Case Study:

Results of tool tracking system implementation by AMECO at the Scottford Upgrader Facility

Independent Research by

Building Services Research and Information Association

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The HOUNDware™ barcode asset management system for tracking tools and equipment on the Scotford Upgrader construction project

Enabling technologies in this case study

Bar codes, handheld, wireless transmission barcode scanners, wireless LAN's (local area networks), project intranet.

An overview of the Houndware Onsite™ system employed on this project

The total tools, equipment, construction consumables and personal protective equipment inventory on this project is catalogued in the HOUNDware Onsite database, which is located on the project intranet. Each item is identified by a barcode. Every construction worker has a unique ID badge

A distribution centre operative, using a wireless handheld barcode scanner records each withdrawal or return from the project inventory.

The data is transferred through a wireless local area network to the central database in real-time, so that the history of every item and every worker is instantly available.

Numerous reports relating to such criteria as product, individual, construction trade, construction project zone, item price, overdue returns or low inventory level, can be automatically generated the database.

The Client: AMECO

Construction organisations outsource the supply and management of plant, tools, equipment and construction consumables to AMECO, so that they can concentrate on their core business of building.

AMECO, delivers integrated equipment and tool solutions, to construction, mining, government and industrial markets in five operating regions - Canada, The USA., Mexico, The Caribbean and South America. Although focused on these regions, AMECO also support projects in other parts of the world such as Uzbekistan and The Philippines.

AMECO Canada, who are managing this project, have increased annual revenue from £225,000 in 1991 to £41 million in 2001. They are now one of the largest tool and equipment providers in Canada.

AMECO are responsible for the provision of fully maintained plant, tools, equipment and personal protective equipment (PPE) to the workforce on this project. Their scope of supply on this project ranges from marker pens, drill bits, welding kits, power drills, wrenches and safety glasses through to 125 different cranes of up to 300 tonnes in capacity.

For more information about AMECO see www.AMECO.com

An overview of the project on which the enabling technologies are deployed

The £775 million Scotford Upgrader construction project is located beside Shell's Scotford Refinery in Fort Saskatchewan, Alberta, Canada. The project involves the construction of a facility, which will convert 155,000 barrels day of bitumen, pumped from the Athabasca oil reserves 500 km away, into a range of premium, synthetic crude oils.

The project is part of a £2.4billion investment by the Athabasca Oil Sands Project partners Shell Canada Limited, Chevron Canada Resources Limited and Western Oil Sands Inc.

At the time of this study there were 8800 construction workers on-site.

For more information see:
www.shell.ca/code/products/oilsands/dir_oilsands.html

The technology provider: HOUNDware Corporation

AMECO employs the HOUNDware Onsite asset management system for day-to-day management of issues and returns of tools, equipment, construction consumables and personal protective equipment (PPE) on this project.

The HOUNDware Corporation has been established for over 16 years. They provide solutions based on bar code and portable scanner technology to help clients control and monitor their assets, such as tools, equipment and consumables, in real time. They have completed over 300 installations worldwide and clients include Bechtel Corporation, The Ford Motor Company and Air Canada.

They offer 3 different asset management solutions:

- HOUNDware Onsite, which operates on a company's own intranet/network and is scalable from an individual desktop computer to an enterprise wide solution.
- HOUNDware Online, which delivers applications via the Internet. This system enables asset management on multiple, geographically dispersed, construction projects within the same organisation. Instead of paying upfront for software licences, buying and maintaining servers and hiring applications and administration experts, HOUNDware provide all of this for one monthly fee, starting at £140.
- Tool Hound III, which is designed for single-store applications. (See the Agrium case study in this BSRIA series for data on this solution)

For more information about Houndware see: www.houndware.com

Key statistics and feedback from the site study

- There is an average of 21,000 tool and equipment, issue or return transactions each working day
- There are currently 3348 different part numbers in the tools, equipment, consumables and PPE database on this project
- There are 780,000 items in the plant, tools, equipment, consumables and PPE database on this project (A particular part number, such as a 15mm spanner, may have hundreds of units in stock)
- AMECO is using 200,000 barcodes for the control of the tool, equipment, construction consumables and PPE inventory on this project

- The tool, equipment, construction consumables and PPE inventory on this project is valued at £13.6 million
- Each one of the 8800 construction workers on site has a unique identification number with which they interact with the AMECO asset management system
- There are 23 tools, equipment, PPE and consumables distribution centres on the construction site. The major centres are in use 24 hours a day, 7 days per week.
- There are 40 wireless-enabled barcode scanners used by AMECO in the equipment distribution centres on this project
- Each of these distribution centres has a wireless LAN (local area network) to transmit data from the barcode scanners to the HOUNDware asset management database located on the project intranet.
- AMECO employ 55 people on this construction project to manage the provision of plant, tool, equipment, construction consumables and PPE to the construction workforce of 8800 people .
- AMECO's contract to supply plant, tools, equipment, construction consumables and personal protective equipment (PPE) for the duration of the Scotford Upgrader construction project is valued at £25 million.

