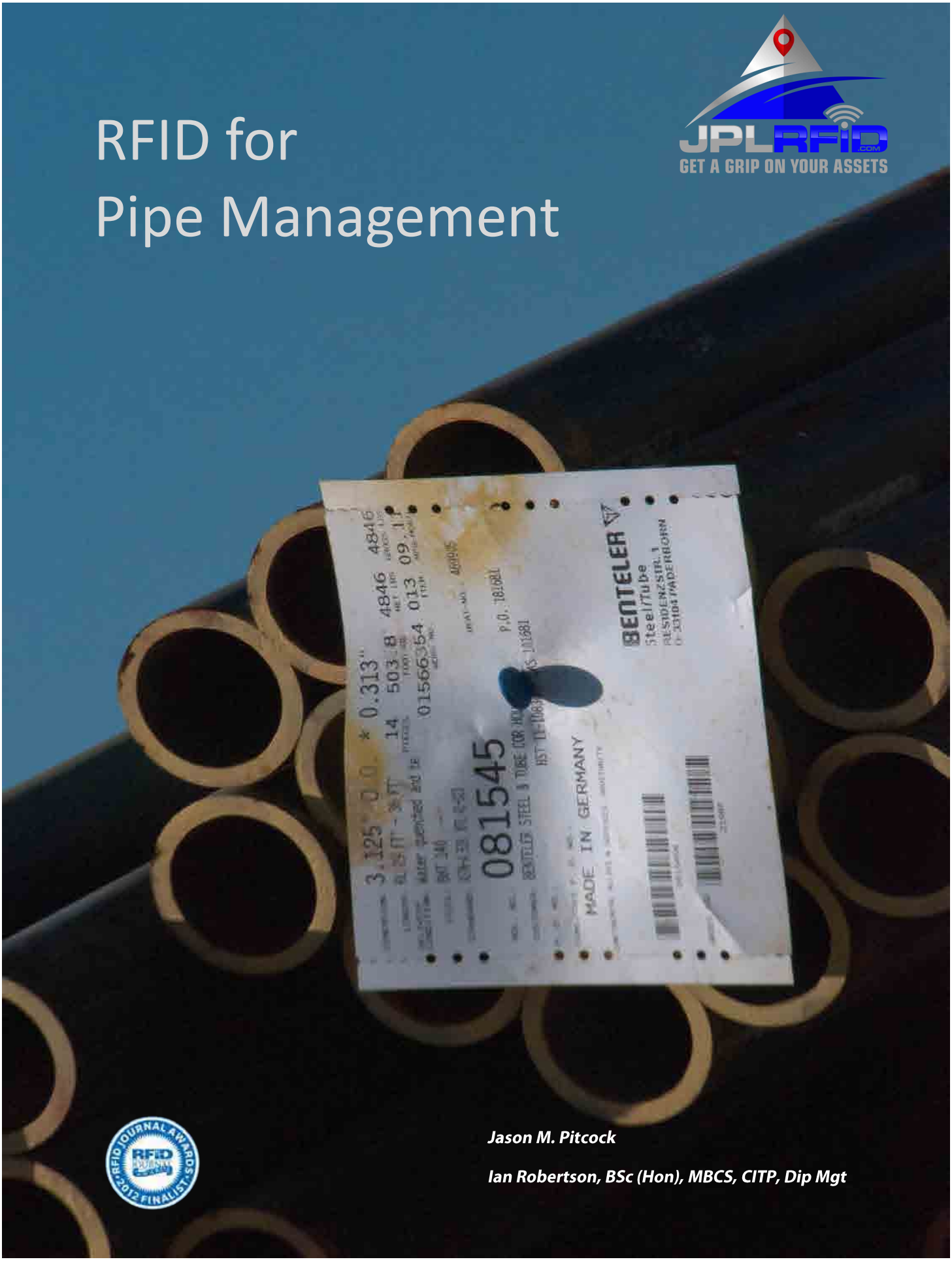
RFID for Pipe Management



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Abstract

The purpose of this white paper, what led to its publication, its scope, our method of investigation and acknowledgements to those who have helped us on the way are contained in this abstract.

