OSIsoft®

New Smart Asset Management Strategies

in the Transmission System Operator (TSO) Industry Enabled by a Real Time Data Infrastructure

THE CHALLENGE

TSOs are under increased pressure to reach capacity planning goals and identify new revenue streams to promote growth, all while reducing operational expenditures (OPEX) and optimizing capital expenditures (CAPEX). In addition, TSOs must address the European Union (EU) Horizon 2020 initiative that seeks to drive economic growth through asset management, renewable integration, and capacity planning.

Transmission System Operators (TSOs) consist of substation equipment and transmission line assets that are often spread across entire countries. Within those substations lies equipment such as power transformers, circuit breakers (CBs), load tape changers (LTC), relays, and switches. To meet business objectives, TSOs must effectively monitor these assets but, with millions of potential data points spread across these numerous assets, it's incredibly challenging to know something as simple as how many times one particular switch has been opened or closed.

There is no downtime for TSOs and, In the midst of these constraints, they must always keep the lights on for their customers.

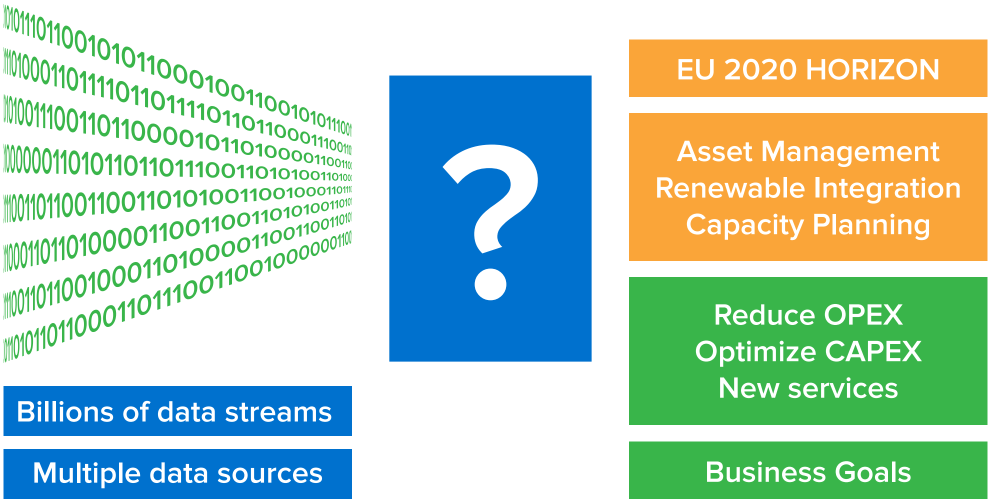


Figure 1 – TSO Industry Challenge

OSIsoft AND THE ASSET MANAGEMENT PROCESS

To stay competitive, a TSO must offer reliable and affordable electricity to customers. Given the "always on" nature of TSOs and the constant need for asset optimisation and replacement, all whilst maintaining continuous service at a reasonable price, a smart asset optimization strategy is imperative to any TSO's success. The challenge lies in the ability to fully utilise the value of operational asset data, both real-time and historical. However, a solid strategy can play a key role in optimising all phases of the asset management life cycle process.

Previously, asset management processes relied heavily on labour-intensive human inspections and manual collection of operational data. Inadequate automation, limited data capture and sharing capabilities across the enterprise, and the slow pace of updating traditional operating processes prevented more efficient means of optimization.

Now, TSOs can transform asset management processes through readily available, real-time data from across the entire electricity supply chain. With the OSIsoft PI System, TSOs around the world are optimizing asset management processes in order to ensure successful business performance and results.

The ability to manage increasing amounts of operational data is already directly impacting the asset management process of TSOs and will continue to do so in the future. Through processing, analyzing, and converting the right data into actionable information, TSOs are adopting this best-practice approach as they strive for continuous improvement.

For over 35 years, the OSIsoft PI System has helped large, asset intensive organisations around the world develop and implement data-driven strategies that maximize revenues and minimize OPEX expenditures.

