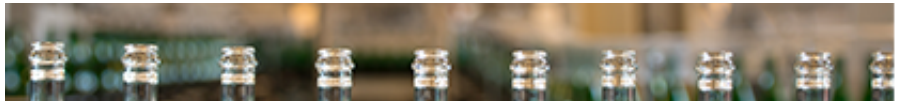

The Rise of Cloud Computing in Industrial Process Automation

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With the emergence of advanced technological developments, especially in cloud technology and data analysis, the general industrial sector and process automation plants, could have greater capabilities to solve business challenges and utilize the rapid spread of

internet based service models.

Cloud computing provides a way to exploit virtualization and consolidate computing resources, with minimal upfront investment, thereby enabling the worldwide availability of services and information. Further, these technological advances can also be utilized to offer prebuilt solutions and services. Big data analytics, for example, enables managing, consolidation, summarization and analysis of high volume and variety data with multiple variables. Many industrial automation applications are made suitable with cloud computing technology including historians, condition based maintenance, predictive maintenance, asset management, and more.

This article provides a brief cloud technology overview and discusses how cloud computing technology is transforming industrial automation for the future, enhancing plant productivity and cost optimization.

The Basics of Cloud Computing

The cloud computing model enables network access, on-demand, to a group of shared computing resources such as servers, networks, storage devices, software applications and services at the user's convenience. This is achieved through the efficient configuration of computing resources and interaction with service providers, all with little management oversight required.

Cloud components typically include:

- *Servers*: For computation of common resource sharing and to perform other services including resource allocation and monitoring, and data security.
- *Storage devices:* Redundant / distributed system for file storage purposes. If one file storage fails, data can be extracted from redundant / distributed storage making

cloud computing highly reliable.
- *Software*: Management and virtualization software (as required), deployment software, virtual machine manager, network; etc.

The main objectives of cloud computing focus on elasticity, on demand usage, pay per use and multitenancy. As such, cloud computing services are generally categorized into three types:

- Software-as-a-Service (SaaS)
- Platform-as-a-Service (PaaS)
- Infrastructure-as-a-Service (IaaS)

Depending on that implementation the cloud service breaks up into one of four basic cloud variants:

- Public
- Private
- Community
- Hybrid

The most commonly used model is the hybrid model, a fundamental combination of two or more clouds, wherein the cloud features include an assortment of public, private and community clouds. Non-critical/general activities are typically performed using public cloud while the critical/company specific and specialized activities are executed using private clouds.

The Technologies of Cloud Computing

A plethora of technologies have combined to make cloud computing a reality in industrial automation, including:

Virtualization

Virtualization occurs when a solitary physical instance of a resource or application is shared between multiple

companies or customers. This is enabled by assignment of logical names to various physical resources and providing pointers to respective physical resources based on demand.

Utility computing

Payment established on usage, or pay-per-use, is the basis of designing utility computing model. Computation resources are offered as a measured service, based on demand. The utility computing model is widely used in IT service industry.
However, improvisation in transparency, scalability, intelligent monitoring, and security need to be considered while utilizing this technology based on application requirement.

Service-based architecture

Service oriented architecture enables use of cloud services for multiple applications, regardless of technology used, product type or vendor. With service oriented architectures, data exchanges between different vendor applications are exploited to the maximum possible extent.

Grid computing

Grid Computing is described in terms of discrete computing, wherein a set of computers from different locations are interconnected to achieve a common business task. These computer resources can be geographically distributed and generally heterogeneous. Grid computing enables the user to break complex assignment into multiple miniature fragments. These fragments are allocated to various computers existing within the grid.

Cloud Data Consolidation and Analysis

We have seen a huge leap in the implementation of cloud computing systems, across various applications and in all sectors. The specific impact of cloud computing in industrial automation can control has been seen to improve data management and performance.

Cloud technology has opened opportunities for the industry to understand seemingly random/unforeseen events, which were difficult to predict in the past, due to lack of data and the right predictive data models. In present day, these models have been deployed in production units and are collecting large amounts of data, which is efficiently sharing data and empowering industry professionals with validated data engines and analysis tools.

Thus far, cloud technology has been an effective and important tool in helping make the Industrial Internet of Things (IIoT) a tangible reality and helping the process industry reap benefits through higher efficiencies and superior quality. As stated previously, this technology has resulted in the creation of process-related applications for a number of purposes including:

- Data historians
- Analysis tools
- Alarm management
- Asset management
- Performance management
- Training simulators
- Remote diagnostics

All these applications are offline activities which require subject matter experts to analyze and solve customer predicaments by consolidating data with expert analysis. In each application, relevant domain data is acquired from multiple sources, consolidated, analyzed for probable failure prediction.

Considering the direction that cloud computing applications have pushed for industrial automation, technology providers and users will likely continue offering cloud services in all these areas. Futher, these services can potentially be made available on an on-demand basis, without the addition of costly software or in-house infrastructure, by cloud service providers.

Foreseeable Cloud Applications & and the Way Forward

We expect the cloud computing efforts for process automation industry to revolve around one of two models:

The OEM (Original Equipment Manufacturer) Model

In this model, manufacturers would have the functions of engineering, asset health management, simulation, system diagnostics in their cloud domain, and would be able to provide specialized support to product users. This model may be the most cost effective, as pay-for-use operation expenses tend to be better for a plant financially, as they minimize capital investments for new computer hardware. Some equipment manufacturers are also developing diagnostic models wherein it may be possible to regularly inform owners about system trips, the functional status of a system, new service maintenance requirements and the overall active efficiency of the system. This model is especially applicable for manufacturers of distributed control systems, programmable logic controllers, vibration monitoring system, etc.

Centralized Corporate Model

The centralized corporate model enables process industries to have performance analysis capabilities asset health management, simulation functions, and system

diagnostics at one central plant location in their cloud domain. In comparison to the OEM model, this model typically provides more privacy, better control and higher security, while still delivering cost efficiency and energy efficiency, as well centralized monitoring of the utilities. The model is beneficial for the owners of multiple, similarly-focused plants, in monitoring this multiple-plant operation.

Many corporate operations in the industry are working towards the creation of a technical foundation for power industrial applications, in order to reduce unplanned outages and improve operational efficiency. Further the improvement of asset management, through superior system debugging, analysis and optimization, and the combination with cutting edge information technology and data analytics products on the cloud, will likely lead to the development of more front end operation technology.

The Future of Cloud Computing and Process Control

In the process control industry, the benefits of cloud computing are still being weighed against risks of production loss, safety, availability and unknown server locations. However, with the bevy of technological advancements, virtualized servers are becoming increasingly more attractive to end users. The rise of cloud computing may be inevitable necessity of survival for older, space-constrained plants who need these latest advancements in equipment, where few applications could be maintained in compact, cloud environment. This can also lead to secondary monitoring and expert systems being migrated to the cloud as well. It’s likely that we will see more and more of these applications being virtualized, providing more cost and space benefits to plant operators.

Perhaps most importantly to the world at large, the latest

developments are focusing on green cloud computing, improving the design, manufacturing, usage, and disposal of computing resources in order to facilitate the minimum level of environmental impact and damage.

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