1. We examine the 'pipeline problem' – by explaining that there isn't just one problem but a series of them which can become a serious drain on resources, time and safety.

2. Current methods focus on identifying joints. We have used joints as the example throughout this paper but virtually everything we have said about using RFID on joints applies just as much to other material and equipment used in the oil & gas industry.

3. Then we look at what key data is needed thru the life of a pipeline, why it must be accurate, up to date and available when needed.

4. This is followed by a brief look at RFID technology (necessary because we assume no knowledge of this subject on the part of the reader); followed by how RFID can help in joint management, and conclude why it is superior in most cases to current methods. We also identify what some of its limitations are.

5. Identifying a joint and accurately locating it provides valuable information that can help manage laydown yards, joint processing and other aspects of joint management. But that information is only valuable if it can be moved to where it is needed. For this we look at the concept of EPCIS – a global standard for exchanging data about 'events' that happen to items in the supply chain.

6. We close with a suggestion for further reading – a book on using RFID to improve supply chains, written by one of the authors of this paper.

Introduction

Purpose of This Paper

This paper takes a look at how identification and other data is captured in the management of pipeline joints in the Oil & Gas industry and how the introduction of RFID technology could help improve such processes.

Background

The initiative for writing the paper was triggered by the many questions we have received on the use of RFID in the Oil & Gas industry, but with a particular focus on pipeline joints.

Acknowledgements

We would like to acknowledge the invaluable help we have received from the many folks within the industry, especially those in and around the wonderful city of Houston, Texas, who have shared with us their current processes, aspirations for improvements, ideas and questions.

What is the Pipeline Problem?

There isn't 'One'

We start off by emphasizing that there isn't a single horrendous 'pipeline' problem but rather a series of them which collectively can, and do, provide what can be a serious drain on resources, time and safety. This breakdown of the 'problem' into its constituent parts is essential not only for understanding what those parts are, but equally for defining possible solutions to those underlying problems.

Which Type of Pipe Is It?

- Pipe joints look the same
- Pipe joints look different

Both of these statements are true. Joints that look different obviously are different, but pipe joints that look the same may or may not be the same. It's not always possible to tell simply by looking at the joint.

It is true that in many pipe lay down yards we found some very experienced workers who can often identify a joint by simply looking at it, but as a *systematic* identification mechanism, i.e. one that is consistently reliable and accurate, we believe that it does not offer the level of accuracy needed.

The pipe manufacturers have also recognized this problem and have taken various steps to minimize it. Among the techniques used we have observed:

Joint End Cap Color

End caps can signify almost any physical characteristics though we have observed that this technique is mostly used to indicate the type of joint. The drawbacks with this technique are:

- The end caps fall off (we have found even screw caps to be missing)
- They can be switched between joints – usually because they have fallen off and are inadvertently placed back on the wrong joint
- Colors fade over time, especially in very sunny climates (though some caps are resistant to ultraviolet light degradation)
- Color blind workers could have a confusing time!
- It doesn't usually indicate the length of the joint
- There is no global standard for which color is used

Joint End Color

The ends of the joints are painted in different colors to differentiate them. The drawbacks with this technique are:

- Colors fade over time, especially in very sunny climates
- Color blind workers could have a confusing time!
- It doesn't usually indicate the length of the joint
- There is no global standard for which color is used

Labels

A physical label is attached to the joint showing details of manufacture, including type of joint. The drawbacks with this technique are:

- Print can fade over time, especially in very sunny climates
- The labels can be become detached from the joint
- The person has to be physically close to the label to read it
- And they could transcribe the details incorrectly

Physical Differences

It is also acknowledged that there is a degree of physical differentiation – a joint with a 4" Outside Diameter (OD) looks very different to a joint with a 12" OD. And we have also encountered workers who rely upon Wall Thickness to differentiate between similar joins with the same OD. But we also observed some variance in the accuracy of this method when we asked workers to identify wall thickness from a distance.

Length

It can be very difficult to find a joint of a specific length, especially within a bundle or where joints are loosely stacked in racks. If the joint is on the outside then its length can be observed but if it's inside then this may not be possible.