The following describes the typical asset management process:

Figure 2 - Asset Life Cycle diagram highlighting phases where major business impacts are provided by OSIsoft's PI System data infrastructure

SMART ASSET MANAGEMENT

SMART is defined in dictionaries as "capable of making adjustments that resemble those resulting from human decisions, chiefly by means of electronic sensors and computer technology," and Asset Management is "coordinated activity of an organization to realize value from assets," Smart Asset Management (SAM) is the process of turning real-time asset operational data into actionable information.

A Smart Asset Management strategy must have accurate asset information, appropriate asset performance calculations, and the ability to extract actionable information to support decision making.

The OSIsoft PI System enables smart asset management with:

- More than 450 Interfaces for the collection and connection of sensor-based data
- An infrastructure that enables calculation and analysis of asset-related real-time and historical data
- Storage and management of data for real-time insights as well as:
  - Historical insights, which is critical for root-cause analysis
  - Predictive insights, so similar patterns of performance and operation can be matched as they occur
- The capability to add critical context to numerous parallel data streams so that data can be shared across an organization and integrated with other enterprise systems and tools

The OSIsoft PI System serves as an enterprise operational data and intelligence hub that provides data and information to many other analysis tools and visualization suites. In turn, those suites convert information into actionable knowledge for data-driven decision making and insight.

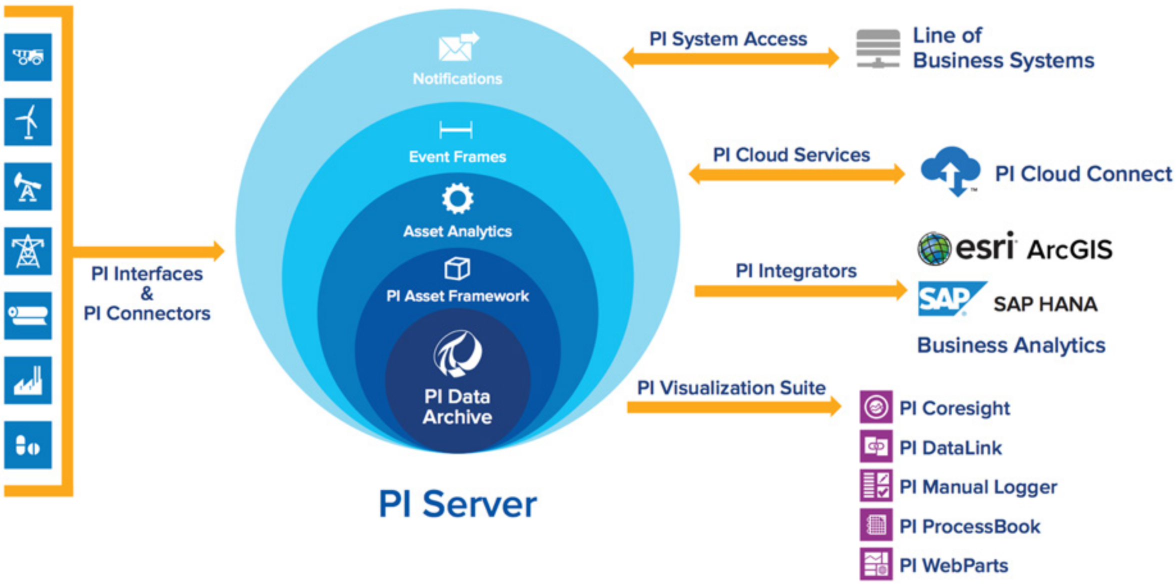


Figure 3 - OSIsoft's PI System Real-Time data infrastructure building blocks diagram

OSIsoft’s customers frequently use PI System technology to implement a Smart Asset Management strategy:

Initiative	Description	Enabler
CMS (Condition Monitoring System)	Full CMS implementations include data collection, aggregation, correlation, and analytics from multiple systems (EMS/SCADA, Dissolved Gas Analyzers, Electrical Tests, Oil Analysis, Manual data): • Asset Health Index Calculation • Asset Replacement algorithm • Asset Score	Standard Connectors Standard Analytics Visualization tools
CBM (Condition Base Maintenance)	CBM initiative is fed by the CMS System to switch from Time-Based Management (TBM) to CBM. CBM implementations include: • Accurate and historical asset condition data • Asset loss of life • Early Warning notification • Integration with the EAM system	Standard Analytics Notification System CMS system Enterprise Asset Management integrator
CAPEX/OPEX Prioritization	CAPEX/OPEX prioritization initiative is fed by the CMS System, Asset Maintenance Historical data, and Risk Assessment Matrix. Prioritize replacement investments or maintenance activities with concrete data.	CMS System Analytics tools Enterprise Asset Management integrator Business Intelligence integrator
Asset Benchmarking	Asset Benchmarking shows how assets behave in various locations on the grid or how similar assets from different vendors are performing. It requires accurate asset performance calculation from multiple data sources.	CMS System Analytics tools Enterprise Asset Management integrator GIS Integrator
Supporting another Business Processes	Asset condition information supports operations, trading, and grid planning. Data is fed into other applications like Geographical Information System (GIS), Trading/ Market systems, Outage Management Systems, Business Intelligence (BI), and Big data platforms.	Standard Connectors GIS integrator BI/Big data integrator

SMART ASSET MANAGEMENT IMPLEMENTATION

A. 7 Step Process

A SAM implementation is a 7 steps process that includes:

- Collect asset data
- View data in the context of assets
- Implement analytics
- Visualize results
- Notify
- Expose asset data to other asset management tools
- Continuous improvement and monitoring KPIs

COLLECT ASSET DATA

In the past, almost all the asset data came from the SCADA/EMS systems. However, there are now multiple data sources, and TSOs must gather from each to gain a complete understanding of asset behavior.

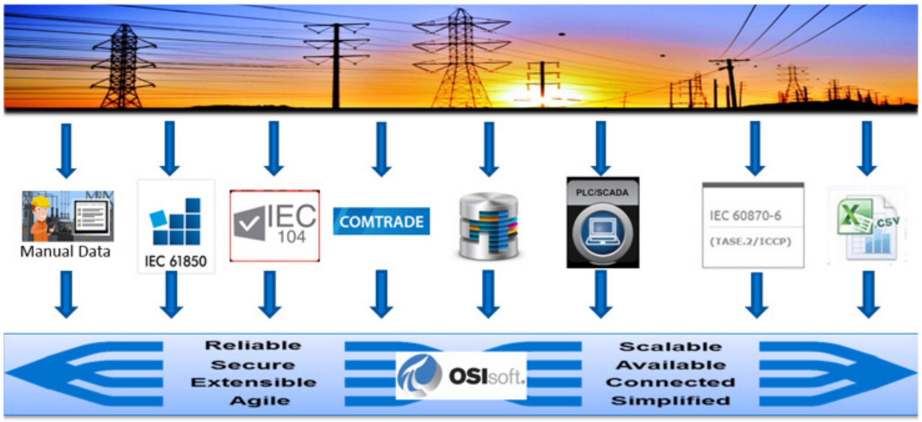


Figure 4 – Typical Data Sources

VIEW DATA IN THE CONTEXT OF ASSETS

Collecting asset data is only the first step: that data must be meaningful across business processes. New standards, such as CIM, have created a common asset hierarchy to facilitate data sharing internally and externally. However, the compliance process is difficult and, to have a successful SAM implementation, TSOs must connect the different asset management tools.

