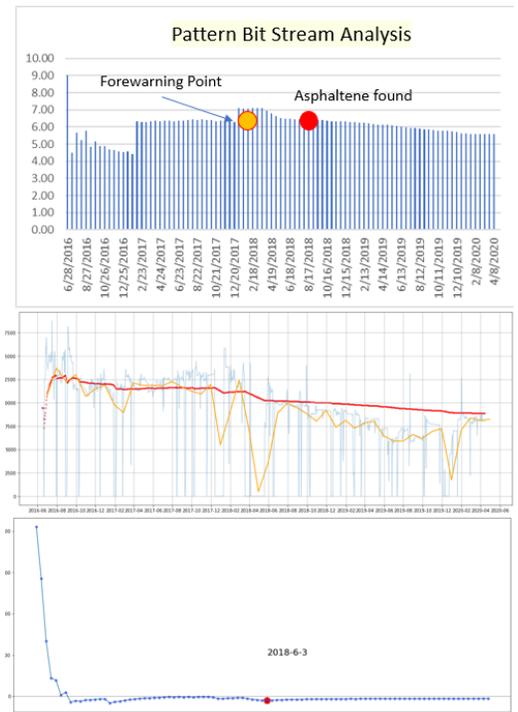
III.   Wind Energy Generation Forewarning

Wind power generation is linked to the weather conditions directly, therefore remains unpredictable and can pose challenges to smooth grid operations for the energy transmission. Most often wind patterns are studied prior to installing a wind farm in a region, however such static studies do not reflect any real time estimation for wind power. A recent need for real time generation of wind energy is felt which can improve the cost of wind farm energy roughly by 20%, mounting to a $BN market opportunity.

METHODOLOGY

Senslytics uses its Intuition Framework to analyze the sensor generated wind speed, direction, humidity, temperature real time and ingest weather forecasting data to combine situational changes and Forewarn the estimated wind power generation from an either a specific generator or from a wind farm of multiple wind turbines.

STATE OF APPLICATION

Senslytics used wind data obtained from Calega, UAE and got initial success by applying Intuition Technology. Senslytics is ready to develop the wind energy Forewarning application that can generate real time estimation of power generation hour by hour from changing weather patterns and weather forecasts.

AGTECH USE CASES

I. FOREWARNING PEST INFESTATION

Senslytics Corporation and Georgia Tech joined hands to solve a $30BN worldwide, $4BN US problem – Controlling Pest Infestation in Grain Storage. Georgia Tech has been developing low-cost acoustic sensors to detect pest signature in grains. The joint collaboration under the guidance of USDA entomologist plans to design smart silos that can cost-effectively control the climate inside the silo to prevent pest eggs from hatching. A variation of the technology can be applied for Forewarning pest damages in farms as well.

METHODOLOGY

The IoT platform feeds the pest detection signature along with the silo ambience parameters e.g., temperature, humidity, oxygen content to Sixth Sense Suite, hosted on cloud. The Pest Infestation Forewarning App generates the Lead-Time alerts along with recommendations, which are sent as mobile alerts to the operator for controlling the silo climate by adding or adjusting amount of Oxygen absorbent inside the silo. With time, forewarning based climate control will be automated and operator intervention will not be needed to control Oxygen absorbent amount in Silo. The laboratory setup shown above is an efficient way to analyze ambience threshold conditions for stopping hatching for all possible pest-crop combination.
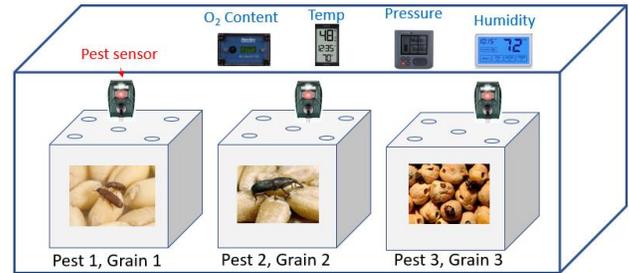
SCALE-UP FOR FARM ENVIRONMENT

The developed Intuition Model can help forewarning potential pest damages in the agricultural farms though controlling pests will need another method unlike the silo solution described below.