Which Joint Is It?

Unique Identification

Not all joints have or need a unique identity but there are reasons why a joint could have one:

- The joint is for a special order and unique to that order
- It is subject to regulatory control such as UV inspection & certification
- The customer has asked for it to be uniquely identified
- The manufacturer has given it a unique identifier to assist in processing it when it is returned

The problem is then similar to that of identifying what type of joint it is, only more complicated as a unique reference must be searched for and found.

How to Capture that Identity?

Current Methods

There are methods that help in the data capture process, each with advantages and disadvantages. But it is important to note that *none of the methods described below will work once the joint is part of a string that has been laid underground*.

Barcode

Barcodes have been used in industry since the early 1960's so have developed and matured over half a century. Almost every product sold today has a barcode on it and transportation and logistics could not operate today without them. However, they too have advantages and disadvantages:

Advantages:

- Cheap to produce on paper (more expensive on metal)
- Technology well proven
- Global standards
- Can be read optically as well as with infrared

Disadvantages:

- Tendency to fade in paper printed form
- Requires a direct line of sight to be read, so cannot be read if on the surface of a joint that is on the inside of a stack
- Limited reading distance with normal scanners
- More difficult to apply on contoured (pipe) surfaces

Label

This method is really an extension of the barcode label concept, the main difference being:

- Additional information is carried on the label that is not in barcode form, so cannot be captured automatically
- The information & barcode is printed on a paper/Mylar label that is then attached to the joint

This method shares all of the advantages and disadvantages of the barcode method above except that the difficulty of apply on contoured surfaces does not apply.

It has the added advantage of carrying more information albeit with the restriction of not all of it being captured automatically.

Stencil

With this method the information is stenciled directly on to the outer surface of the joint. There are systems available that will print directly on to the surface (they are used for instance to put barcodes directly on to cartons) but this requires expensive and costly equipment not necessarily suitable for joint processing.

Advantages:

- No logical limit on the amount of data that can be stenciled – limited only be available surface

- Technology well proven
- Easy to read if not faded or damaged

Disadvantages:

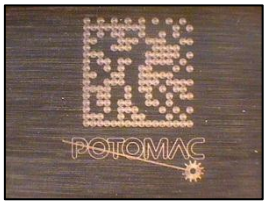
- Can be covered by dirt and grime
- Requires a direct line of sight to be read, so cannot be read if on the surface of a joint that is on the inside of a stack
- Limited reading distance
- Time consuming (have to make each stencil and then place on surface before painting)
- Can be made illegible thru abrasion

Direct Part Marking (DPM)

With this method the information is permanently etched into the surface of the joint. This technique has been used for many years in industries such as aerospace where permanent marking of parts is essential for safety reasons.

Advantages:

- Much more resistant to damage thru abrasion
- Technology well proven
- Global standards
- Does not fade or weather
- Can carry larger volume of data in relatively small area (~4k characters in a Western alphabet)



- Has redundancy built in (at a high degree if Q level is used)
- Can be read optically as well as with infrared

Disadvantages:

- Dirt may fill the depressions which would make it unreadable
- Requires a direct line of sight to be read, so cannot be read if on the surface of a joint that is on the inside of a stack
- Limited reading distance (usually ~ 10 X the width of the QR code)
- More expensive than printed barcode
- Requires some contrast between raised and depressed areas

  Not viable where no degradation at all of the surface is permitted

Hands, Pen & Paper (HPP)

Readers over the age of ~45 will recognize this as the system in general use before barcodes! It means that the data is captured by writing it down on to paper, usually so that it can be entered into a system later in the process. Any information on a label that is not in barcode form and all information on a stencil has to be captured using this method.

Advantages:

- Less costly in terms of equipment than any other system to execute

- The information can be in any human readable form
- Centuries of use so well proven technology!

