Digital Transformation

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ABSTRACT

Plant engineers and operators typically use paper and clipboards when completing inspections, checklists, calibrations, maintenance work, inventories, etc. With the recent availability of Class 1, Division 1 and Class 1, Division 2 tablets, the plants are undergoing a digital transformation of their paper-based systems and procedures.

The digital transformation process begins with identifying paper-based systems and procedures to convert to digital form. The operating system, software, and tablets must then be selected. This is usually the hardest step due to the vast differences between the operating systems and tablets and the unique needs of each affected department. Once selected, the software and tablets undergo field testing and studies to gain user insight and measure performance. The digital transformation is then finalized, and the paper and clipboards are replaced with tablets and software.

Recently chemical, oil & gas, and hazardous waste incineration plants have begun pursuing digital transformation projects. The use cases are plant-specific and confidential. The customized digital forms and procedures that are developed range from compliance and safety inspections, to annual integrity checklists, to digital maintenance procedures, and more. All projects resulted in time savings, improved data collection and quality, and improved worker satisfaction.

This paper will discuss some operating systems and tablets that are currently available for Class 1, Division 1 and Class 1, Division 2 environments. This paper will also discuss recent use cases from plants throughout the US, and potential use cases for incinerators and boilers.

INTRODUCTION

The operators of incinerators and boilers have traditionally used paper forms and clipboards for operation tasks, maintenance tasks, compliance tasks, safety tasks, and more. This paper system means double work and less accuracy due to manual data entry. Today, the operators are being asked to do more with less resources and less headcount. Meanwhile, skilled talent is in short supply. These are the drivers for digital transformation and the implementation of advanced technologies.

One reason that many facilities continue to use paper forms and clipboards is due to the potentially explosive environments within the plant. Most electronic equipment has the potential to be an ignition source, thus the use of electronic devices such as mobile tablets have been banned from operating facilities. Today, intrinsically safe mobile tablets are available for all classifications of hazardous environments. The tablets come in different sizes, have different operating systems, and have different capabilities. Now digital transformation is a reality with the utilization of intrinsically safe mobile tablets within operating facilities such as incinerators and boilers.

USE CASES

There are too many use cases to include in this paper. The use cases herein are known or are potential use cases for incinerators and boilers. One use case discussed herein is a known use case that is so futuristic that most will be amazed to know of its existence.

Known Use Case #1

The environmental compliance burden on plants is time consuming. There are shift inspections, daily inspections, monthly inspections, numerous daily reporting requirements, annual reports, and more. In the past these inspections and reports were performed using a clipboard and paper forms. Once an inspection and report are conducted, the paper form may be converted into an electronic form by manual entry or in the form of a pdf document, and then is placed into a file cabinet and/or onto a server. This paper process takes significant time and effort. Furthermore, the ability to retrieve paper reports is often time consuming.

Hazardous waste incineration facilities have daily, weekly, and monthly container storage area inspections, tank storage area inspections, incinerator equipment inspections, landfill inspections, storm water inspections, potable water and sewage treatment systems inspections, and more. In this use case, a commercial hazardous waste incineration facility has converted all inspection forms and reports to electronic form that are completed using an intrinsically safe tablet. The completed inspections and report are automatically uploaded to the facility's server.

The benefits of this digital transformation use case includes:

(a) Significant reduction in labor costs;
(b) Reduction in errors that occur during the manual entry of paper data;
(c) No paper to file and maintain;
(d) Improved access to electronic compliance inspection forms and reports; and,
(e) Improved accountability of the inspectors.

Known Use Case #2

The maintenance activities at an operating plant involve a high level of attention to detail when it comes to daily calibrations of equipment including continuous emissions monitoring systems. In the past, standard operating procedures (SOPs) and calibration forms were in paper format on a clipboard.

