



# Supply Chain Technology Basics



As a global logistics company, Expeditors is keenly aware of the role that technology plays in the supply chains of our customers and the operations of our carrier service providers. When our customers entrust us to coordinate the transportation of their goods between suppliers, factories, warehouses or stores, technology enables greater coordination, predictability, and precision in virtually all of the underlying logistics activities.

The applications of technology, both existing and new, are all around us, changing and in many cases improving the way we do things in our personal as well as professional lives. This eBook is intended to explore the ways that technology can help us improve work processes and overcome the challenges in our supply chains, primarily within the domains of logistics and transportation.

Expeditors is not a technology producer; making logistics software is not our core business. Like you, we use technology and, more importantly, we work alongside thousands of customers who try, buy, and employ supply chain technologies of every kind, every day. The technology this ebook focuses on, and how we describe it, is informed by our experiences with customers just like you. It doesn't come from our own exclusive experience, let alone an ability to see into the future and predict how emerging technologies will work.

We hope to share with you the awareness of supply chain technologies, and how they can be used, which we have gleaned from our customers over the years. In doing that, our goal is to give you a level of familiarity with technology, and the ability to cut through buzzwords, so that you can pursue more in-depth learning about tech functions and capabilities that will help you and your organization continuously improve your supply chain. Rather than make you an expert, which we are not capable of doing, we hope to make you comfortable having technology conversations with business partners like customers, software vendors, and service providers like us.

To that end, we have tried to make this ebook easy to navigate, read, and digest. You'll find information about many supply chain technologies, organized into "functions," a solution with a concrete application, or a "capabilities," technology-supported process enablers used in multiple ways. You will also find links to sources of additional information, and helpful explanations of ambiguous or confusing terms.

We hope you enjoy and, more importantly, benefit from this ebook and we look forward to exploring the topic of supply chain technology with you.

*Please don't hesitate to let us know how we can help.  
You'd be surprised how far we'll go for you.*





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# GENERAL CAPABILITIES

## COLLABORATION & WORKFLOW

In the supply chain software domain, collaboration and workflow may be considered separate systems, although they are so closely related that we've opted to address them together. The bottom line here is that there's hardly a workflow that doesn't involve multiple people, so collaboration is a natural complement.

Companies implement workflow systems when they want to streamline a process, capture the steps as a digital record, automatically alert someone when a step isn't completed on time, etc. These goals are all eminently achievable when using a workflow system.

At their core, workflow systems support structured communications between people. Deploying a workflow system begins with designing a process that illustrates how to get something done. Within that process, considerations might include:

- Who owns it?
- What constraints are there?
- What timing is attached to it?
- What are the input and output artifacts to each step?
- Are there reference documents available that help someone complete a step?
- Is there an escalation path when a step doesn't get done in a certain time? Perhaps when the financial impact of the step exceeds the owner's approval limit?

Workflow systems tend to be agnostic to the type of work being done, although many of the systems providers have created templates for specific types of common workflows (accounts payable, employee timecard management, etc.).

There are many benefits associated with these systems. Designing a great process that's not followed by the people responsible for carrying it out is not ideal. These systems make that virtually impossible, since they force people to follow the prescribed process. They also make process metrics completely transparent, since each step has a digital timestamp. This allows a manager to assess the performance of people on their team, for example. They support the provision of reference materials needed to understand how to carry out a process – particularly valuable for new employees. And last, but certainly not least, they allow people who have a shared responsibility for a process to collaborate easily in the form of messaging and chat in the system while looking at the same data.

*There are countless opportunities for workflow systems in the management of logistics*

The main consideration is economic, and it starts with reflecting on the cost and performance associated with the manual process and comparing benefits to the cost of the system.

As the future unfolds and an increasing number of companies seek to automate processes in their supply chains, these systems will be foundational.





## ENTERPRISE DATA WAREHOUSE

A data warehouse is a dedicated enterprise system that holds and organizes system-generated data to facilitate analysis and reporting to solve a specified problem, or for ad-hoc data exploration purposes to gain further insights related to an organization's business. As the name implies, it is a system where large volumes of data are housed awaiting further value-adding usage.

