RFID Is the Alaska Gas Pipeline's Strongest Link

A construction project this huge, and in such a hostile environment, faces some unique challenges, which RFID can help address.

Nov. 6, 2006—Alaska is a remote area, its boundaries sharply defined by few transportation points using ships, aircraft and limited road infrastructures. One land road connects Alaska to the Outside (the word *Outside* is a proper noun in the Alaskan vocabulary). This road, the Alcan Highway, passes through Canada, then down to the United States—the only land route between the nation's 49th state and the others to the south. And yet despite its remoteness, Alaska is positioned to be a first frontier for RFID.

The Trans-Alaska oil pipeline stretches 800 miles from the top of Alaska to its bottom, crossing more than 800 rivers and streams, torturous mountains and valleys. One road parallels this pipeline for daily logistics support by commercial carriers hauling logistics supplies and project management materials, as well as for daily operation and maintenance activities. The Alaskan pipeline development stories, more than 30 years ago, are part of the history books for today's young logistics managers and project managers to peruse, and part of today's news stories as sections of the pipeline wear out. But a new world-class pipeline is coming, and RFID will play a key role to show how a small computer chip can save millions of dollars. The Alaska Gas Pipeline will connect Alaska's North Slope to the Lower 48, stretching 2,140 miles.

When work started on the oil pipeline in April 1974, the initial equipment required weighed nearly 40,000 tons. Each ounce of this material was shipped in by air, and trucked across roads made of ice, in the winter. By the end, transporters had moved more than 3 million tons of material into the pipeline construction area, and each item had been hand-counted. Millions of cubic yards of gravel had to be mined, stockpiled and hauled, and thousands of individuals had to be moved, housed, fed and kept safe within a hostile environment.

Putting aside any political issues, the pipeline took three years to complete and used a workforce of more than 70,000 people, with a surge capacity of nearly 30,000 people one year. The physics of building of the crude-oil pipeline was more than just connecting pipes, however—it involved conducting more than 300 archaeological surveys, drilling nearly 4,000 boreholes, examining in excess of 15,000 soil samples and building 29 construction camps.

aintaining an inventory of the material's location, where it needed to be and where it was finally installed was, essentially, a manual process. Warehouse personnel, logistics personnel, construction crews and a small army of support personnel kept track of the material as it moved through the supply chain. In the process, databases were developed and maintained, inventories taken, mistakes made, reorders required, material lost, and emergency shipping and costs incurred. And throughout it all, constant communications were essential to keeping things moving. The final project costs exceeded original estimates, in part attributable to the challenges of manually maintaining a supply chain. While supply-chain challenges did occur, the crude-oil pipeline achieved its unique mission of bridging the need to move crude oil from the north slope of Alaska to the rest of the world.

The Alaska Gas Pipeline will need better processes, such as RFID technological methods, to help control project costs, manage financial risks and keep the project on schedule. When dealing with literal mountains of materials, error rates of 1 percent or more are not acceptable. By way of example: If a single section of pipe is 20 feet long, a mile of pipeline would need 264 pipe sections. For the 2,140-mile pipeline, this would equate to 564,960 pieces of pipe. If the error rate were only 1 per 1,000, there could still be approximately 564 errors made while installing the pipe alone. If using RFID could lower the error rate to a Six Sigma level, the total numbers of errors could conceivably drop from hundreds to in the single digits, resulting in directly measurable result savings in costs and time.

Six Sigma, a method of project management intended to assure excellent performance, is known for a "sigma level" number representing the capability of a business, enterprise or project. This sigma level is defined as defects per million opportunities to get something done correctly. For example, a sigma level of 6 represents 3.4 defects per million opportunities. It can be interpreted as 99.9997 percent accuracy in the completion of a project or task. The table below provides a similar breakdown of each sigma level.

Sigma Level	**Defects per Million Opportunities**	**Percent Accuracy or Yield**
6	3.4	99.9997%
5	233	99.977%
4	6,210	99.379%
3	66,807	93.32%
2	308,537	69.2%
1	690,000	31%

Project Defects Defined as Sigma Levels

This focus on the number of errors or defects is different than that historically used in logistics management or in project management. Six Sigma's use of six different levels is supposed to allow one to compare process or production capability over a wide range of different processes. The point of using Six Sigma and a related error-rate metric (per unit of time) is to insure that much simpler processes do not overtake those that are more complex, especially when an error occurs.

