Implementing Barcode Materials and Work-in-Process Tracking Systems in Manufacturing Plants and Industrial Distribution Warehouses

1 Introduction

Plugging a barcode scanner into the USB port of a computer and having the scanned barcode data "magically" appear in an Excel spreadsheet, as if you had typed it in, makes the implementation of a barcode data collection system seem trivially easy.

And yet, over the past decade, many organizations have spent hundreds of thousands and sometimes millions of dollars on barcode tracking systems that have failed. These systems have sometimes failed technically but more often they have failed because the resultant systems failed to meet the many diverse operational needs of different users within the implementing organizations.

Tracking the location of materials, such as in an item locator inventory tracking system, is reasonably straight forward. But, as soon as we have to also track the transformation of those materials, in manufacturing and industrial distribution operations, these projects get really complex as they typically involve a lot of people within the organization.

Things then get even more complicated when these tracking systems have to automatically exchange data with accounting, CAD, and ERP systems, as well as with customer and supplier supply-chain systems.

In this white paper, we look at the project management issues in implementing a real-time barcode inventory and work-in-process tracking system in manufacturing plants and industrial distribution warehouses.

Here we refer to:

- The "client" as shorthand for the senior management team and staff members of the plant or warehouse in which a system is being deployed.
- The "systems integrator" as shorthand for the staff systems integrator(s) responsible for implementing the tracking system.

The systems integrator may be a barcode equipment reseller working in conjunction with experts in the software being used, such as KnarrTek for the BellHawk barcode tracking software, and experts in other systems, such as ERP, CAD, and accounting systems, with which the barcode tracking software will exchange data.

In some larger organizations, a corporate IT department may act as the systems integrator, directly purchasing licenses for the needed software, as well as needed barcode scanning and printing equipment.

2 Checklist for Project Implementation

This is a list of the things that clients need to do when implementing a barcode work-in-process and materials tracking system. These steps, which are explained in subsequent sections of this chapter, are

1. Appoint a project leader from within the client organization. If there is an IT staff member or manufacturing engineer on-site then they are usually a likely candidate. If not, then someone like an operations manager who is in the plant or warehouse on a daily basis is best.

2. Select an initial area in which to start operational tracking. This may be in the receipt and put-away of raw materials, in work-in-progress tracking, or in tracking the picking, packing, and shipping of finished products.

3. Work with the selected systems integrator to do a preliminary system design on a remote basis. This will require that the client send a written description of their tracking problem to the integrator along with photos or videos of their operations. In return the systems integrator will recommend which software modules to use for the initial deployment, and which equipment and supplies will be needed, together with an estimate of the support services will be needed during the initial deployment.

4. Sign up with the systems integrator for a 3-month pilot subscription to the tracking software running in the Cloud. This will give the client's team ample opportunity to try out the system in actual operation before committing to a long-term agreement.

5. Setup a "training room pilot" installation in a training room at the plant or warehouse. This will typically consist of a PC with a corded barcode scanner and an office laser or waterproof inkjet printer. If inventory tracking is to be performed, then add a mobile computer and a preprinted roll of tracking barcodes plus some sample location labels. This equipment and supplies can be ordered through your systems integrator.

6. Work with the systems integrator to setup a limited amount of test data in the tracking system, which will initially be running stand-alone. Then, after training in how to use tracking system, start testing its use to capture data, using actual operational scenarios, to see whether it meets the organizations needs and where changes to configuration or customizations to the transactions may be needed.

7. After appropriate changes to the transactions, made by the tracking system software support team, then use the training room pilot to train the operators or material handlers in how to use the system. Pay careful attention to any issues they raise, as these may need more configuration changes or customizations to the data collection transactions.

8. Next have the client's senior management team examine the standard reports and Excel exports generated by the tracking system, as a result of the pilot testing. Do these meet their needs or do they need customizing? If so, the systems integrator's team can modify these standard reports. If additional custom reports are required then these can also be created by the system integrator's team. Alternately the systems integrator or the client can generate custom reports using external interfaces to the tracking system.

9. If custom barcode label generation is required, then a barcode label printer needs to be added to the training-room pilot along with an industrial PC containing the on-site software needed to print labels on a local printer from data stored in the tracking system database at the remote data center where the tracking system is installed. This will be used in its own testing cycle, after the software labeling rules and the barcode label formats have been setup in the tracking system.
10. Once the pilot system is operating to the satisfaction of the client, then it is time to deploy the system in operation in the chosen initial deployment area. This may require:
    a. Ordering more equipment
    b. Ordering and installing rack and floor marker location barcodes
    c. Ordering more rolls of preprinted tracking barcodes
    d. Importing more setup data needed for full operation into the tracking system.
    e. Preparation of a standard operating procedure manual for process management
    f. Additional training for operators and materials handlers.
    g. Integration with an existing ERP or accounting system.