Data in a data warehouse may adhere to common standards and formats (structured data) or it may be in multiple formats with various representations of the same physical element, such as a 40' ocean container, expressed by different values and codes (unstructured data). Whether data is structured or unstructured, a data warehouse will facilitate bringing it together and transforming it into a new data product or object that can be consistently added to and utilized for reporting and analytics that end-users in leadership roles can gain accurate insights from.

Data warehouses have applicability for all areas of a business, since they function to provide people in leadership roles with specific business intelligence about a part of the business that is deemed important, a problem or an opportunity. They also provide data for leadership to understand and monitor the overall health of the business as a whole, a specific business unit or a key focal area such as a top customer or supplier. Data warehouses may also function to combine disparate data elements into a new type of data product that can then be reused systematically in another functional area, such as combining customer data with order size and frequency to use for marketing purposes.

While data warehouses are not unique to the transportation and logistics domain, they do have significant benefit to organizations

with supply chains that stretch across multiple geographies and utilize dozens, hundreds or thousands of carriers and suppliers. The ability to combine and bring together data that is processed throughout the supply chain in [order management systems \(OMS\)](#), [transportation management systems \(TMS\)](#) and [warehouse management systems \(WMS\)](#) and harmonize the data to gain insights into functions like order lead time or landed cost allows the organization to achieve a level of visibility that is otherwise unobtainable if trying to report off of a single system.

Depending on the breadth and complexity of an organization's systems, there may be one data warehouse that can be used for all reporting and analytics needs, or multiple data warehouses, each functioning to receive specific data sets that are then used to report on a specific area.

*A data warehouse is the industry-standard way to bring disparate data together for reporting and analytics*

For an organization that generates transportation related data from a mix of in-house and third-party systems (both procured third-party systems and suppliers' systems) it also functions to allow the organization to control its own data even if other systems are responsible for generating or processing that data.

Since supply chain costs can top 50% of a product's selling price, it is extremely valuable to have a rich data set that allows leadership to accurately monitor transportation activities from cost and performance standpoints, at both the gross and item levels, in order to understand whether the supply chain is delivering optimal value or not





## MODELING, OPTIMIZATION & SIMULATION

As supply chains expand globally, they tend to become quite complex, with expanding product portfolios, trading partners, etc. Add to that the fact that nearly every activity has a level of variability, whether it be suppliers making and shipping products on time, forecasts being accurate, customers changing orders; the works.

The way a supply chain is designed has a significant impact on how well it performs. There are four distinct aspects to supply chain design:

### 1. Network design

- Where are your physical “nodes” – such as shipping locations, receiving locations, intermediate warehousing facilities, etc.?
- How do goods flow between these nodes?

### 2. Inventory strategy

- What quantity of which goods are stored where
- How do you size orders to balance capital costs against forecasted sales while containing your freight expense?

### 3. Process design

- How are business processes designed to optimize your employees’ time?

### 4. Organization

- How do you design an organization that can make the supply chain work effectively

One of the most effective ways to analyze complex scenarios and get to data-driven decisions you can trust is to create a digital model that reflects your physical supply chain. This capability is specifically targeted at network design and inventory strategy.

With a digital model, you can run optimization algorithms that suggest the best way to structure a network, and the optimal inventory levels, per SKU, to meet demand while containing risk. When the future can’t be predicted, you may want to simulate multiple scenarios, then step back, analyze them all, and pick the one that you feel most comfortable with.

Optimization and simulation are both run on the same data sets, which exist in the form of a digital model. Because they’re rooted in math, they tend to be considered reliable. By contrast, some companies resort to hastily assembled calculations in Excel, cutting corners, and quite possibly resulting in a poor decision. Optimization and simulation techniques are used by supply chain managers and analysts, logisticians, data scientists, and industrial engineers.

Most optimization and simulation is conducted on a project-by-project basis, though the idea of a “**digital twin**” is emerging, where the model is fed with live data, staying 100% synchronized with the physical supply chain. This capability provides a means to monitor overall network health, quickly sense changes that should trigger a redesign, and spin up simulations very quickly. Optimization is often conducted to satisfy a specific objective, like a reduction in supply chain cost, an increase in delivery responsiveness, reducing inventory, etc. Modeling sophistication ranges from basic spreadsheet-based analytics to purpose-built applications and analytics platforms.

