



BellHawk Software Platform Architecture

Introduction

The BellHawk software platform is used to implement real-time operations tracking and management systems for manufacturers, distributors, food and pharmaceutical processors, construction, defense, repair and other industrial organizations.

The purpose of these systems is to provide a set of software tools to aid operations managers so they can efficiently run their operations with as few overhead staff as possible.

Two decades ago, the major cost in an industrial organization was in the labor of material handlers, machine operators, pickers, packers and shippers. Today, much of this cost has been eliminated due to automation. Now the major cost elements are the labor required for managing these operations, including:

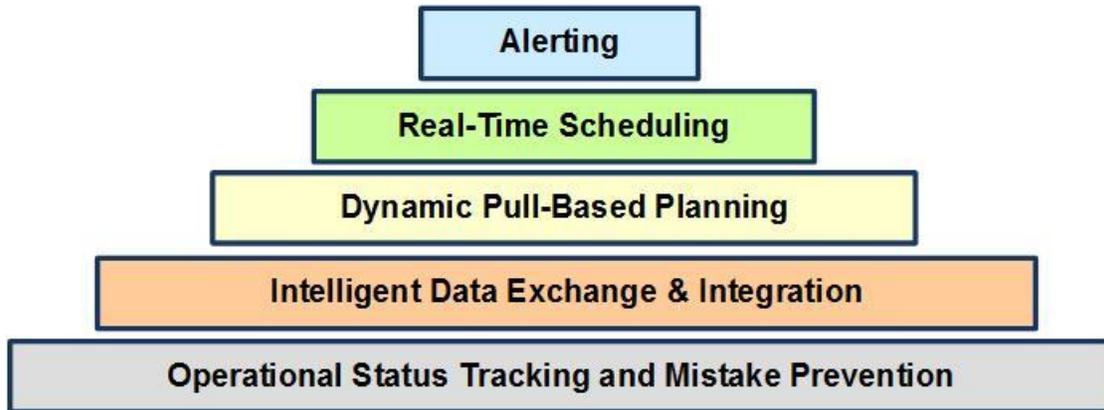
- Materials ordering
- Materials tracking and management
- Production planning and scheduling
- Operations tracking and mistake prevention
- Managing the receipt and shipment of materials
- Capturing traceability and quality control data for regulatory compliance.

BellHawk, with its combination of real-time license-plate materials tracking and built-in real-time Artificial Intelligence methods for operations management typically provides over 90% of the needed code to implement systems that enable operations managers to be more efficient and to cut the costs of their operations by 20% or more.

BellHawk has many built-in rules that can be configured by clients to embed the knowledge about their specific operations. Where this is not adequate then BellHawk is designed to be easily customized to embed knowledge about client specific operations and to automate much of the routine operations tracking and decision making that consumes so much of the time of operations managers and their support staff.

These systems can make routine decisions automatically but, in many cases, they act in an advisory role to the managers, alerting them as to situations that need their attention and guiding them as to alternate solutions to problems. This approach combines the general knowledge of experienced managers with the speed of computers in evaluating data to alert managers to impending problems and to propose alternative courses of action.

BellHawk Five Layer Model:



At the lowest level, BellHawk tracks the real-time status of operations. This includes tracking materials at widely dispersed geographic locations and operations, such as manufacturing, distribution, repair, and installation performed at multiple geographic locations. It can also include tracking materials in transit from suppliers and material in transit to customers or distribution centers.

The next level is intelligent data exchange, where BellHawk can automatically exchange information with other systems to build a real-time world view of operations taking place at multiple geographic locations. This integration layer is where interaction with other systems in the supply chain takes place as well as with ERP and accounting systems, E-Commerce websites, and with process control equipment.

Customer orders are typically entered through the data exchange layer and are used in conjunction with the current world-view of operations to dynamically perform planning in real-time, such as to what materials to order or make, materials to move, and materials to ship. This layer may also make decisions as to what materials need to be delivered by truck, where, and when.

Based on the results of the planning, which are continually evolving as events occur, BellHawk can then dynamically schedule products to be made, products to be shipped, and products to deliver based on the resources available. This scheduling is done in real-time as events occur so as to ensure, as far as possible, that customer orders are delivered on time despite unexpected events that may occur.