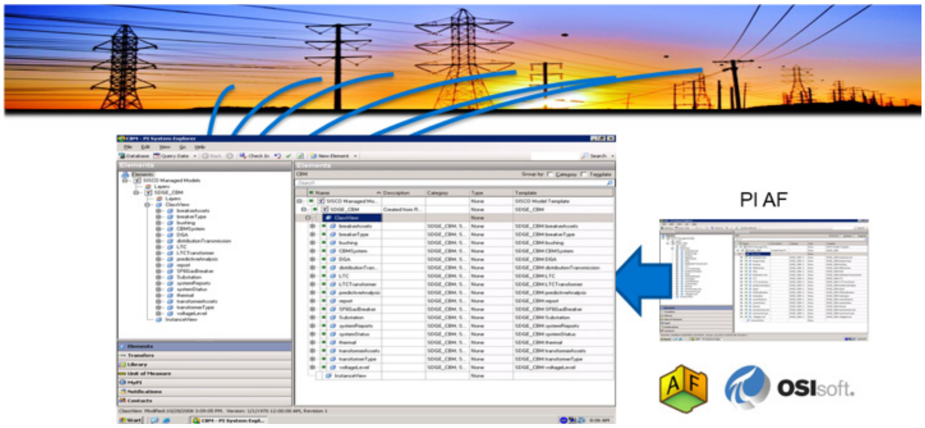


Figure 5 – CIM compliance asset hierarchy

IMPLEMENT ANALYTICS

Once the data is captured and contextualized, implementing analytics is simple math. For example, a health index (HI)/condition assessment (CA) calculation for a transformer is:

CA = F1*W1 + F2*W2 + Fn*Wn

“Fx” represents different set of data, such as hot sport winding temperature, detectable acetylene, moisture, oil temperature, or dielectric strength. “Wy” represents weighted factors.

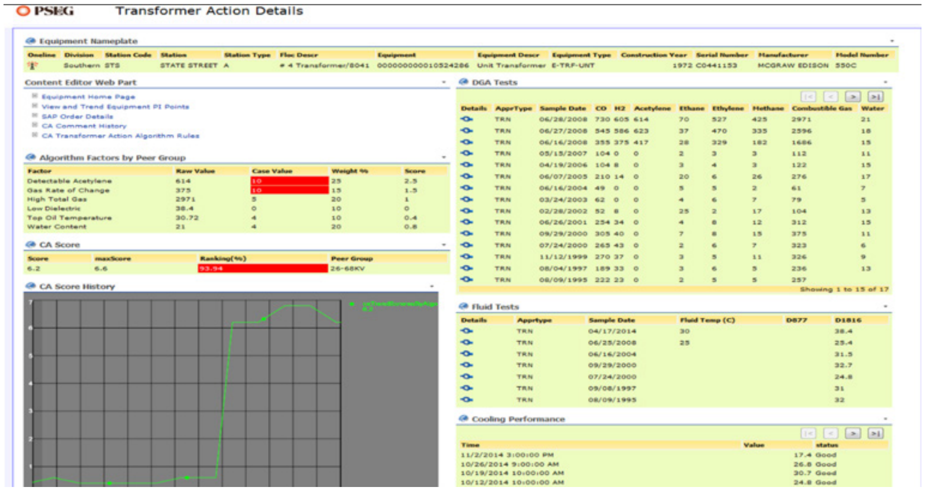


Figure 6 – CA (Conditions Assessment) example from PSE&G

VISUALIZE RESULTS

Once the raw data has been transformed into meaningful and actionable information, it needs to be spread across the organization. Combining different data sources is crucial to enabling a smart decision making process and creates a single source of truth.