Given that the modeling software and talent required to operate the more sophisticated solutions can be quite expensive, many companies are opting to outsource this function.





## REPORTING & BUSINESS INTELLIGENCE

Supply chains are volatile because the industries, economic climates, and marketplaces they operate in are under constant change. To manage that volatility, and keep their businesses running smoothly, supply chain professionals are constantly looking for information on their shipments, orders, and other logistics processes.

Various approaches are used for getting visibility to that information, depending on what you're looking for. Some look for tactical information such as shipment statuses, transportation invoices, milestone events, or exceptions. Others look for Key Performance Indicators (KPI) of strategic trends, such as transportation on-time performance, container utilization, order fill rates, or logistics spend. Without the right tools, gathering this intelligence can be very time-consuming and challenging.

A wide array of reports and other kinds of business intelligence tools, everything from static spreadsheets to interactive dashboards, is available to the desired information. Some of them are "off-the-shelf" and therefore quick and easy to set up through a template. Others can be customized to the needs of the user. Also, they can then be produced on a one-off basis or with a scheduled frequency.

The most fundamental benefits of reporting and business intelligence are understanding performance at a macro (i.e., overall network health) and micro (process metrics in a specific department) level, either right this moment or over a longer term, and being able to extract meaningful insights from that understanding. Accessing and using that visibility is the key to unlocking the benefits of reporting. Every supply chain professional should be working with their service providers, carriers, and software vendors to define what they want to see and determine which

reports will show it to them. Once the "right" reports are set up, because the information is organized in a report or dashboard, the user does not have to waste time gathering bits of information from various sources. That makes the data gathering process much more efficient. Reports or dashboards can be sent directly to multiple different parties at the same time, giving everyone visibility to the same information, the "one version of the truth," which can eliminate confusion and bring extra efficiency.

Chances are very good that any supply chain software or managed service available will have some level of reporting or **business intelligence (BI)** built into it. And the vendor or service provider won't be shy about letting you know about their solution's reporting capabilities. Most logistics service providers offer digital tools to their customers for the purpose of building and delivering reports, either developed by the providers themselves or by third parties.

Two challenges all solutions will present are the usability of the reporting or BI functions and the ability to integrate the information it provides with data from other parts of the supply chain process. Ask for a demo of any reporting capabilities for applications or services you investigate. Tools that have reporting or BI as only a minor accessory to their main purpose might end up creating a mediocre user experience that frustrates your reporting needs. That frustration with built-in reporting may point you to external solutions with friendlier interfaces and more flexible reporting configurations. If you are interested in analyzing supply chain activity captured in reports, or combining several reporting sources, the data can be presented via analytical and visualization tools such as Tableau or Power BI. Service providers can assist with setting up those tools.

Integrating reports, particularly from multiple outside providers, with data from internal supply chain functions to create a broader view can be a challenge. When investigating external tools, look for ones that explicitly support integration with your other logistics technologies to smooth the path to implementation.

Regardless of how reporting data is presented, it needs to contain the information the user is looking for, completely and accurately. Data quality plays a key role in this. Data quality is a broad concept, but it calls for information to be consistent, available timely, reliable, and complete. The data can inform the recipient of a certain status, trend or expected outcome (i.e., predictive analytics). It can be based on internal milestones or external updates within the logistics provider's **TMS** or on updates from external sources. This data is typically enriched via **EDI/API** feeds from external parties such as carriers, customers, suppliers, and forwarders. Integrating quality data from multiple sources can be made easier, providing you with the information you are looking for.





## ROBOTIC PROCESS AUTOMATION (RPA)

Typical companies with complex supply chains have hundreds, if not thousands, of repetitive processes with consistent inputs and predictable outputs - tasks like placing a predefined replenishment order through a website, or copying data from a spreadsheet and pasting it in an ERP application. These operations all have specific instructions that are reliably followed without deviation. They do not require any active thinking or learning where people excel. But they do require speed and consistency, which are not the skills humans are best at. And people tend to get tired or bored with repetition, which is when mistakes are made.