The final layer is mistake prevention, which takes two forms. One is warning material handlers and machine operators in real-time if they are about to make an operational mistake, such as using the wrong material. The other form is where the system dynamically compares the current status of operations with planned operations and notifies managers when there are issues they need to pay attention to.

This is in contrast to managers "walking the floor" to try to spot troubles, or customers calling to want to know the status of overdue orders, or managers spending hours staring at a computer screen, or in planning meetings to try to head off problems before they occur. Or even worse, reading reports about problems that occurred yesterday or last week.

By letting the computer do the routine real-time planning and scheduling and then alerting managers only when and where their attention is needed, more efficient operations with fewer overhead staff, lower operating cost, and lower job stress can be achieved.

BellHawk Computer Architecture



The BellHawk software consists of a specialized website and a SQL Server database that run on a Windows Server computer. All user interaction is performed using web-browser based devices.

For data collection these can consist of devices such as PCs or Android tablets that have external corded or cordless barcode scanners which are used for data capture. These devices can also include ruggedized PDAs with integral barcode scanners as well as gun-style units equipped with long-range scanners, which are suitable for scanning from the seat of a fork-lift truck. Data viewing can be done using these same devices as well as using smart phones and tablets.

This data collection and viewing can take place over a local area network, over a wired Internet connection, or over a mobile phone data network, anywhere there is an Internet connection to the server computer.

Industrial Internet of Things (IIOT) devices in each plant enable communications between barcode label printers, weighing scales, and other systems and devices in each local plant or warehouse and the BellHawk software, which can be run at a corporate data center.

Where multiple manufacturing plants or distribution warehouses are to be supported then each can have its own website and database running on one or more Windows Servers in the data center. This enables the people in each plant or distribution center to only see their own materials and operations, to avoid confusion. At the same time materials can be tracked from one plant or warehouse to another and roll-up global reporting across all locations can easily be performed.

Because it is Internet based, BellHawk is ideal for tracking materials, their processing, delivery, and installation across multiple geographic locations. This includes tracking materials on trucks

(warehouse-on-wheels), the delivery and pick up of materials, as well as materials on consignment at many locations.

Every plant or distribution warehouse gets their own private website(s) and database(s). Also communications between data capture and viewing devices and the IIOT boxes and BellHawk is encrypted. This helps ensure security and privacy of data.

The use of a private website and database for each plant or distribution warehouse also enables clients to rapidly deploy BellHawk by using the Cloud-based servers of BellHawk Online and then to easily migrate to using BellHawk on their own servers simply by moving the website and database overnight.

Mobile Data Capture



BellHawk is designed for use by material handlers and production workers who have limited computer literacy and for whom English may not be their primary language. The data entry screens are modeled after data entry forms, such as those used for ordering goods from a website such as Amazon.

This makes the user interface very familiar to users. Users start at the top of the form and use barcode scanning or touch-screen or keyboard selection to enter data. When they are finished entering data, they simply select the [Enter] button and the data is saved away.

What makes BellHawk different is that, as users enter each line on the form, a message is sent back to the server to use rules in its knowledge-base to check the data entered for data collection and operational mistakes. This is so that the user can be warned immediately of a pending mistake so they can correct it before it becomes an issue.

Also BellHawk modifies the form as data entry proceeds. In collecting data, for any given transaction, there are many possible options. Rather than present the user with a screen with many data entry boxes, from which they have to choose, we simply modify the data entry form dynamically, so they only have to fill out the boxes shown, which are appropriate to the choices they previously made closer to the top of the form.

This method makes it easy for material handlers and production workers to learn how to use the BellHawk software for real-time data collection. This also enables BellHawk to deliver real-time point-of-action warnings before mistakes are made. This is in contrast to using ERP and

accounting systems for inventory and work-in-process tracking, where the users write down the tracking information on paper forms and office-staff key it into the computer, often the next day.

An important feature of BellHawk is the ability for clients to specify their own data capture parameters, which avoids the need for customizing the software to capture these application specific parameters. BellHawk also has the capability to track materials with different dimensions, colors, and sizes, using common part numbers. This can be highly beneficial in many make-to-order situations.