SCALE-UP FOR SILO INDUSTRY

Once Intuition Models are developed from the above experimental datasets for different pests-crops combination, the cloud hosted Forewarning software can help control the infestation in grain by controlling Oxygen content in air using Oxygen absorbent and thus making the ambience unfriendly for egg hatching. This environment-friendly solution can scale up to the industrial need of handling many silos simultaneously.

OTHER AGTECH USE CASES

II. FOREWARN SOIL MOISTURES FOR SMART IRRIGATION

Figure 1: Field Trials - Experiments

Water is rapidly becoming one of the most-scarce natural resources in the world. Forewarning soil moisture can determine irrigation need and thus save millions of gallons of water as well as avoid water leaching. Smart Irrigation is a $2.5 BN worldwide problem. Intuition Technology can be applied along with weather forecasting and the soil humidity sensor reading to plan better water distribution in farms.

STATE OF APPLICATION

Figure 2: Experimental Setup

Soil Moisture Forewarning is an application in Senslytics roadmap and can go for a pilot.

III. FOREWARN MALE CHICK TO MAXIMIZE EGG PRODUCTION IN POULTRY INDUSTRY

Forewarning the chick's sex within a few days of when laid can save the egg hatcheries between $1.5 -$2.5 billion each year. Over 6 billion male eggs laid worldwide are unmarketable and are mulled today, avoiding such a practice through Forewarning would reduce the cost and carbon footprint of incubating eggs. Intuition Technology can be used in conjunction with MRI imaging of eggs as well as gas release from egg to early detect chick sex.

STATE OF APPLICATION

Male Chick Detection Forewarning is an application that is in Senslytics application development roadmap.

SUSTAINABILITY IN HEALTHCARE USE CASES

I.   Forewarn Fill Status of Surgical Recycle Bins in Hospitals

Surgical instruments are required to thoroughly disinfected prior to be reused in operation theater. Reuse vs. new use of an equipment is a challenging sustainability question in the hospital operation. Often the issue lies with collection of the surgical equipment recycle bin. Many a times the collection crew not being aware of the fill status of the bins cause a disruption in the wash cycle pipeline. These specialized wash centers are few in numbers and are located far from the hospital which require collection, handling and transportation between hospital, wash centers and the equipment manufacturers to effectively recycle the instruments on time in required operation theater.

METHODOLOGY

Senslytics uses Intuition Technology to model the fill pattern of the surgical recycle bins and can transfer the fill status of bins over the Wi-Fi, mobile or Sigfox network to the cloud hosted Sixth Sense Suite which can be accessed by the mobile application giving the recycle bin transportation crew a map of optimized collection points. The diagram beside gives an idea of the value that Sixth Suite can bring to optimizing the sustainability operation.
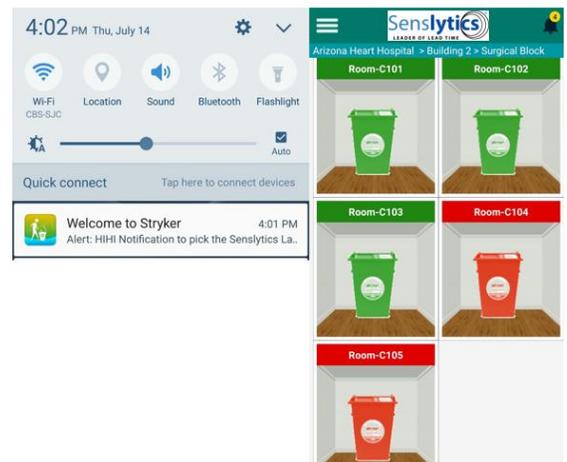
STATE OF APPLICATION

The proof of concept was demonstrated to the Stryker Corporation. Senslytics is ready to pilot the application and deploy.