Robotic Process Automation (RPA) is a method of “scripting” processes so that the exact same steps are followed by a computer processor as opposed to a person. For RPA processes to work, they must be based on specific instructions (if this, then that), and require that specific conditions be met (such as an item inventory threshold). If they are not, an RPA won’t learn its way around an unexpected variable. It isn’t **artificial intelligence**; the RPA will simply stop and, ideally, alert you that there has been a problem and your attention is needed.

*The major benefits of RPAs are time and cost savings and fewer mistakes in repetitive processes*

The hours saved by not doing routine tasks can be used in more cost-effective ways by employees to perform complicated tasks that a computer cannot. RPAs perform tasks that a person could also perform, but without the errors resulting from boredom, inattention, or typos.

RPA solutions typically exist in the form of “bots”- small, automated “robotic” programs coded to follow specific instructions, triggered when stipulated conditions are met. Because they are small individually, RPA bots tend to be narrowly tailored to perform a specific task within a specific system, rather than perform end-to-end data processing or exception management functions within a business process. RPA functionality can be acquired as stand-alone commercial or custom-built software that integrates with existing systems (which requires security and integration consideration) or natively built into the codebase of enterprise software by the software vendor or in-house or third-party teams with access and expertise to do so.







## SENSORS & CONNECTED DEVICES

Typically supply chain visibility is limited to **milestones** and status descriptions linked to the progress of a shipment throughout its journey. These milestones are created through human data entry, **EDI** messaging, or external readers like barcode scanners in a warehouse. These progress milestones tell us where our goods are, but only in the form of where a shipment is. They tell you nothing about the goods themselves. In many cases this is not enough for shippers, who need know about the environments through which the goods passed, the condition of the goods themselves, and/or their exact position. And they need this information in real-time.

Mobile sensors that travel with the shipment itself are designed to provide more direct, physical evidence about where goods are or were, and what is happening to them. They can be affixed to a truck, a container, a pallet, carton or even to an individual item – it all depends on what the shipper needs to track and how much detail they need. Sensors can continually record data and share it in near real-time. Sensors can record data like temperature, location, tilt, shock, air or light exposure, barometric pressure or humidity.

Many sensors can be connected to through cellular networks so data is transmitted to cloud applications and delivered to the user immediately. Or it can be downloaded to a PC and viewed later. When they are continuously connected they become a single digital node in a network consisting of multiple nodes, hence the term the **Internet of Things (IoT)**, sending information about goods in transit which can be combined with information from other connected devices. All of this gives shippers the ability to magnify and focus visibility to goods in transit.

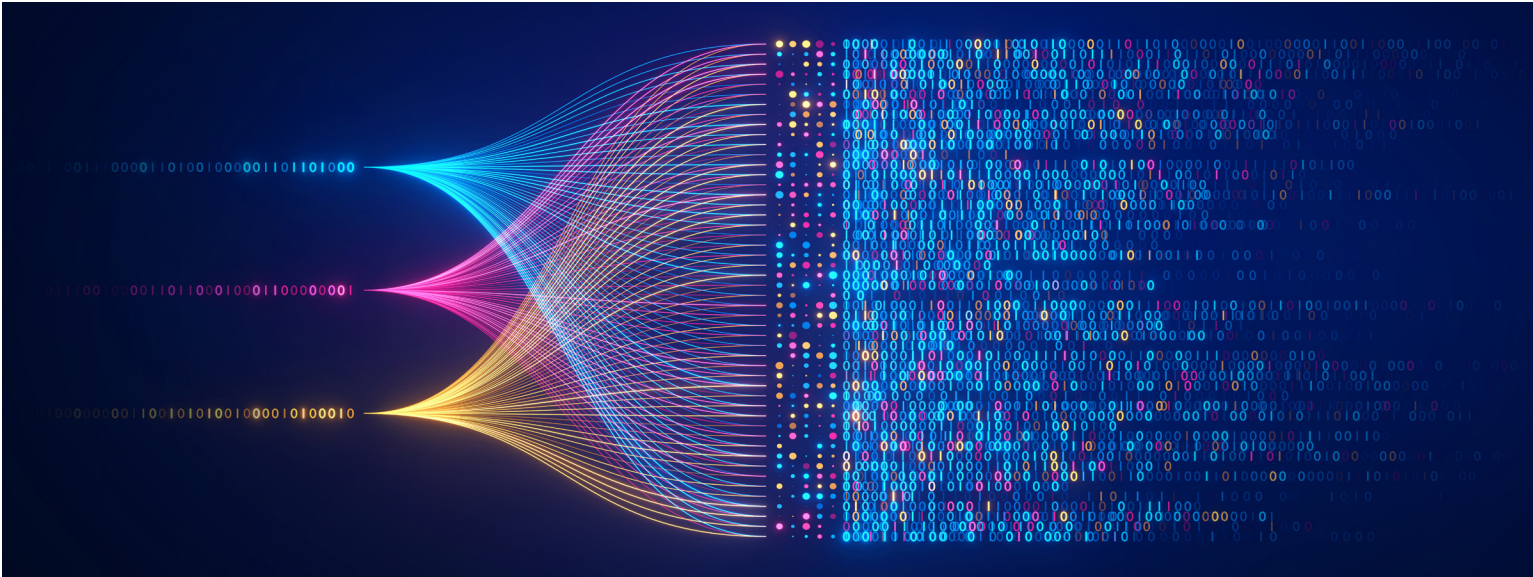
There are many use cases for sensors, among them:

- **Security** - Sensors allow shippers to see the location of valuable goods in real time, so they know if an incident is occurring. Using practices like **geofencing** users can see if goods deviate from an approved course, which can be caused by theft or possibly a driver simply getting lost. Shippers can intervene immediately, and if needed they can alert law enforcement while a security incident is happening and can still be mitigated.
- **Quality** - Many of the conditions that affect product quality, like exposure to shock, tilt, abnormal temperatures, or water, can be captured by sensors, when they would be overlooked by typical visibility systems. This data shows where and when exposures happened, who had custody of the shipment, etc.

Using this enhanced visibility, shippers can make decisions which can reduce loss, increase customer satisfaction and, in the case of foods or pharmaceuticals, ensure consumer safety.

The market for sensors includes the devices themselves and their software. Available devices range in cost and size, from very small ones much like a label or an RFID chip, to units the size of a small cell phone for pallets, up to permanent devices inside a container or vehicle. Managed services are also available, designed to monitor and analyze data, with 24/7 staff to alert law enforcement to an ongoing incident. Service providers can combine mobile sensor data with other information (such as weather or vessel location data) to form a more complete picture. An example of such a managed service is [Cargo Signal](#).





## SYSTEM-TO-SYSTEM DATA INTEGRATION

With apologies to the poet John Donne: no logistics system is an island. Your supply chain processes don't stand alone, and neither should the systems that enable them. You need to integrate them.

Integration is the way that data produced by one system becomes the information input for the next. For example, a trucker might use an app on their phone to confirm they have arrived at their delivery address. When that app is integrated with your system, it sends that arrival information from their phone to you. Now your system also knows that your freight is at its destination. Or you may have a [transportation management system](#) that integrates with a company tracking ocean vessels with satellites to provide their precise location on a map. That integration lets you see where your freight is and predict when your containers will arrive in port. In both examples, two systems are integrated by sending data from one to another.

Integrating systems means less room for human error, fewer hours spent on the phone with your partners, and not rekeying data from one application into another. No waiting for someone to get to it or limitations to only during business hours.

*With real-time integration, you can act quickly and confidently to achieve higher levels of service*

You've probably heard of a few integration methods, but it's worth thinking about all your options and considering the tradeoffs with each:

- An **API** (Application Programming Interface) is a spec for pushing or pulling information from an application. These are not industry standards, each one will be system specific. This makes APIs more flexible, so the owner can improve them more rapidly if business needs change. Unlike other methods, you can pull data from the API in real time. They are used by systems within a company as well as between companies. This is where integration technology is generally headed.
- **EDI** (Electronic Data Interchange) is a standard for exchanging documents and data, like purchase orders or shipment notifications. The data is always pushed, so you can't pull it like you can from an API. Since this is an industry standard, you can expect many partners to understand or reuse it, potentially lowering your integration cost. There is broad support for this with experienced carriers, forwarders, government agencies and other partners.
- **FTP** (File Transfer Protocol or its secure variations) is like email but without the inbox. The systems send files in formats like XML, CSV, JSON, or others from one partner's system to another. There is often no industry definition, so what you exchange with your partners is up to you. Again, this is a push-only model of communication. You may need another tool to extract the information from the file and load it into your own system.