By using barcode scanning and mobile computers, BellHawk is able to avoid the delays in availability of real-time status information and is able to provide real-time feedback to prevent mistakes. It can also save all the labor hours needed to fill in paper forms and subsequently key the information into a computer, as well as the time taken to find and correct errors that inevitably occur with paper forms and manual keyboard data entry.

Barcode Label Printing

BellHawk does not require any barcode printers to work. Barcoded picking sheets and travelers can be printed on office laser printers and pre-printed rack, bin and floor location barcodes can be ordered from BellHawk Systems. Also pre-printed license-plate tracking barcodes from a roll, such as that shown here, can be used to track individually barcoded items as well as containers of material.



For those applications where printing out barcode labels is required, such as for:

1. Labeling incoming or intermediate materials with hazardous materials, expiration dates or other critical materials.
2. Labeling finished goods cartons and pallets with labels in customer specific formats.
3. Creating shipping container barcodes, such as with global supply chain SSCC barcodes.

BellHawk has an optional rules based software module, named TAG, which works with the BarTender Automation barcode labeling software, to enable users to create their own label formats. These labels can include data from the BellHawk database, and can be printed on demand as part of the BellHawk transactional data capture process.

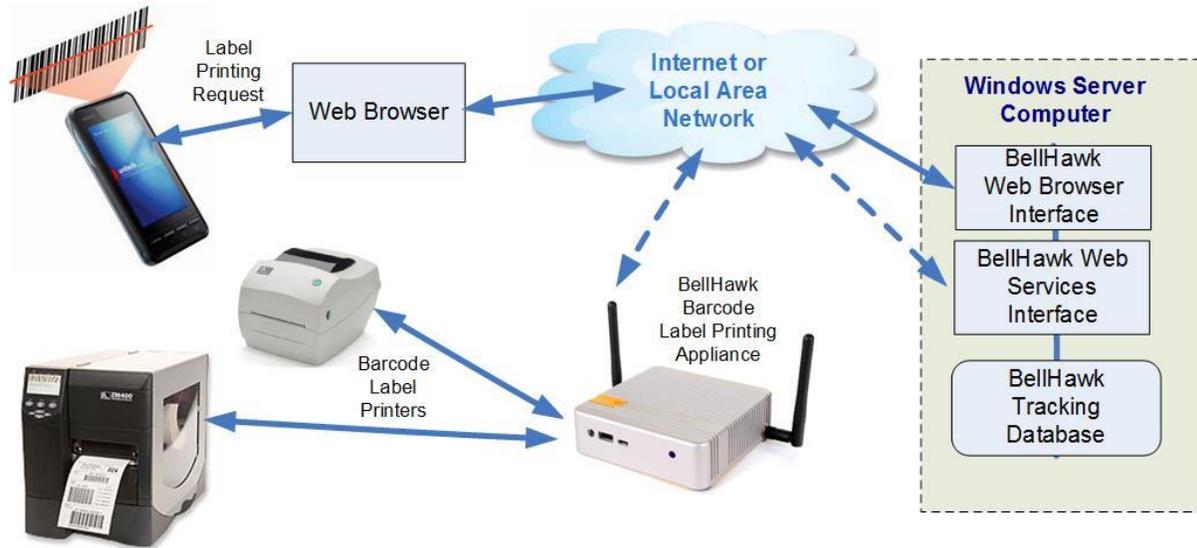


The BellHawk TAG label printing software works with a wide-range desktop and mobile barcode printers. BellHawk TAG uses client defined rules to automatically select the correct labels for each situation and then automatically fills the labels with the correct data. This prevents mistakes, such as in selecting the wrong label for specific customers or container types, and also eliminates data entry mistakes for information to appear on each different label.

Where the barcode label printers are local to the server on which BellHawk runs then the TAG label printing mechanism can be run on the same server as BellHawk.