This Six Sigma concept seems to promote simplicity over complexity in project management or logistics management. The Trans-Alaska oil pipeline had no such Six Sigma number for the amount of errors, problems or defects. It did have basic project-management data recorded for risk management, as most projects have today, but 800 miles of engineering work can cloud total asset visibility of the material management for even the top manager—especially in weather conditions well below freezing, in which employees can work outdoors for only 20 minutes at a time before coming in to get warm. Who keeps track of snow-covered parts during windy whiteout conditions? RFID technology could help solve some of the problems, but these tags must be tested in temperatures as low as -50 degrees F.

The logistics side of most projects has many factors. When dealing with a project such as the Alaska Gas Pipeline, logistics factors are greatly magnified due to the enormity of material and supplies that must be transported across a challenging landscape. Logistics transportation involves how to efficiently and effectively transport millions of tons of construction materials. These materials must be categorized, staged in a supply-chain management network, and tracked from production to storage to the work site.

Storage areas and warehouses will be minimal, if available at all, so the pipeline project must be carried out in a way similar to the just-in-time process for today's manufacturing operations. In an effort to minimize supply-chain costs and shrinkage, the project must have the materials on site when the construction crews require them. Conversely, failing to have the material on hand will delay efforts and result in significant cost increases. The logistics manager will have to work with the project manager to decide when materials are delivered to construction sites, which will usually be remotely located. An essential key to moving the right material to the correct location at the optimum time is knowing what material is where in the overall supply chain—enter inventory management and tracking.

With millions of tons of freight and millions of pieces of equipment required, the use of RFID tags offers the possibility of limiting waste, the loss of materials, expensive rush replacement orders and duplicate orders, while enhancing safety and security for the pipeline system and for the people working within the project. RFID-generated data will become a key contributor to Six Sigma initiatives to minimize defects with logistics-management and project-management systems, methods and processes.

One of Six Sigma's key metrics for Alaska Gas Pipeline could be the ability to trace and track the movement of material from receipt into the supply chain to final site installation. Tracking the various assets from receipt to installation would allow the project-management team to see in near real time the growth of the pipeline and the location of inventory. The project-management team would be able to monitor the overall system for bottlenecks occurring due to a lack of proper materials at the correct location, and other complications. They could also monitor construction processes in near real time as the material is installed and logged into location. Furthermore, the RFID tags would provide a means to correlate where a piece of material has been installed for later recall on an as-needed basis. And yet, this increased visibility will come with a new set of issues: data management.

The Trans-Alaska crude-oil pipeline relied on first-hand receipt and transportation inspections that required valuable time to process the data. The use of RFID on the new gas pipeline, on the other hand, would change that process by automating the data transfer process and eliminating or minimizing many delays that a manual system currently causes. RFID, however, can generate a new RFID-based Six Sigma issue of how to manage the database with millions of pieces of streaming data radiating from potentially all material items. The vast quantity of information will need to be managed.

The Trans-Alaska Pipeline heavily relied on experienced and capable project managers, engineers, warehouse personnel and transportation crews, as well as a host of support personnel. The new Alaska Gas Pipeline will need not only need the same types of resources, but also logistics managers and supply-chain management expertise. Without superior logistics management and processes, the pipeline project will incur additional cost and time for what is already a very expensive undertaking. Therefore, Alaska Gas Pipeline planners must consider the use of RFID technology as an essential key link in managing the unknown unknowns of this vast and complex project.

Oliver Hedgepeth Sr. is the chairman of the logistics department at the University of Alaska Anchorage (UAA) and author of RFID Metrics. *Morgan Henrie is a research professor in RFID and logistics at UAA. Oliver Hedgepeth Jr. is a Six Sigma quality-control and project-management expert at Genworth Financial. The authors welcome comments and research collaboration as they continue their search for identifying the future problems of the Alaska Gas Pipeline project, with RFID as a key link to the project's success.*