Fully automated data exchange integration with an ERP system is typically done using an automated information exchange software platform, such as MilramX. This is done as a parallel project between the systems integrator, the technical staff of the organization supporting the tracking system, and the IT group supporting the organization's ERP system. This typically only applies to plants or warehouses belonging to larger corporate groups with IT departments.

It is to be expected that, once the tracking system is initially deployed, further adjustments and customizations may be needed as it is used for a wide-range of different operational scenarios. Also, management may need changes to reports or additional reports as they find other uses for the collected data. These may also require additions or changes to data exchanged with the plant's ERP or accounting system.

It is recommended that once the system is up and running that the training room pilot installation be kept in operation. This will require purchasing additional equipment, but is well worthwhile for:

- Training new employees
- Testing changes and additions to the system
- Testing integration with ERP and accounting systems
- Testing and training employees for subsequent deployment phases
- To act as a pool of spare equipment in case of failure

3 Applicability

In the USA, in 2019 there are over 540,000 separate manufacturing plants, making a wide variety of products. Of these approximately 3,000 are large "super-plants" such as automobile assembly plants, 60,000 are mid-size plants with sales/output of between $10Million and $100 Million per year and about 300,000 are small plants with annual sales of between $1 Million and $10 Million per year.

All the large super-plants employ large numbers of IT (Information Technology) staff, whose job it is to implement and maintain highly customized systems to enable these organizations to track and manage their operations in real-time. These super-plants typically use high-end ERP (Enterprise Resource Planning) systems such as SAP or Oracle, as the basis of their highly integrated systems.

About 80% of the mid-sized plants are still capturing their production tracking data on paper forms and then manually entering this data into mid-range ERP systems, such as those from Microsoft or Sage or one of the other 300 different ERP systems in common use.

About half of these mid-sized plants and just about all the mid-sized industrial warehouses are using some form of WMS (Warehouse Management System) to track their inventory, which may or may not be integrated with their ERP system. Today these plants may have zero or one IT staff member on site and rely heavily on outside organizations to update and maintain their IT infrastructure.

Just about all of the smaller plants and industrial warehouses are still using paper forms to track their inventory and production data. The inventory data is typically entered manually into an accounting system (such as QuickBooks) and the production data is tracked using Excel spreadsheets. These organizations have no on-site IT staff and increasingly reliant on Cloud-based systems to run their operations.

It is to those plants still making extensive use of paper forms and manual keyboard data entry that this white paper is addressed.

4 Paper Forms and Manual Keyboard Data Entry

The reason that many small and mid-sized manufacturing organizations still use paper forms, followed by manual keyboard data entry, is that their ERP or accounting systems, or even Excel spreadsheets, are designed for use by front-office staff. These systems are not designed for use by production workers and material handlers, for whom English is often a second language and who may have limited computer literacy, especially when it comes to using business computer systems.

Most attempts to get production workers to directly enter production and inventory tracking data by keyboard into these business systems have failed, typically due to the complexity of these systems, the multiple days of training needed to learn how to use these systems, often a very high data entry error rate, even for those who have completed the training, and a high level of ongoing supervisory intervention required to correct these mistakes.

As a result, most manufacturing organizations simply have the production workers and material handlers write the data down onto paper forms, with the data being keyed into the appropriate systems, typically on the following day, by supervisors or front-office staff.

While solving the problem of collecting the data, albeit still with some mistakes, this has caused other problems, such as:

1. Losing track of customer orders due to the available status data being at least a day old. This often results in the late shipment of customer orders, increased labor costs for expediting orders including unscheduled overtime, expedited shipping costs, late delivery penalties and, even worse, lost future orders from valued customers.

2. Losing track of raw materials inventory due to data entry being at least a day old, combined with the ERP and accounting systems not recording withdrawal of raw materials until the resultant finished products are recorded into inventory (often many days after the raw materials are withdrawn from stock), or even worse delayed until the products are recorded as being shipped. This can result in stock-outs, which cause production delays, which result in late shipment of customer orders.

3. Maintaining excess inventory, at great expense, to compensate for the errors in the inventory tracking system. With today's make-to-order "Amazon" culture (see companion white paper on this subject) the demand for different products can change rapidly, resulting in this excess inventory becoming obsolete and having to be scrapped.

In addition, many of these organizations are now being pressured by their customers to:

1. Apply unique GS1 standard tracking barcodes to each pallet as it is shipped to a customer and send an electronic record of all the materials packed in nested boxes on the pallet, as part of an ASN (Advanced Shipment Notice). This ASN data needs to be sent to the customer, as soon as the shipment leaves. This is so that the GS1 barcode on each pallet can be scanned and associated with the ASN data when the truck arrives at the customer destination, which may only be a 30-minute drive away. This obviously cannot be done with data captured on paper and entered the next day into some computer system.

2. Electronically capture materials traceability data recording which materials from which suppliers were used to make which products and who they were shipped to. This is so that the source of defects can be rapidly traced back and rapid recalls performed at minimum cost. Typically, the maximum time mandated for recalling traceability data is 4 hours, although it can be as little as 1 hour. The use of paper forms, especially if they are simply stored away in a filing cabinet without the data being keyboarded into a computer system capable of performing materials traceability (which ERP and accounting systems are not) do not fit this paradigm.