HOUNDware Onsite implementation costs on this project

The cost of implementing the HOUNDware Onsite asset management system by AMECO on the Scotford Upgrader project was as follows:

1.	HOUNDware software licence for all 23 distribution outlets on the project = £4550 base price + £1590 per additional outlet location = £4550 + (22 x £1590) =	**£39350**
2.	HOUNDware software maintenance licence for the project = 15% of the software licence price per annum =	**£5900 per year**
3.	40 Dolphin 7400 wireless scanners operating Windows CE with charging station @ £1750[1] each =	**£70,000**
4.	23 Symbol Spectrum24® High Rate 4121 Wireless LAN Access Points @ £850[2] each =	**£19950**
5.	Symbol Ethernet hub =	**£1500**
6.	23 desktop computers @ £1000 each =	
7.	5 days training by HOUNDware personnel @ £430 per day =	**£2150**
8.	5 days site installation effort by 2-man HOUNDware systems integration team @ £430 per person per day =	**£4300**
9.	Provision of 200,000 barcode labels by HOUNDware =	**£11,400**
	Total HOUNDware Onsite implementation costs by AMECO on the Scotford Upgrader project =	**£177,550** (+ £5900 per year from year 2 onwards)

It is important to note that once purchased, the wireless scanners and wireless LAN access points can be re-deployed on subsequent projects.

Business benefits analysis of HOUNDware onsite on this project

The benefits generated by the use of HOUNDware Onsite on this project have been analysed with respect to the following 3 key business areas:

- The personnel manning the tool and equipment distribution centres

[1] Average price from National Barcode: http://www.nationalbarcode.com/ and Liberty Systems: http://www.liberty-sys.com/
[2] Price at Mobile Plane:t http://howtobuy.symbol.com/

- The construction team workforce and management
- The central office and associated back-office functions

Distribution centre personnel benefits

35 AMECO personnel were working at the service windows of the 23 tool distribution centres.

If there are 21,000 dispatch and receipt transactions each day, then this means that each person is undertaking 600 transactions per day. (A unit time of 48 seconds per transaction, which corresponds with BSRIA observations.)

AMECO personnel stated that with a traditional paper- based record system, the recording of individual worker details and product details, combined with the collection of the required item, would take an average of 75 seconds.

To undertake 21,000 transactions per day, at a unit processing time of 75 seconds, would require 437 man-hours of effort. This equates to 54 people working an 8- hour day.

For the same level of service, the use of the Houndware Onsite system therefore generates a saving of (54-35) = 19 distribution centre personnel.

At an average hourly rate of £13 per hour, and assuming the distribution centres are operational 360 days per year, this is an annual saving of :

19 people x £13 per hour x 8 hours per day x 240 days per year = **£474, 000**

Several independent studies have concluded that error rates for data entry using barcodes are between 1 in 1 million and 1 in 3 million characters. In contrast, these studies have shown that manual data entry by humans has an error rate of 1 in 300 characters[3]. It is evident that with over 7.5 million transactions taking place annually on this project, there are data integrity, as well as process speed, benefits of automatic identification and data capture. The AMECO team confirmed this.

The construction team workforce and management benefits

The time spent by a construction worker at the tool and equipment distribution centre is divided into two parts:

1. Time spent in a queue waiting for their turn at the service window. During the site observations, the workers had an average of 1 person in front of them.
2. The duration of their own transaction

If there are 21,000 dispatch and receipt transactions

[3] www.aimglobal.org

each day, and 8800 construction workers on site, then this averages out at 2.4 withdrawal or deposit transactions, per individual, each day. During site observations, it was evident that this did not necessarily mean two visits to the distribution centre, so for the purpose of this analysis we will assume that each worker executed these transactions during a single visit.

Through the use of HOUNDware Onsite, unit transaction time has been reduced from 75 seconds to 48 seconds, when compared to traditional paper-based systems.