Disadvantages:

- Writing in rain, wind or snow is rarely practical
- Extremely time consuming
- Requires a direct line of sight to be read, so cannot be read if on the surface of a joint that is on the inside of a stack
- Capturing of data and entering into a system from paper are both prone to error
- There is a delay between capturing the data and it being available for use in a system (and therefore visible to any inventory, order or administration system)
- May fail regulatory needs to capture and maintain *accurate* data about joint manufacture and use
- Tends to demotivate employees (who know that there are better ways these days to capture the data)

It may seem obvious that with such disadvantages, few companies can really be using this method? In practice, the *majority* of companies that we have visited use this method at least in part – generally upon receiving the joints. Some are using only this method to manage the storage and movement of their joints.

Capturing Joint Identity – Conclusions

- None of the methods outlined above provide a foolproof process for always being able to capture the identity of a joint
- A successful barcode or DPM scan is likely to provide more accurate information
- Other methods are more error prone due to human transcription of data
- None of them provide any means for capturing information once the joint is in the ground
- Not all joints require an identity

Where Is It?

Current Methods

Determination of joint type & specification does not equate to being able to find it easily. Most of the identity capture methods set out above require the person searching for the joint to be within a few feet of the identifier – the exception being when searching for a generic type of joint by color code where the joint length is unimportant.

Locating joints in a lay down yard, port or storage facility can be challenging. Locating a specific joint can be extremely frustrating. We have observed no laydown yards or other joint storage facilities that manage storage locations below a simple rack level. But we have observed many that managed only to a general zone and some that don't really manage locations at all, but rely upon employees searching for the joints.

Location Identity Capture

Even where locations such as rack number are used, we have rarely observed an automatic mechanism being used to capture the identity of the rack itself when the joints are put away into the rack. The location is usually written down, providing yet another opportunity for human error.

Most Common Locating Method

The most common method encountered to locate and pick a joint is to send a person (or even persons) to search for it. On one occasion we encountered a team of two who had been searching for a specific joint for an urgent customer order for 3 ½ hours. They had no idea how much longer the search would take.

How Long Has It Been There?

Does It Matter?

At first glance it may not seem to matter too much how long a joint is stored – after all, it's metal and can withstand a lot of exposure to the elements. And as an asset it may not always be depreciating with time as inventories of finished consumer goods might. On such assumptions the traditional emphasis on FIFO (First In First Out) may not seem to be of much value. But joints that are stored for long periods of time can lead to preventable problems such as:

- Fading barcodes, or labels or stencils

- Repeated physical handling (such as being moved looking for other joints) leading to increased risk of damage to the identifying data
- Natural organic growth obscuring joint markings (yes… we have seen large sections of a rack obscured by such growth!)

In addition, should an issue be discovered with the joint when it is finally located/picked; then taking up the issue with the supplier after a couple of years may prove difficult.

Lack of Identity

Should it not be possible to identify a joint, either individually or as coming from a specific bundle, then it would not be possible to be certain as to when that joint was taken into inventory.

Where Has It Been?

For operations where joint undergoes multiple process stages it helps to know where it has been and precisely when it left there, as such data would provide the basic timing for each process step. So a manufacturer of coated joints using a third party close by to do the coating may wish to know

- When the joint left the manufacturing line
- When it left the manufacturer
- When it arrived for coating
- When if left coating
- When it was finally shipped to the customer

In this particular example this data would enable the manufacturer to know if the coating service was keeping to a Service Level Agreement (SLA) on coating turnaround.

But such data can't be collected unless each join has an identity or it is certain that the bundle that it is in will always be processed together.

Key Pipe Data

What Data?

Most joints used in oil & gas today have key parameters that must be retained and recalled when needed. Examples of this data include:

- Outside Diameter (OD)
- Wall Thickness (WT)
- Heat #
- Internal Design Pressure (IDP)
- Length

Not all joints require all data but when such data is required then it must also be accurate, available when and where required.

How Is It Captured?