In addition, the use of paper forms, followed by manual keyboard data entry into an ERP or accounting system or an Excel spreadsheet is labor intensive and is mistake prone.

The labor costs for manual data capture, using paper forms, are often the equivalent of one or more full-time staff members at a loaded labor cost of $5,000/month or more. These costs can be saved by the use of Cloud-based barcode and mobile computer data capture technology, such as

BellHawk, which typically costs less than $1,000/month for a small or mid-sized manufacturing plant or industrial distribution warehouse to use.

5 Technology Evolution

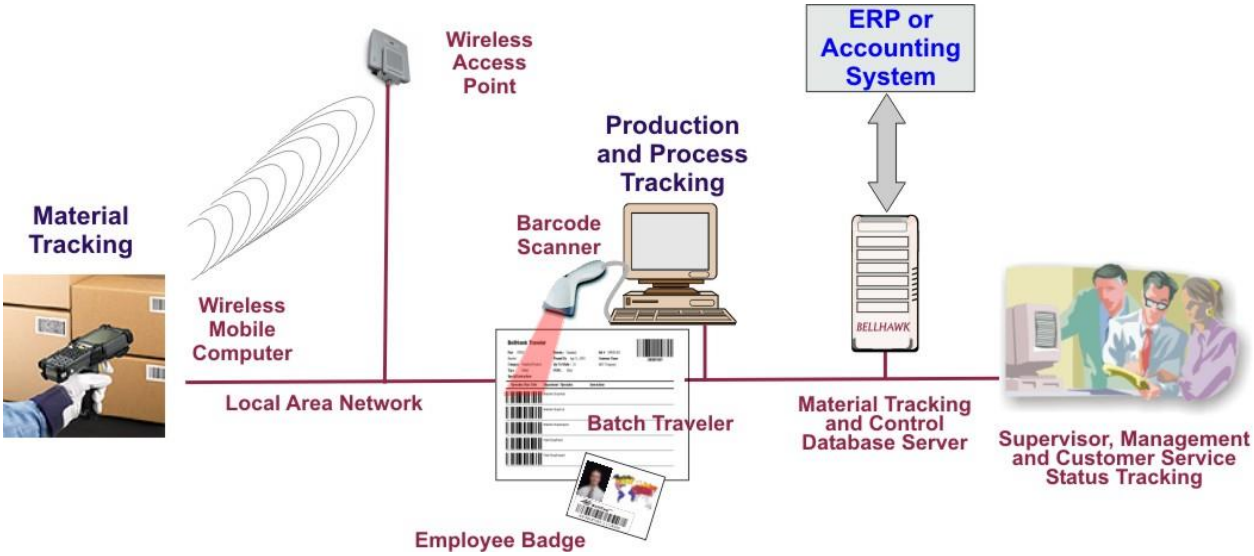
They say that if you don't understand the history of where we have come from then you are bound to make the same mistakes.

I started out in the AIDC (Automated Identification and Data Capture) field, by participating in the development of a simple single-user desktop application, to track operations in a PC board manufacturing plant. This application was written in Visual Basic, with an Access database, to replace an even-older "green screen" terminal application, which was tied to an old custom IBM mainframe application written in FORTRAN. This new application used a corded barcode scanner, which shared a "Y" connection with the PC's keyboard.

This single PC desktop system worked well, for about two days, until the production manager said "I love your new desktop production-tracking application but can you make it work so that all six of my work centers can each have their own PCs?"

So, we rewrote the application as a client-server application with an Access/VBA front end running in each Windows PC and a SQL Server backend. This client-server version of the software worked well and we installed it in a significant number of manufacturing plants, a couple of which are still using this client-server software today, nearly two decades later.

This client-server application, a diagram for which is shown below, worked well and was much-liked by many of our clients because it had a relatively simple database structure, from which it was easy to generate custom reports.



Also, the front-end, being written in VBA (Visual Basic for Applications), was easy to customize for the needs of each client.

But this system also had disadvantages, which were:

1. The software could only be run on PCs connected to the LAN (local area network) within the plant or warehouse. Data could not be captured or viewed from outside the warehouse or manufacturing plant.

2. A separate body of code, written entirely in Visual Basic, was required to be loaded into each wireless mobile computer if mobile data collection, over the warehouse or plant's wireless LAN, was to be integrated into the system.

3. This mobile code, also required a local store-and-forward database in each mobile computer, so as to be able to reliably exchange data with the main SQL Server database. This was also needed to provide local point-of-action warnings when an operator or materials handler was about to make a mistake. This setup required a significant level of IT support as any change to the front-end code had to be installed on all the PCs and Mobile Computers used for data collection or reporting.

4. Unfortunately, the store-and-forward databases in the mobile computers could get out of sync with the main database, especially if the mobile computers were left where they could not communicate with the SQL Server database for several days. This could then require a substantial level of IT support to get the databases back in sync again.