The time savings generated for a construction worker are therefore as follows:

Waiting time saving = Duration of 2 transactions for the person in front in the queue = 2 x (75-48) = 54 seconds

Own transaction time saving = Duration of their 2 transactions = 2 x (75-48) = 54 seconds

Total time saving per visit = **108 seconds**

Assuming a single visit to the distribution centre by each worker, per day, this would generate the following annual savings:

8800 construction workers x 1 distribution centre visit, per person, per day, x 240 days per year x 108 seconds time saving per visit/3600 x £15 per hour tradesman wage = **£947,000**

It is important to note that because HOUNDware Onsite enables accurate monitoring of peak consumption rates and stock levels of tools, equipment, construction consumables and personal protective equipment (PPE), it makes a significant contribution to ensuring that construction delays are not generating through the non-availability of specific items.

BSRIA research over the last 7 years has shown that on a typical construction project 1% of the average working day is lost due to delays associated with plant, tools and equipment not being available. [4] For this construction project involving 8800 construction workers, this would equate to the following inefficiencies:

8800 people x 240 days per year x 8 hours per day x 1% = **168960 ineffective man-hours per year, waiting for plant, tools and equipment** or

8800 people x 240 days per year x 8 hours per day £15 per hour x 1% = **£2.5 million in ineffective man-hours costs per year, waiting for plant, tools and equipment.**

[4]This 1% average figure is normally characterised by a few periods of zero output lasting 1 hour – 8 hours, rather than many small delays of several minutes. In addition, 7% of the average working day on a construction project is spent collecting materials, tools and equipment

A construction project is composed of a logical sequence of interrelated and interdependent site activities. It is also important to understand that in addition to affecting the installation productivity of individual workers, plant, tools and equipment delays also impact on the overall construction programme because delays prevent the timely completion of specific tasks.

It is well known that plant, tool and equipment loss on construction projects is a common problem. BSRIA knows of one UK specialist trade contractor, which has confirmed a stock loss of **£250,000** during the 1999/2000 financial year, on an inventory estimated to be £8 million. The instant accountability generated by HOUNDware Onsite therefore provides a very strong return-on-investment argument when profit-inhibiting losses such as these are discussed.

Central office and associated back-office function benefits

AMECO staff stated that a distribution system of the magnitude running on this construction project could not be operated using a paper-based system.

They confirmed that the accountability that the system provides is crucial to preventing asset loss on the project. With an inventory of 728,000 items valued at £13.6 million this is an essential business driver for AMECO and the construction team that they serve.

Also, the ability to generate instant stock reports, as well as numerous other reports for their own use, for presentation to the ACJV consortia, or to the construction teams is crucial to their business.

The AMECO team also highlighted the massive savings in paper storage space that a digital asset management system generates.

If there are 780,000 items in stock and 3348 item types, then this means that the average stock level for each item is 217 units. We can examine a simple activity such as a quarterly stock take of this inventory:

In contrast to the instant reporting of HOUNDware Onsite, it is predicted that a manual, quarterly stock-check of the 3348 different item types in the project inventory would take the following time:

3348 item types x 5 minutes average count and record per item type = **279 hours per stock-check**

If these stock-check is undertaken 4 times per year this equates to a saving of: 4 stock-checks x 279 hours unit duration x £13 hourly wage = **£14508**

The AMECO team also stated that the use of the HOUNDware Onsite system allows them to transfer benefits on to future projects: They can accurately demonstrate to potential clients the volumes of plant, tools and equipment they will need to undertake projects, they can show patterns of tool use, they can negotiate for new work with authority and confidence, and they can populate new project databases extremely quickly.

Detailed feedback from the site study

Each of the 23 distribution centres on the construction site was a temporary building structure, similar in manner to a Portakabin. The main distribution centre was composed of 3 units joined together.


Although the HOUNDware Onsite system is an extremely powerful mechanism for controlled asset management, it was evident that the excellent level of storage system organisation within the distribution centres was a critical success factor. Other critical success factors identified by the AMECO team were:

- Early integration of the tool and equipment specialist into the construction team must be ensured. There must be adequate lead-in time before construction commences to define needs and to mobilise the site operation.
- The number and location of the distribution centres should generate minimum movement of construction personnel around the site.
- Construction personnel need to be identified within the database on the first day that they begin working on a project. There therefore needs to be an efficient link between the recruitment/payroll departments of the contractors and the tool and equipment specialist.
- Proper training in the use of the HOUNDware onsite system is required.
- There much be a data back-up regime in operation

Commonly dispatched items were readily available near to the transaction windows and the barcodes for bulk commodity items were mounted at the service counters.



All item types were neatly grouped and stored in individual bins or racks and everything was clearly and simply identified.



Items with a unit value of $25 Canadian dollars (£11), such as the sockets shown below, were defined as a piece of equipment by AMECO and had unique barcodes. Items with a unit value of below $25 Canadian dollars, such ear plugs, rolls of tape and marker pens were defined as commodities by AMECO, and either shared the same barcode or were tracked by box volume.