The issues for capturing key data from the joints themselves are exactly the same as for capturing the identity of a joint – because this data is usually in the same place. However, there can be additional issues with capturing the key data such as:

- Barcodes tend to take up a large amount of space for relatively small amounts of data (this is not the case for DPM)
- Multiple barcodes overcome this to some extent but take more time to capture the data and can cause confusion for the user as to which barcode(s) to scan
- The more data that has to be written down, i.e. captured by HPP, the more the chance that errors will be introduced and the longer the task will take
- Not all data will necessarily be found on the barcode, DPM or label. Where this is the case then the stencil must be found to recover the balance of the data

  Where the stencil data can't be recovered, then a decision must be made as to which data on the receiving documents will be recorded against which joint

Business Need

All of the issues considered above can be condensed into a set of real business needs for the safe, efficient and effective management of pipeline joints in the oil & gas industry:

- It must be possible to capture all necessary joint data
- Data capture must be quick and accurate
- Data storage on the joint must be robust in all environmental conditions likely to exist
- Capture must involve minimum effort
- And minimum cost

- Joint must be easily located (including in ground)

There are other capabilities which, while not absolutely essential for pipeline management, provide added benefits

- Knowing where a joint has been and when it was there
- Timing the movement of joints thru processes
- Be able to exchange joint 'event' data (what, where, when) using global standards

We next examine how the use of RFID technology can help satisfy these business needs in ways that are more beneficial than the data capture methods examined above.

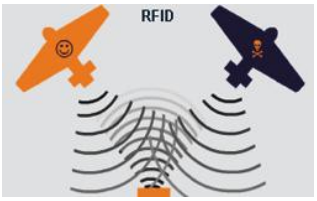
How Does RFID Help?

RFID

We assume no prior knowledge or understanding of RFID on the part of the reader so before embarking upon an examination of how RFID can help; it's first necessary to give a very brief explanation of RFID technology. It is far beyond the scope of this paper to enter into the realms of RFID technology though reader's wishing to understand RFID technology in more detail should start with Pat Sweeney's *RFID for Dummies*[1].

What is RFID?

RFID started as a means to identify something using radio energy. A radio beam was projected at an object and that object responded with its identity.



RFID Origins

The concept has its origins in World War II when both sides sought an accurate method to identify aircraft and distinguish friend from foe. This has developed into modern equivalents IFF (Identify Friend or Foe) for the military and SSR (Secondary Surveillance Radar) for civilian aviation.

Modern RFID

Today's RFID systems have enhanced capabilities compared to their ancestors:

- Passive systems have been developed which don't require the RFID device on the object (the 'tag') to have any power source of its own
- Data other than just the identity of the object can be retrieved
- Tags can be written to as well as read from
- RFID 'readers' do both the reading and the writing
- Data transfer rates between the tag are much faster
- A complete set of global standards for the use of RFID in supply chains has been developed (ISO 18000-ঌ Series)

RFID Practical Considerations

Line of Sight

RFID does not require 'line of sight' to work because radio energy can penetrate many common materials such as cardboard and most plastics. Most RFID energy will not penetrate thru metal but the energy can be reflected off a metal surface. In some cases it is even possible to read a tag behind a metal object because of such reflections. But it is important to remember that the RFID signal must have a path to the tag and a path back from it.

Amount of Data Stored

There is no theoretical limit as to the amount of data that can be stored on a RFID tag but there is a practical one. If the tag is to be read while it is moving then whatever data is needed must be read while the tag is still within range of the reader. This tends to limit the amount of data that is actually retrieved.

Readers

These can be fixed in place and automatically detect tags passing thru their radio energy 'field' or handheld units that often combine RFID capability with barcode scanning and network connection.

[1] Sweeney II, P.J. (2005) *RFID for Dummies*, Hoboken, NJ, Wiley ISBN 978-0764579103

Read Range

Read range depends greatly upon the type of RFID system and the frequency being used. Some systems have a range of up to 100 meters. More common passive UHF RFID used in supply chain operations is limited to about 100 feet with normal readers with optimized long range tags and 30 feet with tags in common use.

Useful Associated Technologies

Simple RFID provides the means to read data from a tag or write data to it. It doesn't tell you where the tag is or how to get to it from where you are. But such capabilities can be provided by combining information gathered from the RFID and other devices.

Geiger Counter

This is the name in general use for the Halogen Counter invented by Sidney Liebson but based upon variations of the original developed by Hans Geiger and Ernest Rutherford in Manchester, England in 1908.