Then along came the Cloud, with its promise of eliminating the need for any local IT support at a warehouse or manufacturing plant. Instead, all applications would run at a remote data center and users would interact with these applications over the Internet using a web-browser, with no need to load any applications software, into any end-point user device.

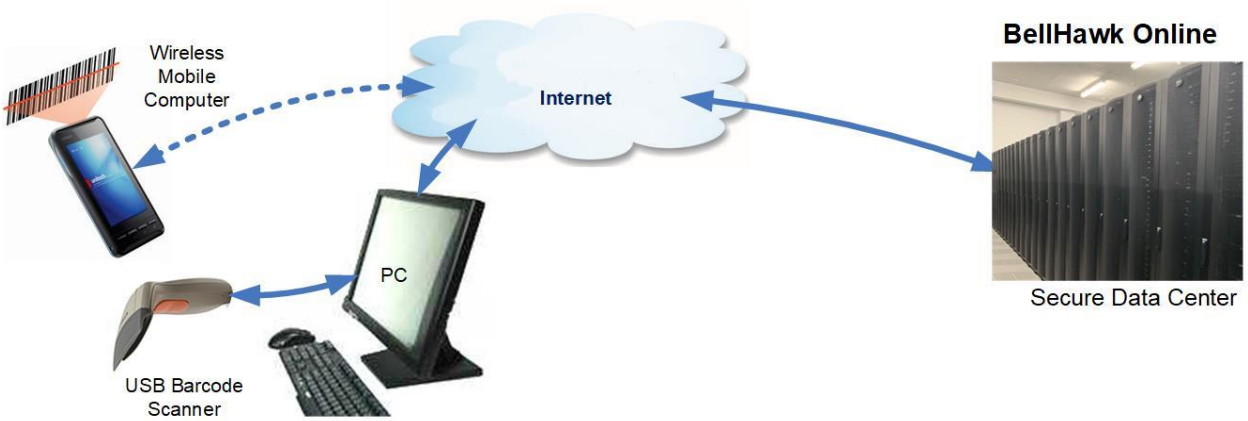
I would like to tell you that I saw this vision of Nirvana and immediately set to work developing a new Cloud-based version of what would become the new BellHawk software, to the sound of heraldic angels.

But no. What actually happened was that Microsoft, to force software developers like me to conform to their new marketing vision, took away most of the features in VBA that we used to support our client-server applications.

As a result, tracking applications, such as BellHawk, had to move to the Cloud, as Microsoft steadily removed the compatibility features in Windows 7 and 8 which enabled old client-server VBA/Access applications still to be run. Then Microsoft drove a stake in the heart of these "vampire" applications with Windows 10, which no longer supported the needed compatibility features.

So, was this transition, the path to the expected Nirvana? Well no. The use of the Cloud brought with it many of its expected advantages but also brought with it a whole new set of issues, which we have had to overcome.

6 Resolving the IT Issues with Cloud Operation



From a project management viewpoint, things have changed dramatically over the past decade or two. Twenty years ago, many of our mid-sized manufacturing plant clients had an IT Department with 5 or so staff members. Today our smaller clients have no IT staff and the mid-sized plants may have a single IT person (if they are lucky).

As a result, we have migrated from clients installing the tracking software on their own servers, in their own manufacturing plants, to using the software "in the Cloud" over the Internet at a secure data center, where the software and the servers are managed by organizations such as KnarrTek, eliminating the need for on-site IT support.

This has brought with it the cost-saving ability of being able to share a single server between multiple smaller manufacturing and industrial distribution clients. While larger organizations still need a dedicated server in the Cloud to run their tracking software, KnarrTek, for example, is able to offer free hosting to smaller organizations which are able to share the use of a single server to run the copies of the BellHawk software to which they subscribe..

This results in a tremendous cost savings for smaller organizations over an organization needing to purchase their own server and especially in the cost of an IT person needed to maintain the server and the tracking software installed on it.

We have also migrated, over the years, from using "thick-client" software, which had to be installed in each mobile device and, in reality, needed a local IT person, on-site, for the maintenance of these devices, to the use of a web-browser interface, which uses the pre-installed web-browser on each device to communicate with the tracking software, running in the Cloud. This again, eliminates to need for an on-site IT person.

But there are always exceptions. Tracking software, such as BellHawk, is also used by large multi-national organizations who want to have the software installed at their own data center, which may be continents away from the manufacturing plants in which it is used. Here the organization's own corporate IT group takes over installation and management of the software but support for the operations people in the local plants is typically done by the local systems integrator.