## VISIBILITY

Supply chains are complex ecosystems, with many interdependencies across related (and seemingly unrelated) functions. Many actors – both internal and external – play a role in the overall performance of the ecosystem through activities they perform on a daily basis.

It's easy to imagine the overall ecosystem working more effectively if people could see the status of work being done by others, especially when that work affects their own. Equally important would be to see the whereabouts of goods that are in transit from their origin to their destination. A visibility system seeks to deliver on the latter of the two needs.

The data available in a visibility system can be wide-ranging. The following are common:

- Details of the shipment (parties to the bill of lading, origin/destination, carrier, description of the goods, order and item detail, package count, weight, measurements, etc.)
- Key events that communicate the progress of a shipment during its journey
- Electronic copies of shipping documents
- An estimated date/time at which the shipment is due to arrive at its final delivery point, and various way points along the way (for instance an ocean port)
- The freight cost

Additional features can include alerting when events happen (or when they don't happen as expected/committed), and satellite tracking for real-time position of the vessel, aircraft, railcar or truck the shipment is aboard.

As a general rule, visibility systems are available from the carriers who ship your goods, but they are also available from technology providers specialized in the field. While many companies have their visibility needs adequately met by leveraging carrier and 3PL tools, an increasing number are adopting third party technology platforms that can ingest data from many carriers across multiple transportation modes. These companies provide a single portal through which a company can see the status of goods in transit when they are managed by multiple providers. Visibility is also a by-product of [Transportation Management Systems \(TMS\)](#).



# SUPPLY CHAIN FUNCTIONS

## BID MANAGEMENT

If you're a typical shipper, your logistics bid process might go something like this:

1. Identify the market of potential providers suitable for your needs
2. Prepare, issue, and evaluate an RFI to standardize and narrow down the choices
3. Prepare a detailed RFX (RFP or RFQ) and issue it to short-list providers, answer questions, and collect diverse responses
4. Evaluate responses in a committee setting and decide on awards
5. Communicate awards and request onboarding or implementation support
6. Spend the next 60 days to a year (or more) onboarding new providers and services
7. Conduct business for one to three years, and then repeat steps 1-6

That cumbersome process has become even more challenging in recent years with "mini-bids" of 30 to 90 days, due to volatile rates and capacity, which only increase the number of bids you must manage at any one time. The resulting glut of bid activity presents an opportunity to streamline the process through digitization.

Bid Management Systems (BMS) are designed to allow shippers and providers to collaborate on bids (typically steps 1-6), using one platform, even if their own processes are diverse and manual.

BMSs can improve the logistics procurement process by making it more objective, standardized, and efficient. This helps when business partners all have separate systems, data sources,



pricing structures, terminology, and even spreadsheet formats. In certain markets, where there are many providers and awards are transactional, a BMS can reduce the need for extensive RFX, or tender, cycles. In highly standardized markets, they allow shippers to "pre-onboard" providers, compare pricing and capacity apples-to-apples, and make confident award decisions quickly.

BMSs do not work as effectively in complex situations involving multiple variables and service requirements, which can be met in different ways. Where pricing and program recommendations are unique to each provider, bids are not well-suited to rigid and standardized formats often used in BMSs. This is usually the case in international air or ocean transportation, as well as value-added services like customs brokerage and distribution, where the majority of services are still procured through traditional RFX cycles.

The market for logistics BMSs typically consists of two major types of systems: load/capacity management applications, and RFX management software. The first generally use online shipment auction boards that allow pre-approved suppliers to see available shipments, quote on them, win them and move them into their own TMS for execution. The latter are used to manage lengthier and more complex bids, often for international shipments, where qualifying questions, program recommendations, and implementation plans are as important as rates. These RFX systems often use online platforms to standardize rate structures, control answer formats, and manage bid timelines.





## CARGO CLAIMS MANAGEMENT

The average cargo claim for loss or damage takes 65 days to resolve, through a cumbersome process as depicted in the “typical cargo claim” graphic below. If each task takes just 15 minutes that’s already 3 ½ hours per claim.

