

## KnarrTek Real-Time Materials Tracking & Decision Support Systems Software and Services Overview

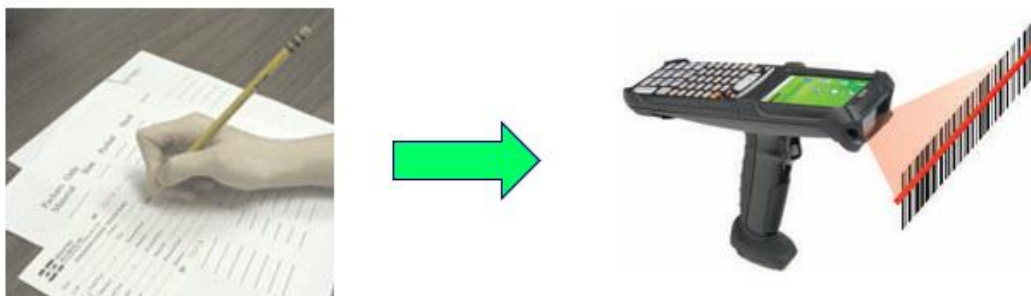
### Introduction

KnarrTek provides software and services to enable the real-time tracking and management of physical materials in the industrial, food, medical and construction supply chains.

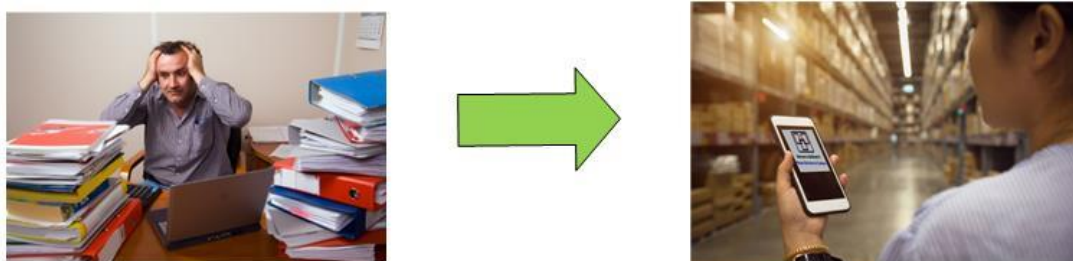
KnarrTek Real-Time Materials Tracking & Decision Support (MTDS) systems are especially applicable to tracking and managing materials for make-to-order manufacturers, engineering and construction projects, and situations where the flow of materials need to be tracked at many different geographic locations. They are also used extensively where materials tracking and traceability are required, such as in food processing and medical applications.

### Paradigm Shift

The MTDS software enables the transition from the use of paper forms, Excel spreadsheets, and after the fact manual keyboard data entry into computers, to real-time data capture using technologies such as barcode scanning and mobile computers.



This enables manufacturers and industrial distributors to transition from after the fact reporting about what went wrong yesterday to being able to see the status of their customer orders, purchase orders, inventory, work-in-process, assets and other materials in real-time anywhere they have an Internet connection



The KnarrTek MTDS software uses established barcode tracking technology to track materials in real-time combined with real-time Artificial Intelligence (AI) Decision Support technology to provide everyone in the organization with the information they need, when they need it, in the format they need.

Materials management decision support may take the form of automatically transferring data updates from one system to becoming new information for people in the other systems they normally use to do their job. It also may take the form of Email or Text Message alerts when situations arise that people need to pay attention to.

Supply chain decision support may also take the form of model-based reasoning in which the system learns statistically how long each operation takes to perform, within a manufacturing plant, warehouse, or field site, based on multiple factors. The factors in the non-linear correlation matrices (Neural Networks) for the model are learned over time from real data.

These models can then be used to quickly predict the expected delivery time for existing jobs or the estimated delivery times for new jobs. This can be done without needing to run a detailed resource-limited simulation, which are typically flawed anyway, at least in quick delivery warehouses and make-to-order manufacturing plants.

