An intelligent platform to manage offshore assets

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The goal of all information technology implementations, regardless of industry, should be to improve productivity. As pointed out in several papers (Oberwinkler and Studner, 2005), the bottleneck for oilfield data flow up until now has been the transfer of real-time data to the engineers' desktop in a clean, timely, and useful fashion. Engineers typically have seen only a subset of data; daily production volumes and rates, along with a few gauge pressures and temperature settings. With databases updated only periodically from real-time historians, engineers have lacked sufficient insight into the dynamics of platform or field operations. What's needed, states the paper, "is an alarm system to inform engineers of under-performing or critical conditions of a well or reservoir", before it begins to degrade production and the revenue stream. Oilfield operations need to move beyond the familiar data management mantra of the "right data to the right person at the right time" and adopt the 21st century goal of "validated data, to the decision maker, before the critical event". (Kozman, 2004). The new breakthrough technology I-Platform delivers the solution needed. By means of a global network it enables local, remote, and external participants—a "pool of global machinery expertise"—to collaborate to optimize facility efficiency and energy consumption based on common views of equipment performance data streams, alarms, and notifications.

In upstream oil & gas, the most obvious measure of increased efficiency is Barrels of Oil Per Day (BOPD). Yet it has traditionally been difficult to correlate the use of advanced technologies with increased production (Brynjolfsson, 1994). Recent surveys indicate that the majority of oil and gas geo-technical personnel could reduce their project risk with access to more computing power and technology (Microsoft, 2008). As new IT capabilities originally developed for down-hole monitoring are adapted to topside work flows, they are contributing directly to reduced downtime on offshore rigs. Applied to offshore condition monitoring of equipment and assets, this set of capabilities is called the "I-Platform" or "Intelligent Platform" solution.

On offshore platforms, asset management, involving the care and maintenance of equipment, is a major determinant of productivity. A primary goal of the I-Platform is to reduce equipment downtime and increase reliability. It does so by helping to 1) define operating envelopes that optimize equipment use, 2) allow early identification of pending equipment wear-out, and 3) enable root-cause failure analysis. The resulting productivity gain is recognized in facility cost reductions, enhanced system availability, reduced manpower requirements, reduction in operating downtime and improved QHSE performance in platform operations. For operators, this means the capability to leverage a small pool of centrally located Subject Matter Experts to maintain a large and geographically distributed fleet. For rig providers, it can mean the difference between building scheduled preventative maintenance into a rental contract instead of paying for unscheduled downtime. At today's rig rates, the payout can be in a matter of hours.

Offshore oil & gas, as a globally dispersed environment, presents special challenges to the implementation of IT solutions. But advances in network, computing, and software technologies have made it possible to address these challenges and make the I-Platform a reality today. Like many IT solutions, the effectiveness of the I-Platform rests on its ability to correlate data from a range of diverse sources, and provide a global level of aggregation and analysis beyond that typically derived from supervisory control and data acquisition (SCADA) systems. Information is brought from the well to onshore engineering workstations where it is combined with data derived from equipment models, engineering analysis and business systems. Advanced tools such as neural networks, self-organizing maps, or other artificial intelligence technologies are used to evaluate equipment sensor readings against performance envelopes or thresholds developed from predictive algorithms. Actionable items are then displayed to a user-configurable, web enabled dashboard with drill down capabilities.

This way of achieving the I-Platform vision utilizes a combination of hardware and software technologies, a powerful collaboration based on expertise in information technology and the petroleum industry. It is an integrated solution that connects equipment sensors onto a common infrastructure, to aggregate and analyze data as it is received, analyze it against predetermined or ad-hoc businesses rules and deliver it efficiently to onshore personnel. Given the scarcity of expert resources in the petroleum industry, its global nature, and emphasis on wide-ranging and transient partnerships, the I-Platform must first and foremost deliver information access to a wide range of parties vitally interested in the pursuit of productivity goals. The loss of subject matter experts to declining demographics in the oilfield and operations in both geologically and geo-politically hazardous areas add to the pressures on technology systems.