It detects many forms of radiation and signals the presence of radiation by emitting a beep tone. As the level of radiation increases, the volume of the tone increases and the interval between tones decreases.

Certain RFID readers can achieve the same effect, not by measuring radiation, but by measuring what is called the *Returned Signal Strength Indicator* (RSSI). The user tells the reader what tag to look for and once the reader finds that tag in range it starts the Geiger function. Moving closer to the tag will increase the strength of the returned signal, thus increasing beep volume and speeding it up. Moving further away from the tag will have the opposite effect.

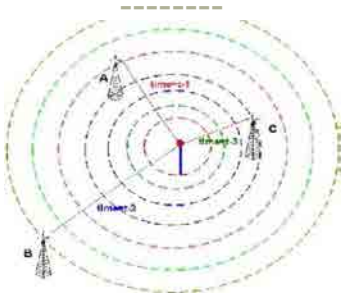
Global Positioning by Satellite (GPS)

Some readers have inbuilt GPS sensors and others can accept external GPS receivers as an add-on. Provided the reader has sight of at least three GPS satellites, this gives the reader the ability to know where it is all the time.

If the reader knows where it is and it has located an item with a tag on it, then it knows approximately where that tag is too.

Triangulation

This technique will be very familiar to anyone who has mastered the art of terrestrial navigation. Since radio energy travels at a constant speed; readers can work out the distance of a tag from the reader by the time the signal takes to get to and from the tag.



If three or more readers in a large area such as a laydown yard could do this, and a central controller knows the precise location of each reader, then the approximate position of the tag can be deduced by triangulation – finding the intersect of the three radii from the three readers.

Combination

Lastly, it is possible to combine these capabilities to enhance processes. An example of this is to use the GPS functionality of the reader to guide the user to the approximate location of the item being searched for. Switching to Geiger functionality will, if the tag is in range, then guide the user to the precise location.

Capturing Joint Data

Automation

Where joints are going thru a natural choke point, such as an exit gate from a laydown yard, it is possible to install fixed readers & antennas that operate at higher power levels and so can detect what is leaving the facility. This should reduce shipping errors and can be used to automatically trigger customer invoicing.

Speed

The data on a RFID tag can be captured by scanning the tag with a RFID reader. It happens very fast, especially if a small number of tags (<50) are being scanned. Barcode/DPM scanning is also very fast once the infrared beam is lined up on the barcode/DPM and the trigger is pulled on the scanner. But to scan the next barcode/DPM you must then reposition the barcode scanner to aim the infrared beam or optical device at it. RFID can scan multiple tags in a second.

Some movement of a handheld RFID reader may be needed to optimize the antenna orientation but this is not in any sense 'aiming' the scanner at the tag.

Accuracy

Barcodes, DPM and RFID all capture data accurately.

Data Volume

RFID tags can hold much more data than barcodes. In theory they can also hold more data than DPM but in practice they will hold about the same.

Read Distance

Barcodes and DPM have a very limited distance in joint management application because to read them at distance beyond ~10 feet would require them to be too large.

RFID read range depends greatly on the type of RFID and the design of the tag being used. For joint management it is recommended to use UHF Gen2 systems. It's possible to read tags on joints from distances up to 20 feet with flexible on metal tags. Special tags designed for long range, which tend to be larger, can be read at up to 100 feet.

Robust Data Retention

The issues with data retention for barcodes and DPM have been outlined above. Passive RFID tags, as would be used for joints, have no moving parts and are solid state computer/memory devices. There is nothing to wear out, fade or fill with dirt.

About the only things that will cause a passive RFID tag to no longer work are:

- Hitting the chip (which contains the computer and memory) with something hard and heavy
- Cutting the connection between the chip and the antenna

Flexible tags used on metal could suffer from both of these though we have tested some that survived being hit with a 3 lb hammer and being attached to a metal file and run over with a Ford F-150 truck (the video of these tests is on YouTube).

Tags that are encased within plastic, silicone or polycarbonate should not be impacted by either problem.