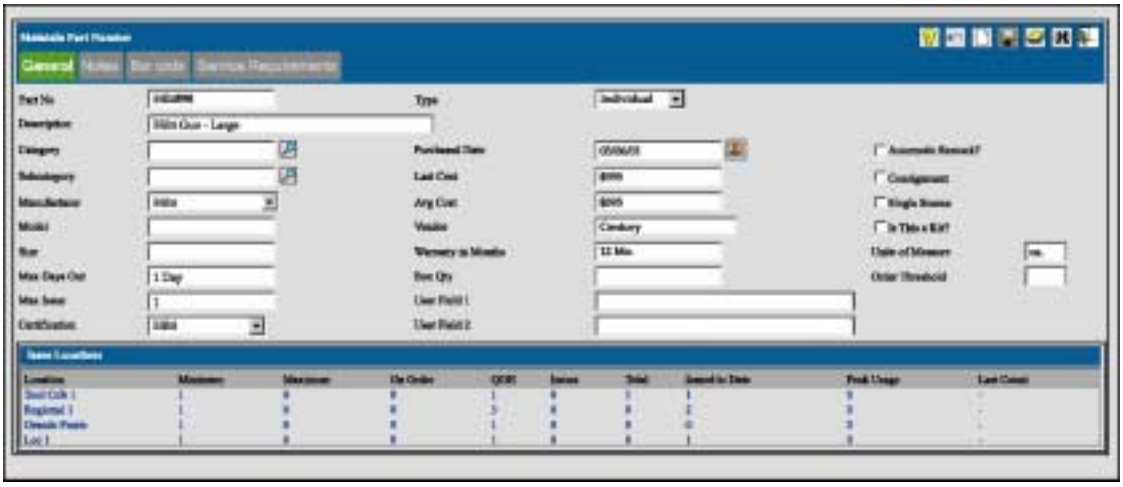
The 200,000 barcodes for the project have been produced by HOUNDware for AMECO. AMECO was provided with a sequential range of barcodes such that each new order of labels had unique numbers.

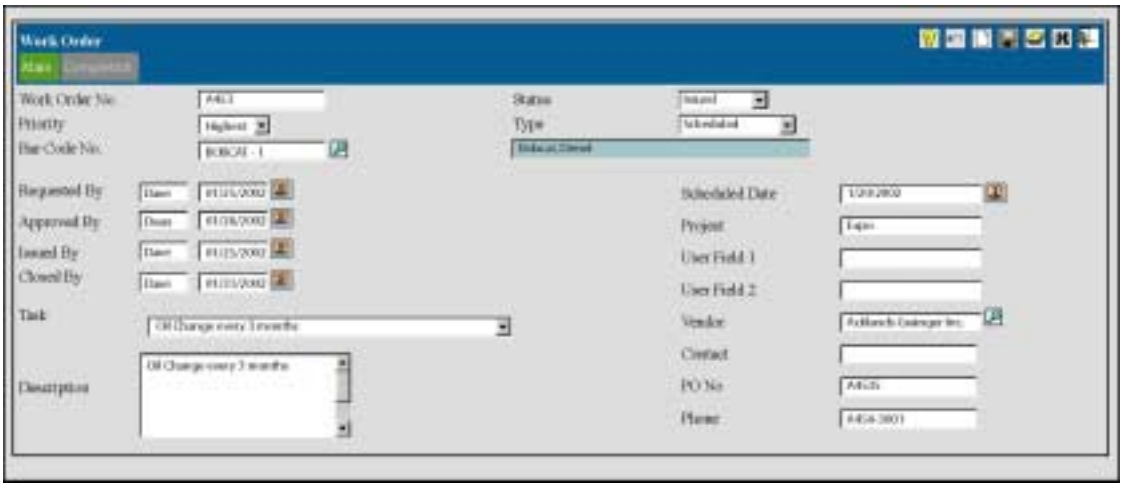
Any additional project barcodes are produced in the same manner.

The AMECO team have also composed kits for the construction workforce, such as the welding kit shown here. The contents of each kit are defined in the database and each whole kit has a unique barcode.

This approach has saved a large amount of tool and equipment collection time for the highly paid welders.

The AMECO team confirmed that the HOUNDware system is intuitive and simple to use once basic training has been provided. The following screen shots show the inventory management, issue and return, and automatic work request fields respectively.