### **KnarrTek Software Capabilities**



The KnarrTek Materials Tracking and Decision Support (MTDS) software:

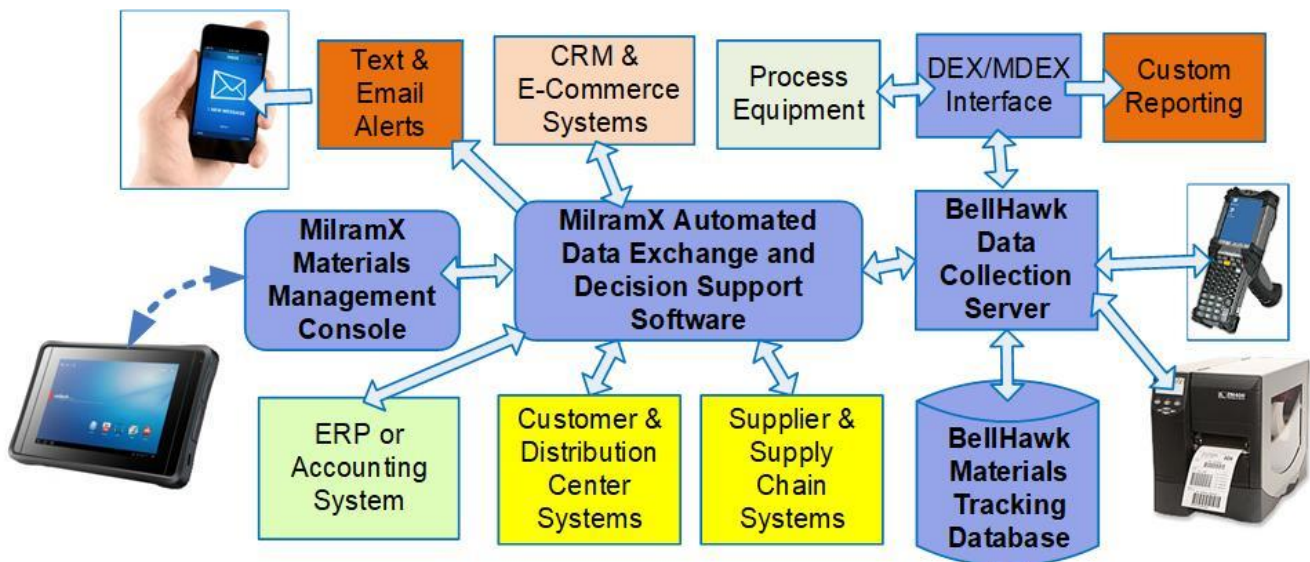
- Tracks containers of material and serialized items, including using license-plate-number (LPN) tracking methods, in real-time
- Tracks materials in the supply-chain, in-transit, and at multiple geographic locations
- Tracks the transformation of materials in manufacturing plants
- Tracks warehouse management functions such as receiving, picking and shipping
- Tracks nested containers of material by lot and serial number and expiration date
- Prevents the use or shipping of potentially defective materials
- Tracks the incremental cost of products as materials, labor and equipment time are used in their manufacture.
- Maintains a materials traceability history of what materials went into which products and who they were shipped to.

In providing decision support, the goal of the KnarrTek MTDS software is to make sure that all operations personnel have the information about materials needed to do their jobs, when and where they need it, in a format that is most useful.

This includes:

1. Providing managers and their staff with the real-time status of materials, including how they relate to customer orders and projects.
2. Automatically exchanging data with other systems to ensure that materials tracking can be performed efficiently without duplicate data entry.
3. Providing the information to assist managers and their staff with planning and scheduling the movement and transformation of materials to ensure customer orders get delivered on time and/or projects get completed on time.
4. Providing the information that managers need to plan the procurement of needed materials when they are needed.
5. Monitoring the movement and processing of materials and generating Email or text-message alerts for materials management personnel when there are issues that need attention.
6. Automatically exchanging materials tracking data with other systems, to ensure that everyone in the organization, as well as customers and suppliers, have the materials tracking data they need in the systems they normally use.
7. Enabling industrial organizations to generate business intelligence reports based on the materials tracking data.

### KnarrTek MTDS Architecture



KnarrTek MTDS systems are based on the use of the BellHawk real-time materials tracking software platform and the MilramX automated data exchange and decision support software platform. Together these provide over 90% of the software code needed for a typical MTDS application.

In a KnarrTek MTDS system, the BellHawk software runs on a Windows Server computer and is responsible for data capture and optionally barcode label printing.

There is also a special remote DEX Data Exchange interface, which provides a store-and-forward “mirror” of the BellHawk tracking database in each local facility. This can be used for generating custom reports as well as interfacing to process-control-equipment, weighing scales, RFID tracking portals and the like.