The requirement for data in "real time" is now accepted as a relative term. Here, an operation is called real time if the combined operation and reaction time of a task is shorter than the maximum delay allowed within the larger dynamic system. This is sometimes referred to in the oilfield as "relevant time" and can involve short (seconds to minutes), medium (hours to days) and long term (months to years) data loops depending on the combinations of data streams involved. With its focus on top-side equipment monitoring, the I-Platform leverages ongoing breakthroughs in technologies currently used to optimize well production and performance through better information management in all of these time frames.

The I-Platform system is unique from other data aggregation systems in employing data delivery and unique capabilities for data mining and conditioning. The capability of artificial intelligence techniques such as self-organizing maps has already been demonstrated in oilfield projects such as fracture stimulation optimization in gas fields. (Stunder and Nunez, 2006).

The use of data mining technologies is an indicator of advanced capability maturity in using oilfield data (Kozman and Gimenez, 2004). As discussed at the recent PNEC Data Management Conference in Houston, most oil and gas operators are functioning at lower maturity levels than other data and technology intensive industries such as medical or retail, and pending implementations of I-Platform could help close this gap. The I-Platform is also modular, configurable and adaptable to a wide range of operations, meaning it can be quickly leveraged in onshore operations with similar challenges. Operators in the Horn River play in northern British Columbia were recently introduced to the I-Platform at the Canadian C3GEO Frontiers and Innovation conference in Calgary, where they discussed its use in this harsh and remote winter operating environment (Levson et al, 2009).

Data is displayed in increments that make it valuable. The most frequent problem with delivery of offshore data to the office today is that operations personnel have a flood of data, but no way to reduce it down to actionable items. Too much data can be difficult to work with, too little may mask meaningful deviations. The data stores must be able to aggregate and synchronize different time increments, and, by means of rules or model interaction, identify critical events from combinations of multiple data streams. In Digital Asset Management strategies such as those proposed by ExxonMobil, Statoil, and Chevron in recent SPE papers (Reece et al, 2008), production data must be evaluated in the context of a range of functions, including physical equipment management, configuration optimization, asset lifecycle management, and workflows and events related to maintenance and supply chain. Workflows such as predictive maintenance analysis, scheduling and dispatch can directly impact digital technology applications such as drilling rate optimization, production surveillance, and energy management.

The I-Platform concept benefits greatly from recent adoption of standards for delivery of wellsite data such as WITSML. At a recent Public Forum sponsored by Energistics, operators such as BP, StatoilHydro (Grovik, 2009), and Total, and technology providers including BakerHughes, Wellstorm and Perfomix all showed examples of productivity increases based on standardized delivery of operational data.

Challenges to a successful I-Platform implementation include the following:

- Production monitoring requires collecting data from equipment not necessarily running on a common “bus.”

- Accurate fault detection and root-cause analysis requires multiple data streams from the platform to be correlated. As recently pointed out by TransOcean at a Data Quality Executive Dinner, maintenance on a specific equipment type is impacted not only by its own history, but the ambient conditions on the rig, such as climate and motion, which are seldom monitored by the same supplier.

- Fault detection requires pattern recognition and automated data analysis.

- Data analysis often calls for skills that are globally dispersed.

In a successful I-Platform solution, the many, diverse data sources are brought onto a single bus by means of a multi-level, secure local-area network (LAN). Read-only access is achieved across the company business LAN. Advanced network implementations also can be configured for read-and-write access to data and packaged monitoring systems, or to support engineering functions accessed via desktop interfaces from on-shore locations. Open systems and standards, combined with use of select third-party analysis tools and services, and integrated at the database, web services, or application programming interface level, facilitate these advanced implementations.

Until recently, access to production and asset-management data flows was site-specific and often controlled by a single equipment provider. This made it difficult to describe the dynamic nature of well behavior with a single, all encompassing model. But once an asset is equipped with an infrastructure network proven for high data volumes and mission-critical applications, the relevant equipment performance streams, alarms, and notifications can be delivered to a distributed pool of global machinery expertise. This is enabled with a common interface to on-board packages and equipment, real-time data processing, alarm management, and historians. Notifications and alarms can be based on either simple threshold rules or complex performance models. In operations, such a system would allow:

- A global view of operations, and the ability to identify and locate events;

- Correlation of behaviour of similar equipment across multiple installations

- Determination of the event's nature: is it a condition or a failure?