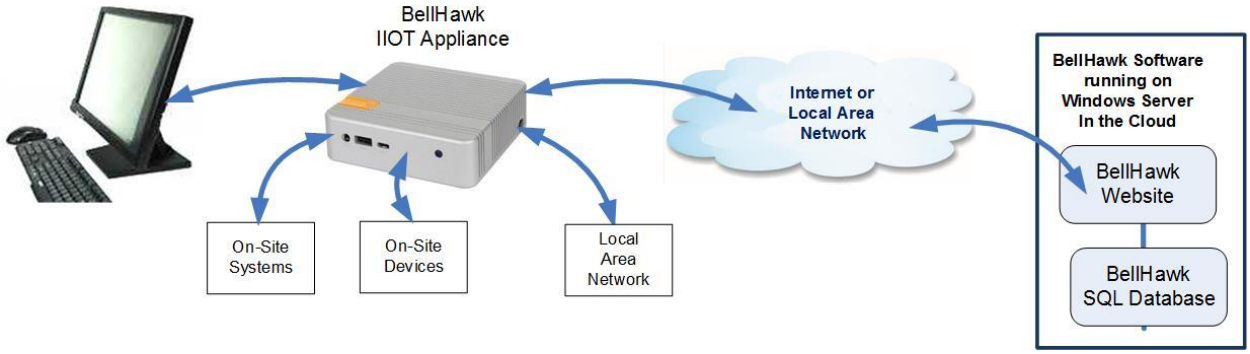
The other exception is the military services and their defense contractors, which have high security requirements, for some applications. Here the tracking software needs to be installed on

the organization's own servers and, sometimes, store-and-forward software installed in each mobile device to avoid the use of wireless communications. But these are very special (and expensive) implementations.

The use of Cloud computing also has issues, such as:

- Lack of access to the tracking system database in the Cloud for locally creating custom reports and/or for exchanging data with other locally installed systems.
- Inability to send the large volumes of data over the Internet to drive barcode label printers.
- Inability to directly communicate with devices in each plant such as RFID portals or weighing scales.

A solution to each of these issues has been to use software running in on or more Windows Workstations in the local manufacturing plant or warehouse. This software communicates over the Internet to the Cloud-based tracking system server to provide a local interface.



But, of course, we have now introduced software running on local computers which could need on-site IT support for installation and maintenance, which would defeat some of the benefits of running the software in the cloud.

Fortunately, systems integrators, such as KnarrTek and its partners, are able to supply this on-site software pre-loaded into IIOT (Industrial Internet of Things) computers which act as appliances that are self-starting and can be maintained remotely over the Internet, just like any other Cloud computer, thereby eliminating the need for on-site IT support.

7 End of the Waterfall

It used to be, that systems integrators would start out each tracking project with a design phase. In this, they would send a person to a client's site to view their operations and to gather information about all the problems they needed to solve. The integration team would then design and document a system to meet all these requirements and prepare a detailed schedule and budget for its phased implementation. This was done in what was called, back-then, the "Waterfall" method, as the implementation project progress was represented on a Waterfall chart showing how each task within each phase flowed into the next.

These projects, which typically cost $50,000 to $200,000, were often funded on a 50% up-front and 50% payable on successful completion of the project to meet all the requirements in the design document, which was approved in writing by the customer.

The problem was that each phase took many months to deploy, with the overall project taking several years. During that time:

1. Requirements from the manufacturer or distributor's customers often evolved dramatically over time making the features, which were planned to be added in later phases, no longer needed and a whole new set of features and functions needing to be added.

2. As deployment progressed with the first phase, the client's staff became much more knowledgeable about the nuances of barcode and mobile computer tracking and their benefits and potential problems. As a result, they realized that the specifications they had signed off on were not what they now wanted.

3. The people involved in systems deployment changed from phase to phase as people moved on to new career opportunities. Often the new people would have a different vision as to what the system should do from the people who signed off on the original design.

4. Technology evolved, opening up opportunities for cost savings and better performance, over what was required by the original design.

These factors resulted in the failure of many of these projects. Many were cancelled after one or two phases, because they no longer met the organization's requirements. Others were completed to specification but never used as they no longer met the requirements of the company.

Unfortunately, in many cases, this resulted in unhappy customers, who often went back to using paper forms and Excel spreadsheets, and unhappy systems integrators, who ended up in lawsuits to try to get paid for the work they had done or from customers seeking redress for the failed systems.

Fortunately, there is a solution to these problems, which lies in the adoption of "agile" incremental deployment methods.

8 Agile Deployment

This method starts out by recognizing that the managers and staff within many organizations:

1. Have limited capacity to introduce new systems, including all the setup and training required, because people are busy doing their regular jobs.

2. Have limited visibility of future customer requirements. This is especially true of most small and mid-sized manufacturers who make products to order, with lead times of a few days or weeks at most.

3. Typically, have limited knowledge, when the project starts, of the potential operational benefits and the pitfalls in implementing a barcode tracking system.

4. Have very limited knowledge, when the project starts, as to all the steps involved in implementing a barcode inventory and production tracking system.
5. Have very limited time to manage a project such as this, in addition to their regular jobs.

One part of the solution to this, is to incrementally deploy the system, starting in one area such as the receiving and put-away of raw materials, or work-in-process tracking, or in the picking, packing, labeling, and shipping of customer orders. The choice will depend on where the client is currently having the most problems.