Writing data to tables in a local DEX database automatically causes the corresponding tables in the tracking database, which may be running at a remote data center, to be automatically updated. Also, all the transactional data captured by MTDS is automatically mirrored into the local DEX database, for use in producing custom reports and/or interfacing with process control equipment and the like.

In most configurations, MilramX is run on the same Windows Server as the BellHawk tracking software and is used to automatically exchange data with other systems as well as to monitor materials tracking data in the materials tracking database and generate Email or Text Message alerts when managers or their staff need to take action.

MilramX has a materials management console (MMC) web-browser interface, which can be used for controlling and managing the actions of MilramX. It is also the place where custom reports, visualization screens, and materials planning tools are implemented. These functions are based on the MilramX Materials Databank, which contains materials tracking and management data extracted from BellHawk and other systems.

## Data Capture



The BellHawk software consists of a specialized website and a SQL server database, which run on a Windows Server computer. This software can be installed at a client's own data center or



used on servers managed by KnarrTek at secure data centers in the USA through its BellHawk Online service.

Each organization gets their own private website and database. This ensures privacy of data for long-term users of an MTDS system through KnarrTek's BellHawk Online service. It also enables clients to quickly start out using MTDS on BellHawk Online and then to easily transition to installing the software on their own server.

With MTDS, data can be collected using any web-browser based device with an integral or attached barcode scanner. No special software is required to be installed. Just point the device's web-browser to the URL of the client's MTDS website and start collecting data.

Information collected in the SQL Server database can then be viewed from any web-browser based device, including mobile phones, over a secure encrypted data link, anywhere a user has an Internet or Intranet connection.

The MTDS software is based on a rules-based expert-systems engine that enables the MTDS system to be readily configured and customized for a wide-variety of applications by clients importing rules in the form of Excel spreadsheets. MTDS also makes extensive use of rules to dynamically adapt the user interface and to provide immediate point-of-action feedback when an operational or data entry mistake is about to be made.

This enables a KnarrTek MTDS system to be used by production personnel, such as Materials Handlers and Machine Operators, with minimal training and without needing a high-level of computer literacy.

MTDS does not need the use of a barcode label printer as barcoded work orders and pick sheets can be printed out using an office laser printer. MTDS can also use preprinted rolls of LPN tracking barcodes to track containers of material. If needed, the TAG barcode label printing option can be used to print out labels with both a tracking barcode and human readable information

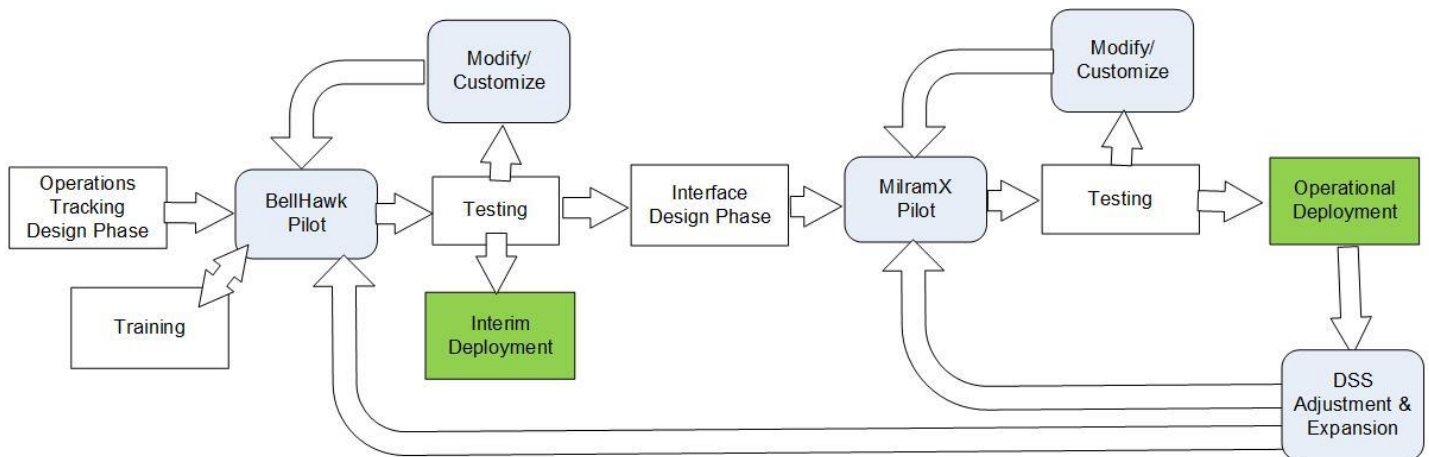


## **Software Pricing**

BellHawk and MilramX consist of many optional modules. A bundle of the most commonly used MTDS system options is specially priced at \$1,000 per month to use on a client's own Windows Server plus \$20/month, per data capture device in use, plus \$30/month for each manager or staff member login. Each data capture device can be shared by unlimited users without payment of an additional licensing fee.