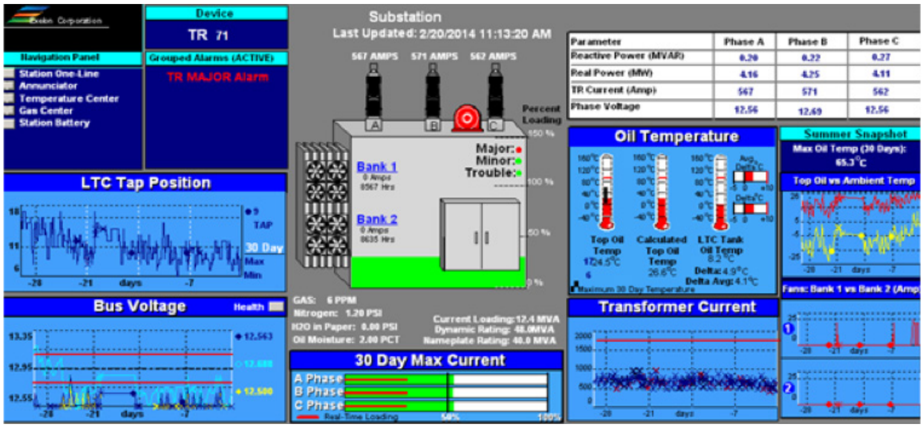


Figure 7 – Transformer on-line condition monitoring example from ComEd.

NOTIFY

Currently, there is a shortage of skilled TSO labor, so TSOs must prioritize where to spend time to achieve operational excellence. When the asset behavior is not compliant with best practices or industry standards, notifications must be in place.

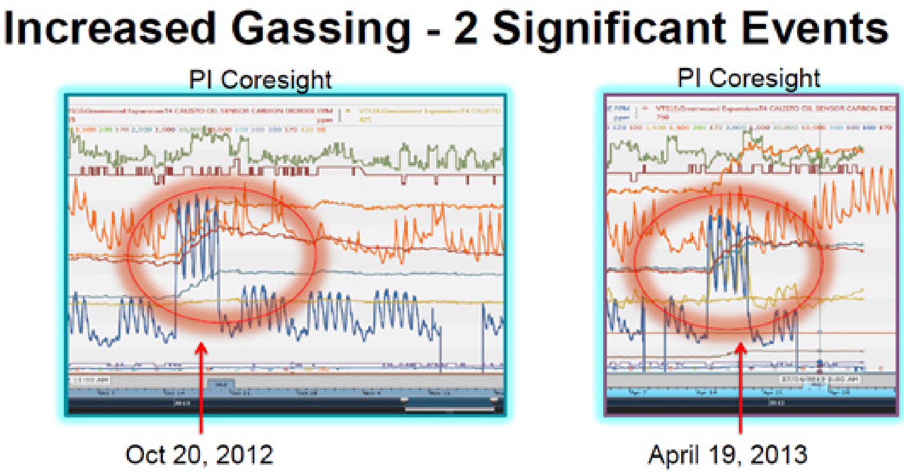
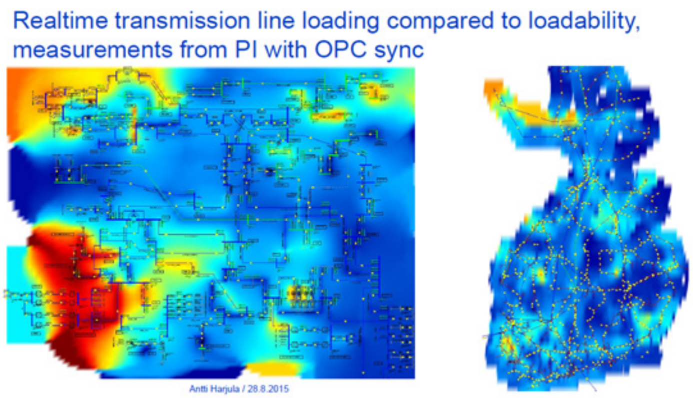


Figure 8 – Increased gassing events detection and notification example from PowerStream.

EXPOSE ASSET DATA TO OTHER ASSET MANAGEMENT TOOLS

An asset management system ([2]) is a set of interrelated and interacting elements of an organization whose function is to establish the asset management policy and asset management objectives and the processes needed to achieve those objectives. The elements of the asset management system should be viewed as a set of tools, which are integrated to give assurance that the asset management activities will be delivered.

Understanding asset data in a contextualized and meaningful way is crucial to a successful SAM process. Geographical information systems, enterprise asset management, network modeling, and big-data tools need to be interconnected and fed the right asset data.