We have found few tags that will survive heat treatment beyond 300℉, so this must be considered if a joint is to be heat treated. There are tags that can survive such conditions but they are extremely costly and require special application. It is more effective to replace the tag after heat treatment.

Locating Joints

We have briefly described above in some methods that can be used to locate joints quickly. If the joint searched for is known to be within a general area then the Geiger functionality can be used to locate it. The time taken will of course vary but it will certainly be much quicker than using a visual search, reading labels, scanning all barcodes/DPM and so on.

If the GPS coordinates were taken of the put away location when the join was placed there, then that can be recorded in a central system, downloaded to the handheld and then used to guide the user to the general area where the item should be. The Geiger functionality would then take over.

Many readers are also capable of indicating how strong the return signal (RSSI) for each tag is in relation to all other tags, and even ordering them so that the tag with the strongest RSSI is at the top of the list on the display screen.

Where joints are already underground then RFID can be used to detect where they are by reading their tag. This is much more limited in performance because of the impact of the earth, moisture and elements now covering the joint. Generally speaking passive systems are limited to a depth of up to 5 feet.

Data Capture Effort

Capturing data from a joint with RFID is far less effort than using HPP as there is no writing to do! It is also less effort than barcodes or DPM as there is no need to line up an infrared beam or optical device to scan.

Where multiple tags are to be read then the difference can be substantial. We have read the identities of entire stacks of joints in just a few seconds.

Data Capture Cost

It will be many years before the cost of a RFID system is lowered to where it can complete with barcodes or DPM on cost alone. However, a comparison of costs alone is usually extremely misleading.

The use of RFID in managing joints provides significant benefits that:

- Speed up identifying, locating and processing joints
- Significantly reduce human intervention, effort and time
- Reduce human induced errors

- Enable all key data to be carried on the joint if required
- Improve the level of service given to customers
- Enable trading partners down the chain to also benefit from the presence

RFID Help - Conclusion

There seems little doubt that the use of RFID on joints could beneficially revolutionize the way that the pipeline industry operates. So far though, we have found few companies who are considering adopting this technology. We have been given various reasons as to why this is the case:

- Passive RFID doesn't work on metal – not only does it work on metal but recent innovations actually use the metal surface to improve performance
- We can't afford it – given the current boom the industry is enjoying, this one is hard to understand
- It's too new for us – would you not use a super new effective joint coating because it was new?
- We don't have time – probably because your resources are looking for joints
- We don't understand it – we'll help you
- We think we'll wait and watch what happens – if everyone does this it will be a long wait and there won't be much to watch

Like most new disruptive technologies, and RFID is just that, it will take time for industry to see the benefits and take the plunge. But implementing RFID is not something that should be rushed or entered into without careful thought of the impact on processes, people, customers and assets. It is not, or at least should not be, a quick transformation.

So if you competition does take the plunge ahead of you, then catching up will be quite hard. In fact, you may never actually do so.

How Do Standards Help?

Introduction

Simply put; standards:

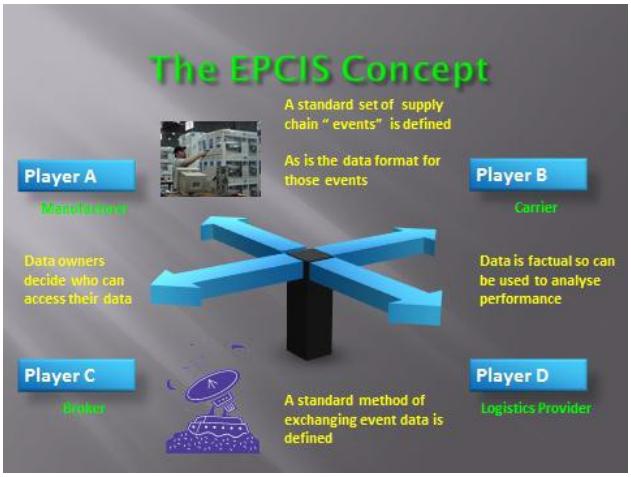
- Avoid duplication of effort
- Avoid unnecessary effort
- Save time
- Lower costs
- Encourage cooperation across industries, countries and cultures

Joint Data Standard

The Oil & Gas industry has many standards at a country level though there are groups, such as ISO Technical Committee 67 Sub Committee 2, that develop standards at a global level. But we believe that what is needed is a global standard for representing the basic parameters of a joint.