In addition, KnarrTek technical staff can configure and price custom subset MTDS systems from the separate optional BellHawk and MilramX modules for those clients who do not need all the features in the standard MTDS bundle. This can be especially helpful for those clients who wish to start out with a limited Pilot installation before committing to a full implementation.

## KnarrTek Services



KnarrTek offers a full range of supporting services to assist its clients implement MTDS solutions. These fall into a number of categories:

1. Support for KnarrTek's standard MTDS product. These are performed on an hourly rates basis. This may include making minor customizations to standard reports to meet specific client needs.
2. Customizing the BellHawk and MilramX software platforms. This includes creating custom Excel imports and exports and writing custom MilramX data transfer objects to meet client needs. These tasks are typically performed on a fixed/estimated price basis and often require a prepaid design phase to develop a written set of requirements before the overall project can be quoted.
3. Implementing custom MTDS solutions, based on the BellHawk and MilramX software platforms. These are value priced, but may include variable elements, such as for monthly software rental and support and training services, as well as fixed/estimated price elements, such as for initial systems design and for software customization.
4. Implementing a Pilot Tracking Solution, based on the use of KnarrTek's MTDS software through the BellHawk Online Service. These systems may start with a standard MTDS bundle or may start with selected BellHawk and MilramX modules, as appropriate to the client's needs. Here the client pays for the labor involved in getting the Pilot system up and running, including possibly for report customization and using the DEX interface. Once the Pilot system is working to the client's satisfaction and is ready for operational use, then the client starts paying subscription fees for using the system through BellHawk Online on an operational basis. Alternately the client can pay on an hourly rates basis for KnarrTek staff to assist the client's IT staff to install the software on their own Windows Server and to pay annual rental fees for operational use of the software.
5. Providing hourly rates training and support for developers who will directly use the MilramX and BellHawk software platforms to implement their own custom solutions. This includes the IT staff of large organizations who have purchased source-code licenses for these platforms.

Work performed on an hourly rates basis is charged to each client's prepaid support account as the work is performed. Funds are added to these prepaid support accounts by purchasing prepaid Support Services Bundles, as shown here

1. Bronze Support Services Bundle \$1,000. Provides approximately 6 hours of support.
2. Silver Support Services Bundle \$2,500 Provides approximately 15 hours of support
3. Gold Support Services Bundle \$5,000. Provides approximately 32 hours of support

Standard MTDS and Pilot projects require the purchase of at least one Gold Support Services Bundle.

Fixed/Estimated price contracts are pre-paid by the project Phase. Small projects may only have one-phase, such as for implementing a custom report. Larger projects, such as for implementing a complex MTDS project may be performed in multiple prepaid phases, the first of which is always a systems design phase. These fixed/estimated price projects are always based on a formal proposal submitted by KnarrTek to the client, often after the completion of a fixed-price design phase. The estimated cost for each phase is typically fixed unless the scope of work is changed by the client.

### **Return On Investment of a KnarrTek MTDS System**

Our experience indicates that the materials tracking component of a KnarrTek MTDS, in a mid-sized manufacturing plant or warehouse, can save the time of between one and three full time equivalent (FTE) people at a loaded labor cost of at least \$5,000 each per month. This savings comes from eliminating the use of paper forms, manual keyboard data entry, and manually filling out Excel spreadsheets.

Likewise, while we have far less historical data, the AI based decision support component of an MTDS would appear to save the time of at least one FTE management level person at a loaded labor cost of around \$140,000 per year.

In addition, millions of dollars can be saved by increasing the efficiency of the operations and minimizing losses due to mistakes and oversights. These savings also do not include many millions of dollars that can potentially be earned through increased sales by meeting the needs of customers for better information exchange.

These savings also do not include the ability of a KnarrTek MTDS system to help prevent major financial losses by preventing mistakes and limiting product recalls or large losses due to late deliveries and poor-quality control and the resultant loss of customers.