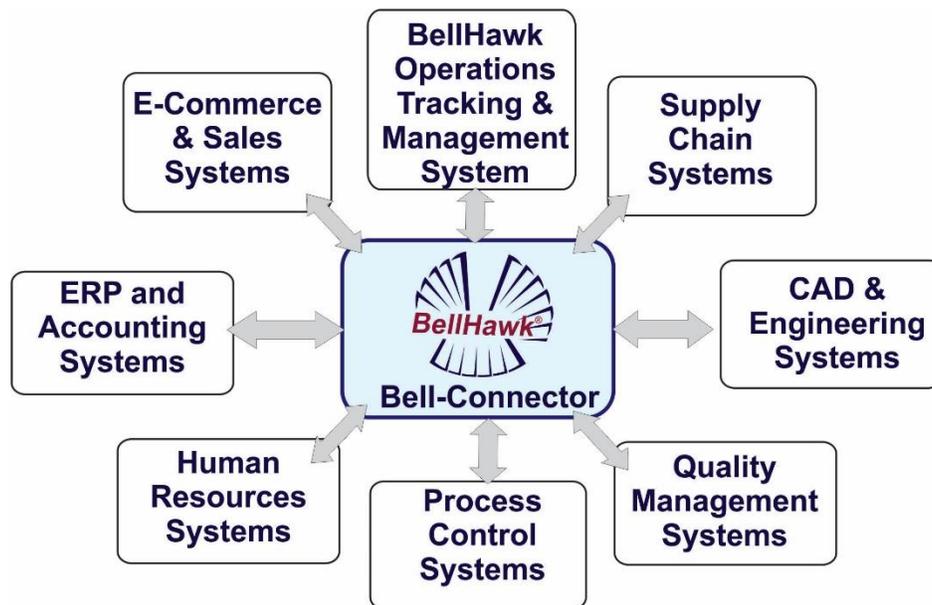
Where BellHawk is run at a remote server from the plant or distribution center then a Barcode Label Printing Appliance (BLPA) IIOT device is used to communicate with the server and to host the TAG label printing mechanism and BarTender Automation. This enable efficient and

speedy printing of labels on a wide variety of barcode label printers in each plant without needing "holes" in the plant's network firewall, which could cause security issues.



Automated Data Exchange

An important component of the BellHawk software is Bell-Connector. This software platform is used for rapidly implementing automated data exchange interfaces between BellHawk and other systems. Bell-Connector is a knowledge-based data exchange interface in which users can specify their own data exchange rules simply by importing the rules in the form of Excel spreadsheets.



For more complex cases, Bell-Connector will typically supply or automatically generate over 90% of the code needed to implement a reliable automated data exchange interface. Bell-Connector then provides an environment which enables the rapid development, configuration, as

well as testing and monitoring of the needed data exchange interface code. As a result, the interface development time and cost is typically reduced by an order of magnitude.

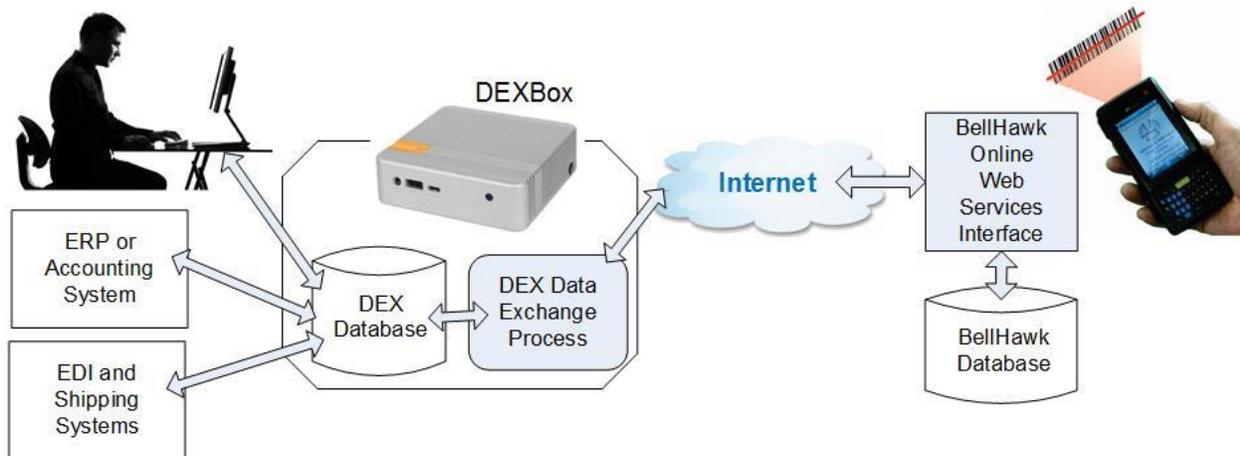
BellHawk can be used stand-alone but is often used to complement ERP and accounting systems. In this latter case, BellHawk provides all the real-time operations tracking and management capabilities to run manufacturing and warehouse operations while the accounting system is used to handle the finances.