A chemical plant has a digital transformation project underway to convert all maintenance SOPs and calibration and inspection forms into electronic format. The maintenance, instrumentation, and electrical technicians have intrinsically safe tablets that communicate via Wi-Fi to the server to access the SOPs and forms needed to conduct their maintenance tasks. In addition, the tablets are used to access plant drawings and to take photos. The completed inspections, calibrations, and photos are automatically uploaded to a database on the facility's server.

The benefits of this digital transformation use case includes:

(a) Significant reduction in labor costs;
(b) Speedy improved access to SOPs and plant drawings;
(c) Ability to capture photos with a tablet;
(d) Improved access to electronic inspection and calibration forms, reports, and photos; and,
(e) Improved accountability of the technicians.

Potential Use Case #1

There is a potential use case for incinerators and boiler that treat and store hazardous waste. The storage of hazardous wastes involve a high level of attention due to the health, safety, and regulatory requirements. Digital transformation allows the ability to report the data, analyze the data, and create dashboards for the storage of hazardous waste. In this dashboard, a waste management unit contains a total of ninety (90) containers with sixty (60) non-bulk containers and thirty (30) bulk containers displayed on the left side. On the right side, the containers are broken down by classification completeness, waste types, and off-site destination.

Hazardous waste generators are limited to the amount of time containers can be stored based on their classification. Permitted hazardous waste storage areas also have a need to know the quantity and time that waste has been in storage. Many facilities struggle with tracking the age of containers. With digital data, dashboards can be easily created to provide overviews, graphs, warnings, and more. An example of such a dashboard is presented in Figure 1.

Figure 1. Hazardous Waste Container Storage Area Dashboard

Potential Use Case #2

There is a potential use case for any facility that conducts safety equipment inspections, such as fire extinguisher inspections. A fire extinguisher dashboard is presented in Figure 2. The dashboard includes a map showing the locations of the fire extinguishers and integrates the inspectors that are assigned to complete the inspections. This is a perfect example of accountability and the ability to benchmark the inspectors. This dashboard identifies the slow inspectors that may need additional training, and the efficient inspectors that can take on additional responsibilities.

Figure 2. Fire Extinguisher Dashboard

Known Futuristic Use Case #1

The most futuristic use case in operation today is the digital transformation of control room operations to the operators' control of the plant equipment utilizing intrinsically safe tablets. The process control room board was migrated to a Windows 10 computer tablet. The operators control all of the plant operations using the tablets. The operators can monitor and control the operations of the plant including the opening of valves, the changing of flows, the changing of pressures and temperatures, the switching of tanks,

and other control room capabilities using tablets while working in the plant away from the control room. The plant has been operated using the tablets for a year now, and there have been no problems. Obviously, the plant has a very secure network from which the tablets operate. The benefits of this digital transformation use case are most impressive and too many to list. One might say that this use case is awe inspiring.

INTRINSICALLY SAFE MOBILE TABLETS

This section explains intrinsically safe, currently available mobile tablets having intrinsically safe certifications, their operating systems, and their capabilities. Most intrinsically safe mobile tablets have cameras, radio-frequency identification and near-field communication readers, and sensors. This paper does not discuss those capabilities; however, those capabilities are considered when selecting a mobile tablet.

Intrinsically safe means that the mobile tablet has been designed to limit electrical and thermal energy to a level below that required to cause an ignition in a hazardous atmospheric location. When there is a mixture of air and a flammable gas, vapor, mist, or dust, then there is the potential for an explosion to occur if there is a source of ignition. When mobile tablets need to operate in such environments or where such environments can occur, it is crucial to ensure that the tablet does not provide a source of ignition. Intrinsically safe means that the mobile tablet is not capable of causing an explosion.

There are several classifications for intrinsically safe mobile tablets. Depending on the environment, mobile tablets need to meet the specified intrinsically safe classification. Class 1, Division 1, Zone 1 is the most stringent requirement for intrinsically safe mobile tablets. Table 1 indicates the availability of the tablets having different classifications and varying operating systems.