## Applications of KnarrTek MTDS Software



KnarrTek provides software and services to enable the real-time tracking and management of physical materials in the industrial, food, medical and construction supply chains. KnarrTek MTDS systems are especially applicable to tracking materials in warehouses and stock room, the transformation of materials in manufacturing and processing plants, and the installation of equipment at building sites.

Some of the areas where the KnarrTek Materials Tracking & Decision Support systems have been applied include.

- Make to Order Manufacturing
- Construction and Engineering Projects
- Food and Medical Supplies Processing
- Hospitals, Clinics and Laboratories
- Disaster recovery, materials recycling, and field repair of equipment

These have one or more of the following characteristics:

1. They involve one-off events, such as the construction of a new building, or are for processing small batches of material, on-demand, where each batch being processed has differentiating characteristics that require it to be individually tracked.
2. They start with an engineering design for a customer project which results in the creation of purchase orders, work orders, and ship orders that require the supply, transformation, movement, shipment, and installation of materials.
3. They require materials traceability as to which materials went into which products or assemblies so as to enable a rapid recall in the event of a materials defect.
4. They require tracking and managing the flow of materials between multiple geographic locations.

## Relationship of KnarrTek MTDS System to other IT Systems in the Supply Chain

The total value of the software systems and services sold in the industrial, medical, and construction supply chains in the USA probably exceeds \$30 Billion annually if you add up all the different software components in use and related services. Some of the systems with which KnarrTek's MTDS systems is used (or sometimes competes with) include:

- **Inventory Tracking Systems:** which track the quantity of materials at each location within a warehouse or stock room. Instead, the MTDS software tracks the flow of containers of material and serialized items between many different geographic locations, including field



sites. While a KnarrTek MTDS system can be used as an Inventory Tracking System, this is probably overkill for simple applications.

- **Asset Tracking Systems:** which are used to track assets such as computers, furniture, and tools, including their depreciation and maintenance schedules. While the MTDS can be used to track serialized assets, including their issuance to people, this is probably overkill for most asset tracking that takes place at a single geographic location, such as in a tool crib. MTDS also does not, as standard, track the depreciated value or maintenance of assets. MTDS is, however, very valuable in tracking project related assets, such as tools, jigs, and fixtures that may move between multiple geographic locations, including field repair and construction sites.
- **Warehouse Management Systems (WMS):** which track the receipt, put away, picking, packing and shipping of inventory. Like inventory tracking systems, these systems typically track the quantity of materials at different locations within a warehouse but may also use subsidiary tables to track the lot numbers and serial numbers of materials. An MTDS system can perform all the functions of a WMS but is probably overkill if all that is required is to track and manage inventory in a single warehouse, rather than track and trace the flow of containers of material and serialized items between different geographic locations in the supply chain.
- **Materials Requirement Planning (MRP) Systems:** which take the sales projections and firm orders for several months in future and then plan and schedule production, including materials purchasing, in one or more manufacturing plants. Scheduling of jobs is typically done by simulating the production and movement of materials based on expected available machines and other resources, such as people. MRP systems are typically used by long-run manufacturers that make-to-stock or assemblers like Toyota, with long lead times, that can afford teams of people to maintain these MRP simulations. They are not typically suitable for quick-delivery, make-to-order manufacturers that do not have long-term visibility of their sales order flow and cannot afford a team of people to maintain the MRP simulation tools to correspond to available resources that are predicted to exist over the next few months. MRP simulations always start “from scratch” and ignore current work-in-process.

A KnarrTek MTDS, by contrast, assists operations managers in make-to-order manufacturing operations to perform dynamic short-term incremental planning of materials purchases and real-time scheduling of needed materials transformations, typically through a sequence of manufacturing operations, based on existing customer orders and work-in-process. This is done to ensure that there is no disruption in production schedules and that customer orders get delivered on time.

- **Accounting Systems:** which track the Profit and Loss, General Ledger, and Balance Sheet for the organization. These systems are typically used to issue Purchase Orders and to record Customer Orders, which are then exchanged with an MTDS system. The MTDS system, in return, exports Receipt and Shipment Data to the accounting system. The MTDS system can also periodically update the quantity and value of the inventory that the accounting system uses for accounting purposes.