- An understanding of the cause of the failure; and

- A deep-dive analysis of the problem that leads to its resolution.

Business-intelligence capabilities, a data-analysis engine and standard desktop dashboard tools provide additional powerful capabilities. By combining multiple data streams and applying business rules specific to the industry, field, and well, it's possible to generate custom notifications when a pre-determined combination of data stream conditions occurs. Alarms or notifications are sent via an operator dashboard to select personnel based on roles and key performance indicators (KPI).

An operator dashboard is important for its role-based view of client-specific maintenance and reliability KPIs, based on domain expertise collected during the concept of operations/site assessment. By tapping into the expertise of the pool of global machinery expertise, KPIs can be tailored to customer-specific metrics such as facility efficiency or energy consumption. The dashboard concept for data delivery makes it easy to incorporate new KPI's as they are developed and to include innovative concepts like ExxonMobil's "Mechanical Specific Energy" (MSE), a measure of the amount of energy expended in the destruction of a unit volume of rock (Hacker, 2008). Individual equipment maintenance parameters can be tracked with respect to operating envelopes either specified by the manufacturer or developed from a history of use in particular environments. Advanced data analysis and mining capabilities and expert systems support root-cause-failure inquiries to identify impending equipment wear-out or failure. Historical data analysis can be brought to bear in decision making — to justify period extensions between overhauls or the rapid identification of fixed equipment fouling from remote locations.

The SPE paper notes that neural networks and genetic algorithms can be a powerful tool in real-time environments involving large amounts of data. Their particular efficacy is the ability to predict behavior based on relationships and correlations between disparate data streams that can be overlooked in single domain solutions. This can provide an engineer with global responsibility and restricted schedules the time needed to react to impending conditions.

The recent SPE Digital Energy Conference in Houston provided a wide-ranging forum for the discussion of issues related to I-Platform deployments and other similar solutions. Among the notable takeaways from various forums, panels, and technical papers were these issues that can be addressed by the I-Platform concept:

- BP discussed their investment in digital technology and the ROI that led to production of an additional 85 MBOED
- Chevron i-field manager Mike Hauser noted there is one element missing from his company's digital strategy that I-Platform could resolve
- Russ Spahr from ExxonMobil described several examples of digital technology that could benefit from an iPlaform implementation
- BP reported some early problems with their test deployment of real-time well data and how they could be resolved with strategic technology deployments

- One offshore operator admitted that their biggest challenge in using collaboration technology is not communicating between continents but getting people from the same building together to work on asset optimization
- Total discussed their plans for implementing real-time well data format standards in a pilot project
- Marathon identified the quality dimension that would bring the most added value to their production data in an I-Platform workflow
- BakerHughes discussed the relative advantages of Low Earth Orbiting satellite communication versus VSAT for streaming data from offshore and other remote assets

I-Platform supports the following business drivers and workflows:

- Downtime reduction
- Reliability improvement
- Maintenance and reliability KPI development based on defined operating envelopes
- Facility efficiency and energy-consumption optimization
- Root-cause-failure analysis
- Early identification of pending equipment wear-out or failure
- Justification for extended overhaul periods
- Fixed equipment fouling identification
- OEM machinery fleet management
- Capacity performance reviews and enhancement

I-Platform, fully implemented, enables downtime reduction and reliability improvement by monitoring and analyzing performance data before failures occur, and the dispatch of the right personnel to take proactive steps to avoid downtime. A successful implementation can be used to manage performance of the offshore machinery fleet, and support capacity performance review and enhancement. In conclusion, I-Platform is an end-to-end offshore-to-onshore solution that brings together a unique set of mission-critical characteristics to ensure operational, development, and deployment efficiency, and a foundation for long-term project success.

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