Table 1. Currently Available Tablets with Intrinsically Safe Classifications

Classification	Android	iOS	Microsoft
Class 1, Division 1, Zone 1	Available	Requires Case	Available
Class 1, Division 2, Zone 2	Available	Requires Case	Available

Regarding the iOS tablets, the tablets themselves are not intrinsically safe. There are intrinsically safe cases that can enclose an iOS tablet in a case to ensure that the iOS tablet cannot be an ignition source. Note that the manufacturer must enclose the iOS tablet within the intrinsically safe case for it to be certified as Class 1, Division 1, Zone 1 or Class 1, Division 2, Zone 2 intrinsically safe. If the case is opened, it is no longer intrinsically safe until the manufacturer re-installs the iOS device within the case and certifies it as intrinsically safe.

There are three operating systems within intrinsically safe tablets, i.e., Android, iOS, and Microsoft. There are capability differences between the operating systems that must be

considered. Important capability comparisons are displayed in Table 2. Lastly, be sure to select an operating system that is compatible with the use case software application.

Table 2. Capability Comparisons of Operating Systems

Capabilities	Android	iOS	Microsoft
Communications	Wi-Fi & LTE	Wi-Fi & LTE	Wi-Fi & LTE
Security	Low	High	High
App Development	Easy	Requires Apple's Approval	Easy
Compatible With Software	Some	iOS Only	Most

WHERE TO START THE DIGITAL TRANSFORMATION PROCESS

The easiest place to start the digital transformation process is to identify low-hanging fruit within an operating facility. Identify a paper-based system that requires significant manpower and generates significant paper forms to convert to digital form. A task that always meets this criteria is environmental and safety compliance inspections. For example, one chemical plant having two (2) hazardous waste burning boilers has forty-two (42) environmental and safety compliance inspections.

The operating system, software, and tablets must then be selected. This is usually the hardest step due to the vast differences between the operating systems and tablets, and the unique needs of the end users and the requirements imposed by the IT department. In the past, the IT department had requirements that were impossible for intrinsically safe mobile tablets to satisfy. Intrinsically safe tablets are designed to limit electrical and thermal energy. It is important to explain the use case, the software, and the intrinsically safe requirements for working in the plants. With this understanding, the IT departments realize that less RAM and slower processor speeds are sufficient for the intended use cases.

In addition, most chemical and oil & gas facilities use the Microsoft operating system and SQL databases. Most engineers working in those facilities use Excel spreadsheets. All Excel spreadsheets and SQL databases can be run on a mobile tablet having a Microsoft operating system. This is another example of low-hanging fruit.

Once the operating system, software, and tablets have been selected, it is necessary to conduct a pilot study or testing within the plant to gain user insight and measure performance. Using a mobile tablet indoors does not equate to using one outdoors. For example, can the operators see the screen outdoors? Can they use the stylus while wearing gloves? Can they access the facility's Wi-Fi within the plant? Is the software user friendly? Can they work online?

The results of the pilot study or testing is very necessary to resolve issues and finalize the digital transformation prior to its implementation within a plant.

CONCLUSIONS

Digital data holds tremendous potential for operating facilities. Yes, the investment in mobile tablets, accessories, and software is significant. The return on that investment is often months, and not years, away. More importantly, digital data holds the key to transitioning into Industry 4.0 with the adoption of mobile tablets and automation to enhance operations with smart and autonomous systems fueled by data and machine learning. It takes a tremendous amount of data to enable machine learning.

The challenges with using mobile tablets within operating facilities have mostly been overcome. The challenges with working together between operations, environmental, safety, and IT are starting to diminish. As with human nature, once the environmental department begins using mobile tablets to conduct their compliance inspections at an operating facility, the safety and maintenance departments want to digitally transform their tasks and want mobile tablets, also.

Ultimately, it only a matter of time before the paper systems are replaced with digital form. It is a necessary transformation for all operating facilities to compete in the future with the growing changes in trade and the workforce.