- **Enterprise Resource Planning (ERP) Systems:** which typically consist of an accounting/finance system, typically with an MRP and Customer Relations Management (CRM) system attached. A KnarrTek MTDS system performs none of these functions but, instead, exchanges information with these functions within the ERP system. As part of their MRP functionality these ERP systems may store bills of materials (BOMs) and routes of manufacturing operations needed to transform raw materials into finished products. This data is then used to issue Work Orders to production, which may also be exported to the MTDS system. In response, the MTDS system can send back information about the materials consumed and produced on each manufacturing operation, along with related materials cost data. As a KnarrTek MTDS system also contains BOMs and Routes, it can be used stand-alone or in conjunction with a wide-range of ERP system.
- **Job-Shop/Manufacturing Execution (MES) Systems:** These systems manage the scheduling of jobs on machines and tracking of the machines used in a manufacturing job shop environment. They may also feed N/C programs to the machines and track how long each operation took to perform. MES systems may also track batches of work-in-process materials as they are moved from machine to machine. An MTDS system may also track work-in-process materials and may exchange information with an MES system as part of tracking the transformation of materials during production operations. In a job-shop manufacturing facility there is substantial overlap between an MES system and the functions performed by an ERP system, excluding the accounting and CRM functions. Many Job-Shop Systems now include MRP functionality and have added the Job Shop accounting functionality needed to become specialized ERP Systems.
- **Shipping and Logistics Systems:** These systems are used to track the loading of trucks, manage their routing to deliver materials to customers, and to track driver hours and mileage, as well as to produce bills-of-lading and shipping manifests. As an MTDS system tracks nested containers of material, such as pallets, within buildings and yards, up to the time they are loaded onto trucks and trailers, there is great opportunity to integrate an MTDS with a variety of shipping systems to avoid duplicate data entry.
- **Engineering and Computer Aided Design Systems:** Here a KnarrTek MTDS may import the BOMs for making and/or purchasing materials for each project from a design system. An MTDS system can then track the purchasing, manufacture, and installation of needed project materials and assets and report back the status of available inventory and the progress of the project to the design system.
- **Project Management Systems,** which enable project managers to manage all aspects of their projects from design, through fabrication, testing, and installation, including tracking costs and schedules. Here a KnarrTek MTDS system can provide status updates for the materials available, used and installed for the project to the Project Management System.
- **Laboratory Information Management System (LIMS),** which capture and track clinical results in medical laboratories. Here an MTDS system can work in conjunction with a LIMS track the reagents used in experiments as well as their composition and ensure that these are withdrawn when they reach their expiration date. A KnarrTek MTDS system can also track samples, whether they be in test-tubes, a well in a 96 well plate, a flask, or other intermediate container and ensure that they are stored under the correct conditions (such as a freezer).

- **Deep Reasoning Artificial Intelligence (AI) Systems:** which use methods such as Neural Networks (non-linear adaptive matrix correlators) to make autonomous decisions using large amounts of Cloud computing power (or a huge number of computers in a self-drive car). Instead, an MTDS makes extensive use of real-time AI methods such as rules, model-based-reasoning and time-dependent filtering, to quickly provide good recommendations to people, on which these people can make their final decisions, using much-less computing power.

## Commentary

KnarrTek is focused on meeting the real-time materials tracking and management needs of mid-sized manufacturing, distribution, food and pharmaceutical processing, engineering and construction organizations that live in a world of rapidly changing demands and supply-chain disruptions.

A KnarrTek MTDS system is ideal for those mid-sized organizations looking for a cost-effective solution to the real-time tracking and management of their materials, whether as a stand-alone system or when used in conjunction with other systems, such as those described above, that a client's personnel may use to run their operations.

With the exception of inventory tracking systems, almost all of the systems described above, when used by mid-sized organizations, rely primarily on the use of paper forms and manual keyboard data entry for the entry of data into each system. Recent studies have shown that over 80% of all data entered into these systems is preceded by writing the data down on paper forms.

As a result, the data is typically out of date by at least one day when first entered and it may be multiple days before data is entered in all the systems where it is needed. This makes planning and scheduling very problematic and often a lot of time is wasted in daily planning and scheduling meetings. This can also result in unhappy customers due to late and unpredictable deliveries.

There are exceptions of course, but these are typically found in the use of multi-million -dollar systems, managed by a large IT staff, for large Billion Dollar multi-national corporations.

But it is also important to recognize that , for small organizations, a KnarrTek MTDS system may be overkill and these organizations may be much better off using a simple inventory tracking system, or even an Excel spreadsheet to manage their inventory.