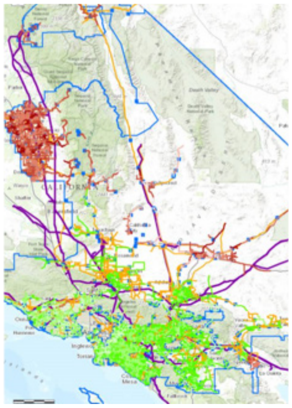


Figure 9 (left) – Integration between SIEMENS ODMS and the PI system example from FINGRID

Figure 10 (right) – Integration between ESRI ArcGIS and the PI system example from Southern California Edison

CONTINUOUS IMPROVEMENT

The Plan, Do, Check, Act Model is widely spread across the TSO industry, and its method supports continual improvement in any business process. Continual monitoring of the asset operational data is crucial to optimizing the asset management process.

Figure 11 – Substation dashboard example from MERALCO

B. Advanced Analytics

An analytics implementation using the OSIsoft PI System is a simple configuration of the standard tools and services. The PI System is designed to be easily configured by administrators and for smart asset data to be accessible to end-users. For end-users, the PI System provides out-of-the-box integration with tools, such as Microsoft Excel, to allow secure access to operational data. The system is designed so only basic levels of training are needed in order to begin configuration and data analysis.

In October 2015, OSIsoft announced the latest extension to the PI System Infrastructure, the PI Integrator for Business Analytics. This allows operational data from the PI System to be easily combined with all other forms of corporate data assets and to be used by many of the most commonly used business intelligence and analytics tools in the marketplace.

In January 2016, OSIsoft also announced details of an extended relationship and agreement with SAP, where SAP will resell the OSIsoft PI System as the "SAP HANA® IoT Connector by OSIsoft." The new connector helps companies combine data from their control and automation systems and their smart devices with transactional and business data within SAP HANA. This "out-of-the-box" integration enables operational data to be delivered to the SAP environment.

A typical architecture diagram of the PI System is shown below:

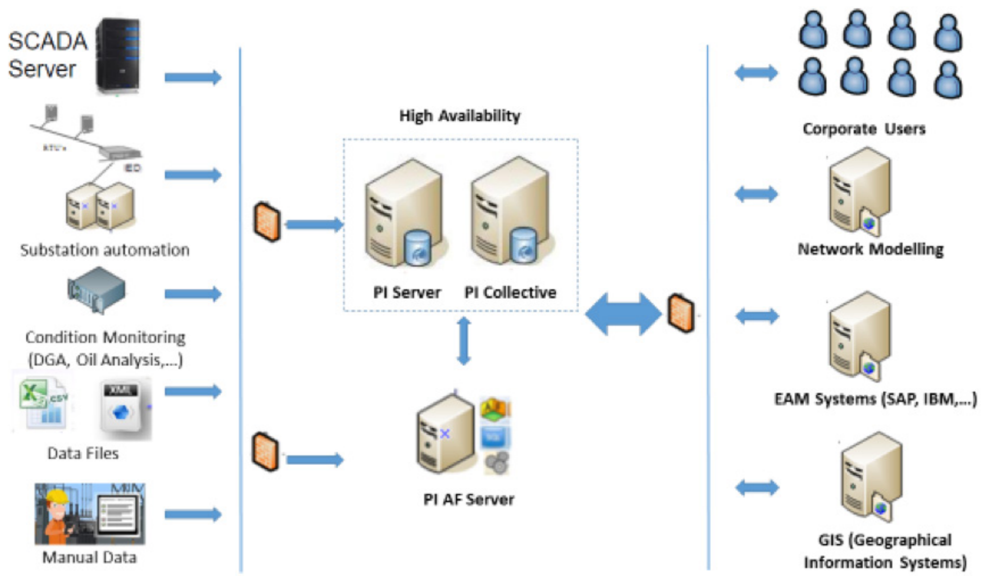


Figure 12 - Typical PI System architecture diagram for Asset Management

WHY OSIsoft?