This will avoid overloading the people in the organization with too many simultaneous deployments. It will also get the collaboration of the people who need the system most. Once this initial deployment is successful, then the system can incrementally be rolled out to other departments, based on the lessons learned in the first phase of deployment.

Another part of the solution is Agile deployment. In software development this consists of. developing a quick prototype, with little or no formal specifications, and then steadily refining the implementation, as it is tested by the users until the system works as required.

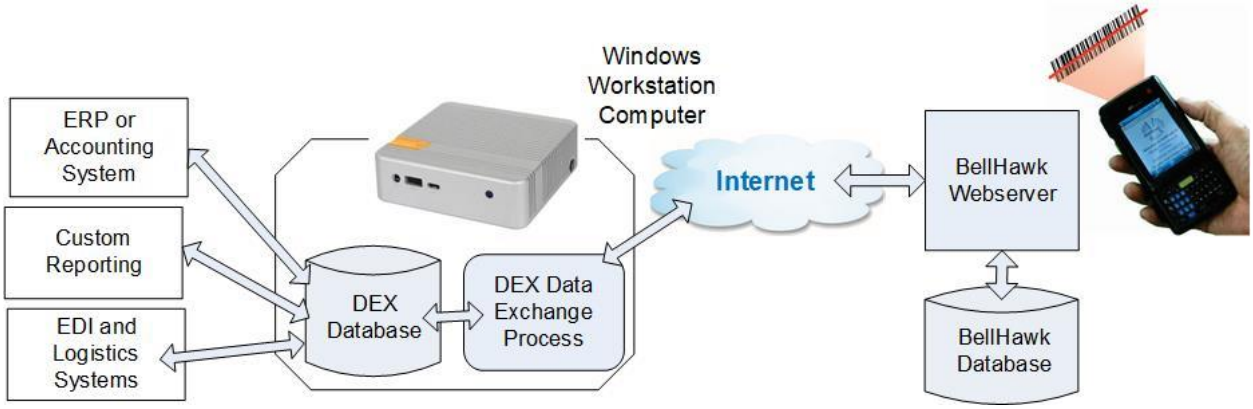
There is no detailed design phase and incremental changes to the system may occur as requirements change during its deployment.

When deploying a barcode tracking system, we use a standard version of tracking software, such as BellHawk, running stand-alone in the Cloud as the "prototype". We pick a set of modules that come closest to our client's requirements and then assist them to set up and start using the system. This usually gets us 80% of the way to their immediate data collection requirements.

Then, without customization, we adjust the rules on which BellHawk is based to more closely meet the client's requirements based on their feedback. Sometime this is all that is needed but sometime we have to customize the data collection transactions to meet the client's specific requirements, especially in the area of error checks needed for the client's specific operational needs.

Once the data collection is working to the satisfaction of the client, we then start operational data collection. But first we need to complete entering all the operational setup data.

Sometimes, as part of entering their setup data into their tracking system, clients wish to transfer large amounts of data from an existing ERP or accounting system or Excel spreadsheet into BellHawk.



This can be done using a data exchange interface, such as the BellHawk DEX interface, which runs in a Windows Workstation PC or Windows IIOT appliance computer, in the local plant. The BellHawk DEX interface has a SQL Server database running on the PC. Data entered into tables in the DEX database is automatically transferred to the BellHawk database over the Internet.

This can be much easier than directly entering the setup data in the tracking system, using its setup screens. Also, importing setup data directly into Cloud-based tracking systems is typically limited to Excel spreadsheets with only a few thousand records, due to taking so long that the web-browser session times out.

Once, we have all the operational data, such as items and locations, setup in the tracking system, then operational data collection can commence.

Attention then typically turns to reports, which may be in the form of printed reports or Excel exports. Users typically find that they can use most of the standard reports and exports supplied with a tracking system like BellHawk but often some of these may need these modified for the client's specific requirements.