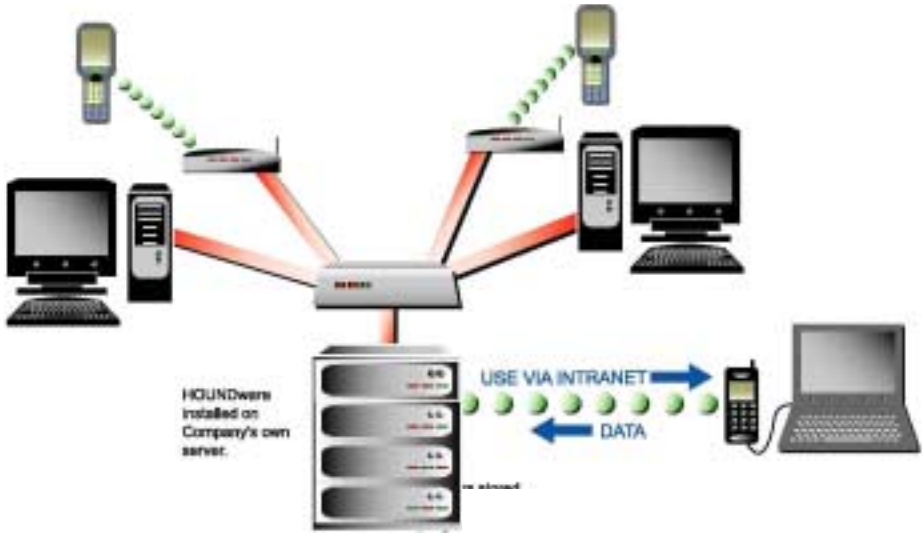


Technical details on the Houndware Onsite system employed on this project

HOUNDware Onsite is designed to operate with a company's own intranet/network and is scalable from an individual desktop into an enterprise wide solution.

The diagram below shows the component parts of a central server with a wireless communications hub, remote desktop computers in each distribution centre, wireless communication access points and hand held wireless barcode scanners.

The technical details of these components are given below.



Work Station Requirements:

- Windows 98 or greater
- Internet Explorer 4.5 or greater
- Processor: Intel Pentium II or better
- Speed: 300 MHz or better
- RAM: 32MB or better
- Hard Disk Space: 200 Mb or more available
- Video Memory: 4 Mb or more
- Modem: Optional
- Mouse: Required
- CD-ROM: Required
- Speakers: Optional
- Serial Port: One available for program uploads to scanner or printer.

Server Requirements:

- Can also run standalone on a single computer.
- MS Server 2000
- CD-ROM drive
- 128 megabytes RAM
- 1 Gigabyte hard disk Space
- MS SQL Server 7.0/2000

Wireless scanners

The scanners used on this project were Dolphin® 7400RF hand held portable data terminals manufactured by HHP. However, any wireless-enabled Pocket PC device can be employed.

The Dolphin® 7400RF devices were enabled with Microsoft Windows CE™ and included an integrated 2.4 GHz spread spectrum, DSSS (Direct Sequence Spread Spectrum) radio for real time data communication. They featured a full alphanumeric keypad, large quarter-screen display, high-performance Intel StrongArm processor, 64MB of memory, touch-screen, IrDA infrared data port, internal compact flash slot, and internal type-II PC-Card slot for 2.4GHz RF LAN or WWAN radios or added memory.

Access Points

Symbol Spectrum24® High Rate 4121 Wireless LAN Access Points were employed on this project to connect the wireless hand held devices to the project intranet.

These access points are designed to the IEEE 802.11b interoperability standards[5], which are the worldwide industry norm for next-generation, direct sequence, wireless LANs. Spectrum24 High Rate delivers data transmissions of up to 11 Mbps.

[5] For more data on 802.11 standards contact AIM – The global trade association for the automatic identification and data capture industries: www.aimglobal.org

Bar Codes & Accessories

The HOUNDware system incorporates industrial strength bar codes and labels. Several types are available according to project specific requirements.

Polycoated, self-adhesive labels were employed on this project because they are a durable and economic solution. These polycoated and pre-printed labels work in most environments and can be rapidly and easily produced in large quantities.

In applications such as the adjustable spanner shown on the right, the AMECO team also used clear epoxy adhesive to ensure that barcode labels remained in place.

Ultra durable, anodised aluminium bar codes are also available and are designed to stand up to harsh environments and abuse. The asset number, barcode, and company name are photographically imaged, dyed, and sealed within the aluminium, not just printed on the surface. The graphics are embedded beneath the hardened surface of the aluminium during the anodizing process, providing decades of asset protection.

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Houndware Support Services

All HOUNDware customers receive 3 months of customer support after the initial purchase date of the HOUNDware Onsite system. Entering into a support agreement can extend this period of customer support.

Contact details for further investigation

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