Event Data Standard

We have made multiple references to an 'event' in this paper. This terminology was taken from the original work done by the EPCglobal - now part of GS1 – EPCIS (Electronic Product Code Information Services) Standards Group.



This group sought to develop a standard, using XML, which enabled trading partners in a supply chain to exchange data about where things were in the processes and to do so in a standard manner. So if an item being manufactured for a customer had been completed and moved to 'shipping preparation' then a standard message could be sent showing:

- What the item was
- Where it was
- When it was there

And by implication

- Why it was there

In this case, things don't go to 'shipping preparation' unless they have been completed and are ready to ship to the customer, so it was there because it was completed.

EPCglobal developed and published this global open standard way of representing an event[2]. It can be used for any industry, not just the Retail industry that it was originally developed for

Standard Data Exchange

But just describing the event is not enough – it's necessary to describe what item the event happened to. Further details of the item can also be described. For joints at a minimum the identity of the joint would need to be provided. An example of an event that may involve providing further data is UV testing and the issuing of a certificate. The event is the testing and additional data may be the certificate number.

Unfortunately, the standards for this aspect were confined to the GS1 system of identifiers used in many commercial supply chains, and these are not suitable for describing joints. We believe that the Oil & Gas industry would benefit from the development of similar standards for joints, and hope that an existing industry standards body such as API would be willing to lead such an undertaking.

ECPIS Flexibility

It is a tribute to EPCglobal/GS1 and those early pioneers of the Event Data concept that they realized that what they were developing would not suit everyone and that other industries would need to develop EPCIS standards too.

They included in the standard a mechanism for extending it to cater for other industries while still remaining true to the original EPCIS concept.

Trading Partner Exchanges

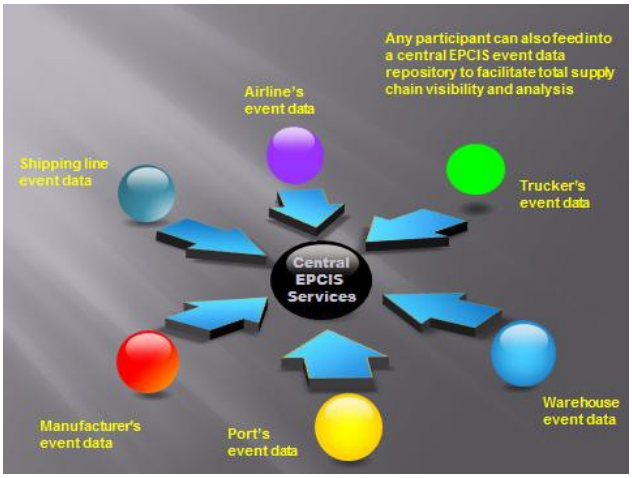
Since any EPCIS compliant system can accept ECPIS messages a company need develop such capability only once. SAP, Oracle and other ERP's; already have such capability available (both companies were members of the original ECPIS standards development group).

This means that a pipe mill could transmit details of a joint or bundle to a pipe distributor, which would eliminate the need for much data capture when the joints are received. Simply reading their tag would produce their identity which is then used to retrieve all other data.

[2] See www.epcglobalinc.org for a full explanation of EPCIS

Complex Supply Chains

Where there are multiple players in the joints supply chain then event data could be subscribed to a central EPCIS Service which made the data available on demand to any authorized user (disclosure – JPL RFID Holdings LLC provides such a service commercially).



RFID in Supply Chains

If you would like to understand more about how RFID can help improve other aspects of supply chains, such as inventory management, logistics etc. then you may wish to read one of our books:

Which you can purchase at www.s-c-r-c.com

Its author, Ian Robertson, was a finalist for the Global Special Achievement Award for Contribution to the RFID Industry at the 2012 RFID Journal Live show in Orlando in April 2012.