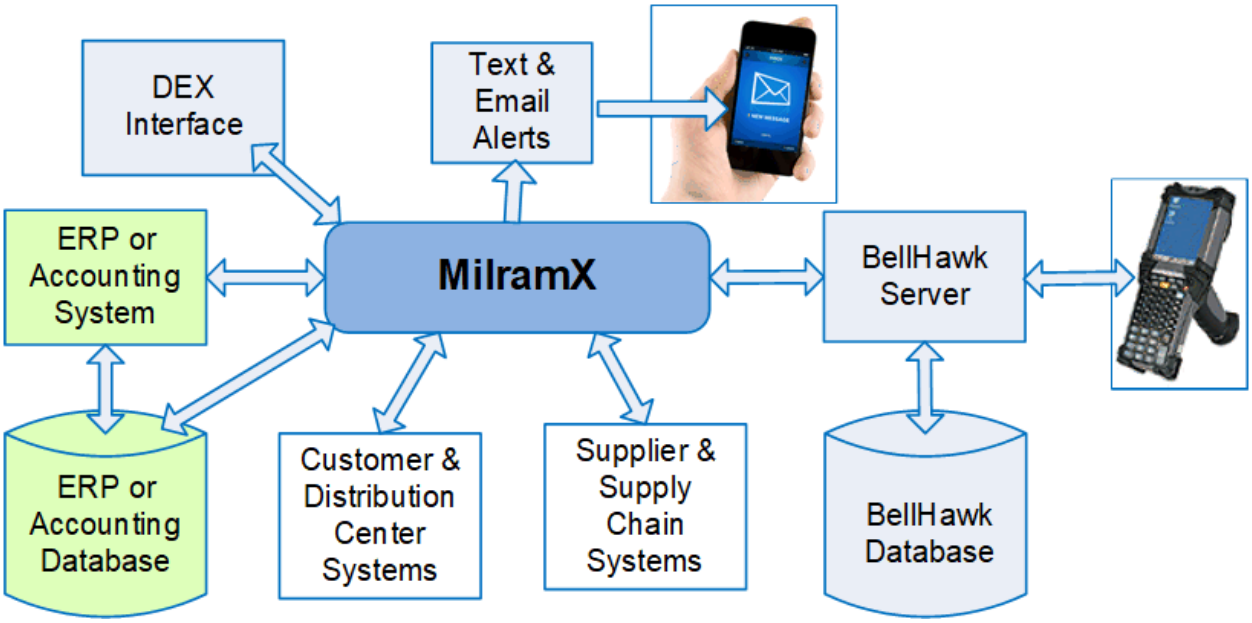
Sometimes clients want to create their own custom reports. In this case, we recommend that they use an interface, such as the BellHawk DEX interface. This automatically copies the data entered into the BellHawk tracking system to the DEX SQL database in the PC. Clients can then link report generator programs, such as Crystal Reports, with which they are familiar, to the DEX database and produce their own custom reports.

This enables multiple users to generate their own custom reports, based on the data captured by BellHawk, without any danger of interfering with the operation of BellHawk, which used to be a real concern when users directly accessed the BellHawk database for report generation purposes.

Sometimes clients need to export Excel "reports" from the tracking system that contain more than a few thousand records. These often fail, especially when running on a shared server, due to web-browser timeouts before the data is retrieved from the database and prepared for download. As a result, these large Excel exports are better performed using an interface such as DEX.

Sometimes clients need to automatically exchange data with ERP or accounting systems. For simple data exchanges, such as transferring work orders to a BellHawk tracking system, the DEX interface can be used. But when many different types of data need to be exchanged on a periodic basis, with reliable 24x7 operation, then a software platform such as MilramX is used.

MilramX is a rules-based automated information exchange platform, which monitors multiple sources of data for changes and then sends information updates to other systems. This includes sending Email and Text messages to user when events occur that they need to pay attention to.



MilramX is typically run on the same server as the BellHawk tracking system or within the same data center. Data exchange is controlled by Data Transfer Objects (DTOs), which are essentially subroutines that are run to fetch updates from one or more specific data sources, and then to translate this data into information to be sent to other systems or people.

MilramX typically only comes into play when there is a corporate IT group which is responsible for maintaining and managing the corporate ERP system, either in their own data center, or in the Cloud. The systems integration team works closely with this IT staff, as a team, to implement the DTOs needed to meet the corporations needs for enterprise information integration as well as their supply-chain information integration requirements.

These projects typically also use agile implementation methods, with DTOs being developed, tested, and deployed incrementally to support the incremental deployment of the barcode tracking system. This development is typically done in a separate parallel project to the deployment of the barcode tracking system.

9 Remote Setup and Training Support

The pandemic changed everything.

For a typical barcode tracking system deployment, before the recent pandemic, systems integrators used to send people on-site to do an initial evaluation, in a system's design phase. Here, a member of the systems integration team typically spent a day flying and driving to the clint's plant or warehouse, then spent one or two days on-site viewing the client's operations in action and meeting with the different staff people involved. Finally, that staff person spent a day to fly and drive back.

This was then followed by the staff person working with the rest of the systems integration team to write up a proposed system design and operational procedure for the proposed system plus prepare a schedule and budget. This was time consuming and expensive.

Now a systems integrator does a preliminary design phase before the project even starts. First, the integrator asks the client to send photos or videos of their operations, including pictures of their warehouse and production facilities. Then they hold on-line meetings with the appropriate people to gather the needed information to assist clients with selecting the right software, equipment and supplies for their first phase of deployment.

This approach, when combined with the incremental agile deployment methods described in the prior section, eliminates the need for the time and expense of an on-site design phase. Instead, the integrator assists clients remotely, using on-line meeting technology, to quickly start testing the software and giving the systems integration team feedback, so they can adjust the software to meet their specific requirements.