OSISOFT'S CUSTOMER USE CASES

Customer	Business Impacts	Use Case Link
FINGRID	• Avoided 2 major transformers failures • Several proactive SF6 detections • Optimize timing of maintenance and replacement Investment	Kimmo Nepola, EMEA UC 2013 (Link)
PSE&G	• Overall reduction of total maintenance CAPEX and OPEX by 10-20% as the result of a CMMS (Computerized Maintenance management Systems) powered by PI System • One single event proactively detected in 2011 accounted for 1.5 Million dollars savings	Richard Wernsing, EMEA UC 2014 (Link)
Power Stream	• Resulted in 2 million dollars of savings by preventing critical transformer breakdowns • Detected 2 major increased gassing events	John McClean, Vince Polsoni, UC 2014 (Link)
Hydro Quebec	• Avoided major failures on transformers (May 2011) • Awareness about aging equipment condition • Detection of malfunctioning equipment • Avoiding unavailability and captive power	Nicolas Di Gaetano UC 2014 (Link)
Manila Electric Company	• $490,000 savings annually for selected 100 transformers • ROI within 3 years of the OSIsoft PI-based CBM initiative	Raymond Herrera, UC 2015 (Link)
ELIA	• Succesful implementation of the Asset Control Concept with focus on innovative competences, contributing to cost efficiency and high-quality asset management activities	Bart de Jong, T&D Forum 2015 (Link)

ComEd	• Proactive detection of several anomalies, such as
	  • Failing bushing pot devices
	  • Excessive circulating VAR's between transformers
		John Juna,
		UC 2014
		(Link)

DEFINITIONS & TERMINOLOGY

The following terms and definitions used within this document are taken from the ISO-55000-2014 Asset Management – Overview, principles and terminology, ISO-55001-2014 Asset Management – Management Systems – Requirements, and ISO-55002-2014 Asset Management – Management Systems – Requirements, all from ISO, 15-03-2014.

- Asset management involves ([2]) the balancing of costs, opportunities and risks against the desired performance of assets, to achieve the organizational objectives.
- An asset management system ([2]) is a set of interrelated and interacting elements of an organization, whose function is to establish the asset management policy and asset management objectives, and the processes needed to achieve those objectives. In this context, the elements of the asset management system should be viewed as a set of tools, which are integrated to give assurance that the asset management activities will be delivered.
- Asset management ([2]) requires accurate asset information. It is more than a management information system: it is also a means for coordinating contributions from and interaction between different functional units within an organization impacting this activity.
- Asset performance evaluation ([2]) can be achieved with different level of sophistication. It can be theoretical, empirical, simple and complex. Effective asset data management and the transformation of data to information is a key to measuring asset performance. Monitoring, analysis and evaluation of this information should be a continuous process.

ACRONYMS	
TSO	Transmission System operator (High-Voltage)
SAM	Smart Asset Management
CA	Condition Assesment
HI	Health Index
ISO	International Standard Organization
GIS	Geographical Information System
EAM	Enterprise Asset Management
AM	Asset Management
OPEX	Operational Expenditures
CAPEX	Capital Expenditures
CMS	Condition Monitoring System
CBM	Condition Based Mantenaince
LOL	Lost of Life

REFERENCES

[1] eBook: A Guide to Getting More Value from Real-Time Data in Condition Based Maintenance (http://pages.osisoft.com/Power-CBM-eBook_LP.html)

[2] ISO-55000-2014 Asset Management – Overview, principles and terminology, ISO, 15-03-2014.

[3] ISO-55001-2014 Asset Management – Management Systems – Requirements, ISO, 15-01-2014.

[4] ISO-55002-2014 Asset Management – Management Systems – Requirements, ISO, 15-03-2014.

[5] OSIsoft and SAP HANA http://www.osisoft.com/corporate/sap-hana/

[6] OSIsoft and Condition Based Maintenance http://www.osisoft.com/corporate/power-cbm/

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