In this role, purchase orders and sales orders may be entered in the ERP/accounting system and automatically exported to BellHawk. Receipts and shipment transactions are then sent back to the accounting system where they become accounts payable and accounts receivable.

Jobs, work orders, or manufacturing orders can be originated in an ERP system or in BellHawk. Resultant changes in inventory due to the consumption and production of materials are then sent back to the ERP or accounting system. This may be accompanied by labor and machine times and costs, or these can simply be incorporated in the cost of the products made.

BellHawk also has a mechanism which can be used to exchange data files, in formats such as Excel spreadsheets and comma delimited files, for those situations where it is not possible to directly exchange data with the database of an external system, or through another interface mechanism. Such data exchanges often include importing design data from computer aided design (CAD) systems and exchanging data with older legacy ERP systems that use obsolete databases.

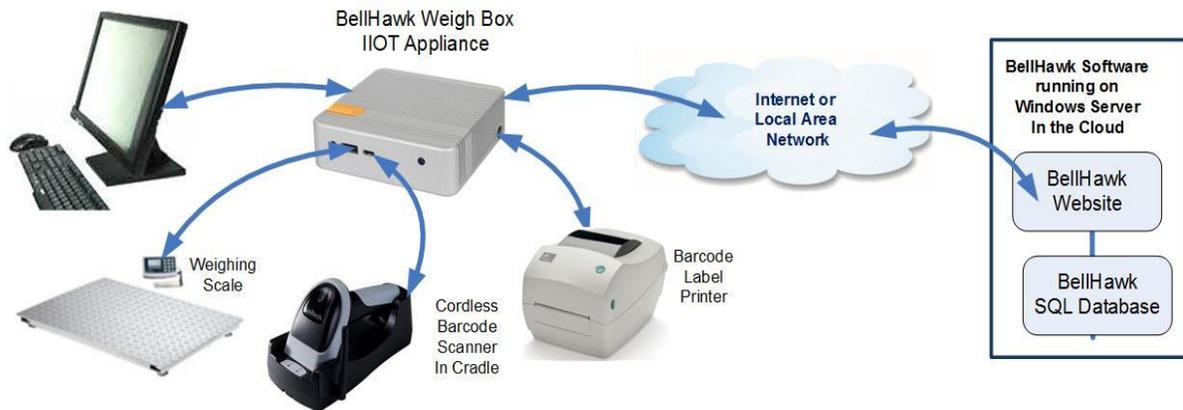
Bell-Connector can also be used for exchanging data, such as advanced shipment notices (ASNs) with inbound and outbound shipping and logistics systems as well as directly with supplier and customer systems. This can be done by direct data exchange over the Internet or by EDI.



Where BellHawk is running at a remote data center, then a DEXBox IIOT device can be used to exchange data between BellHawk and local systems in the plant. This is done by means of a DEX database, which can be written by local systems to automatically send data to BellHawk and the DEX process which automatically exports data such as receipts, shipments, and inventory changes from BellHawk to the DEX database. This BellHawk data is exported in a form that is suitable for import into external systems as well as used for generating custom reports.

Automated Data Collection

Through the WeighBox IIOT device, weighing scales in a local plant or distribution center can be connected to BellHawk over the Internet.



This includes using the WeighBox as a data collection station for automatically weighing materials as part of transactional data entry.

BellHawk can also track RFID tagged material using an RFIDBox IIOT device



For more information

Please see www.BellHawk.com, www.BellHawkOnline.com, and www.BellHawkSystems.com, or call 774-708-9607 or contact Sales@BellHawkSystems.com for expert assistance with improving the efficiency and lowering the cost of your operations.