This is made possible by the use of Cloud technology, combined with the use of remotely managed on-site appliances to handle tasks such as barcode label printing, eliminating the need to send people on-site. Mobile devices and barcode scanners can also be ordered through the systems integrator or from a wide-variety of suppliers, with no need to load any special software, and are essentially plug and play with BellHawk.

The only possible issue is with barcode label printers, if used. The BellHawk barcode label printing appliance, which is shipped to clients loaded with software, can be used with a wide variety of barcode label printers. Setting up the printers themselves, however, can be a little tricky but typically most manufacturers and distributors are already using barcode label printers to print shipping labels and so know how to do this.

In this remote-agile method, all training and support is done remotely using on-line meeting technology, which is proving just as good, in most cases, as sending someone on-site to perform these functions. It is certainly less time consuming and expensive than sending someone on-site.

All interaction with the client's corporate IT staff relative to interface development is done remotely, as it typically has been done for many years. We long-ago found that it is not necessary to get everyone together in one room and, in many cases, this was impossible, with members of the client's IT staff working in many different locations.

We now recommend that clients start out by using a free hosting service, such as that provided by KnarrTek, for subscribers to the BellHawk software, on a shared server in the Cloud.

Their tracking system can then, if needed, be migrated to a dedicated server either managed by the systems integrator or installed at the client's own data center if the performance on a shared server is not adequate for the organization's needs.

10 Pros and Cons of Agile Deployment Methods

The major benefits are

1. Quicker and less expensive deployments of these tracking systems.
2. Flexibility to enable the tracking system to change as customer and user requirements change and new technology becomes available.
3. Flexibility as to how much of the needed setup and training work will be done by the systems integrator's staff and how much will be done by the client's staff. This can vary over time depending on how busy the client's staff members are with their own jobs.
4. Incremental expenditure of funds on software subscriptions and support services eliminates the need for capital expenditure budgeting, with its typical attendant delays.
5. Financial benefits are immediately visible as costs are charged to operating expenses and improved operational efficiency is reflected in increased revenues and decreased operating costs

The major issues are:

1. Total budget for overall project cannot be established as there is no overall system design. Some estimates can be made at the outset but these are usually wrong due to evolving operational objectives.
2. These projects need close collaboration between client's personnel and the systems integrator's support team. This is made more difficult because of the lack of in-person meetings.
3. The assistance that the systems integrator's support team can give is limited by the information shared by the client's team about what is going on in the plant.
4. A significant level of commitment is required by the client team to ensure successful deployment as, in the end, they are the users and beneficiaries of the tracking system.

On balance, we have found that the incremental agile deployment method, combined with remote support, while it does have some issues, results in successful systems deployments whereas many deployments using traditional waterfall implementations have failed badly.

11 Critical Issues

It is critical that:

1. The client appoints one person from their organization to be the internal project manager (much better than a committee). This person needs to "own" the system and be the internal champion for the system as well as handling coordination between the system integrator and client teams.
2. Senior management is 100% behind this project and sets clear goals and a vision to guide the many decisions that will need to be made during deployment.

If needed, the systems integrator's staff can do much of the work in implementing these systems, such as setting up needed data, generating custom reports, and implementing data exchange interfaces with other systems. This can get expensive but may be worthwhile to speed deployment.

It is still essential, however, for the client's team to take responsibility for the successful deployment and use of the system, including the on-site training and supervision of the material handlers and machine operators who will use barcode scanning to capture the operational data.

One issue not to be overlooked is the attitude of the material handlers and machine operators who will do the data collection. They will rightly suspect that management will now be able to monitor their performance much more closely. Many of these employees will experience a FUD (fear, uncertainty and doubt) factor with the deployment of the new system and will push-back against its deployment.

It is important not to tell these employees that the new system will make their lives easier because, at least initially, it will not. Instead tell them that barcode data capture will now become a standard part of their job and that they will be trained in how to do this properly.

In the course of time, employees will become very proficient in using the tracking system and will be the first to complain should the system go down for any reason (such as a switch over to a different ERP system) and they have to temporarily go back to the use of paper forms.

In our experience, it is critical to engage production and warehouse employees early in the deployment of the new system by training them in the use of the system and then getting their feedback as to what works and what does not. In this way changes to the tracking system can be made early in the process and, more importantly, this makes for employee engagement in the success of the new system.

12 Commentary

The changes brought about by the switch to the use of Cloud technology, combined with incremental agile deployment of these barcode tracking systems, and the need to do everything remotely, as a result of the pandemic, have resulted in the development of much quicker and less expensive deployment methods.

These incremental deployments have, been more successful than prior deployments using waterfall project management methods due to the greater flexibility to respond to changes in customer requirements and the requirements imposed on them by their customers.

Will we ever go back to the old waterfall deployment methods? I don't think so, except for high security military deployments, which are a world unto themselves.

Author

The author of this white paper is Dr. Peter Green who is the Technical Director for KnarrTek. He earned a BSEE and a Ph.D. in Computer Science from Leeds University in England. He was a Senior Member of the Research Staff at MIT and a Professor of Computer Engineering at WPI.

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