*If you file 150 claims a year, it’s 13 weeks of full time work*

Complications can easily multiply that. Add urgency into the mix (you may have as few as three days to file a Preliminary Notice of Claim) and the manual claims process is prone to errors, ineffectiveness, and inefficiency.

Claims Management Systems (CMS) are designed to shorten and partially automate the process, capture data, and provide visibility to open and complete claims. A typical CMS provides a central online portal for filing claims, and allows you to upload bills of lading, delivery receipts, photographs, and other evidence to support your claim. These portals prompt you to provide all necessary information, on time, to successfully recover losses from carriers – who are experienced in the process and motivated to deny flawed claims. They help you create a claim, send it, and monitor processing steps (for example, the requirement that carriers acknowledge your claim within 30 days). CMSs can also be augmented with claims management services, to fully or partially offset the human work necessary, regardless of their level of automation.

A deductible of \$5,000 per claim can leave many smaller losses unrecovered. CMSs allow you to submit more claims for relatively small amounts – below your insurance deductible – which otherwise you may have omitted, by making the process simpler and quicker. They eliminate minor errors in claims that can cause carriers to deny them. A key benefit is in the valuable data captured by the system, which provides visibility to the sources of damage, allowing you to focus on correcting them, reduce cargo losses in the first place, and potentially add more value than the claims themselves.

Claims management systems typically feature a centralized platform, with a portal that allows users in multiple locations to view, submit, and manage the same claims. These platforms can be delivered in a variety of cloud-based or SaaS (software as a service) models, giving you varying degrees of control over the data, as well as customization of the software. Because management by people is always necessary, whether by you or a third party, many CMS providers augment the system with claims management services, such as those provided by [Expeditors Cargo Insurance Brokers \(ECIB\)](#). The addition of these services may add to the benefits of the system itself.





## ENTERPRISE RESOURCE PLANNING (ERP)

Back in the days when mainframe computing began to take hold in corporations who could afford them, software innovation started focusing on how entire enterprises might operate on single systems. While the term ERP wasn't introduced until the 1990s, components of enterprise resource planning had been around for a good while before that.

As the name implies, an ERP system seeks to provide a broad set of functionalities, servicing a comprehensive set of requirements across an enterprise.

Modules offered by ERP technology providers commonly include:

- Order management
- Inventory management
- Accounting
- Human resource management
- Manufacturing
- Logistics
- Trade management
- Customer relationship management

The benefits promoted by ERP providers include digitally integrated cross-functional processes and a single source of data for reporting and analytics. While a great many companies have on-boarded ERPs over the past few decades, it's more common for those companies to use an ERP for some, but not all, of their requirements. Instead, they build or buy separate systems that they integrate with the ERP.

ERP providers, recognizing that few companies use their software for all of their needs, have created integration "templates" to make integrating data to/from other systems as easy as possible. They have also forged relationships with other software companies who offer complementary functionality, strengthening their value proposition.

There are very few providers in this space, thanks to the size of investment needed to build and evolve such systems. Licensing ERP applications is costly, but the larger cost is in the implementation. Many companies on board third-party consulting partners to manage these large-scale projects, particularly due to the need for wholesale process changes that run concurrent to the ERP adoption.



## FORECASTING & DEMAND PLANNING

*For companies who buy or build products, demand forecasting and planning is a critical activity*

Done well, there will be sufficient stock to satisfy actual demand, with an acceptable amount of excess inventory. Done poorly, customer orders will not be filled due to stock-outs, or the excess inventory will consume capital and quite possibly result in write-downs or write-offs (due to obsolescence). Achieving an acceptable level of forecast accuracy is a difficult goal, and there are many systems focused on making it possible.

Forecasting is at the root of demand planning, so we've opted to address both topics together in this section. A forecasting system ingests a considerable amount of data, such as:

- Historical demand for a product
- Any demand-shaping plans (promotions, sales, etc.)
- Other influences on anticipated customer buying behavior (season, weather, financial health of a market, etc.)
- Direct customer input

With that data in the system, the process of deciding how much product to deploy in stocking locations (whether bought or produced) is ready to begin. This is a tough balancing act, with risk associated with over- and under-estimating demand. With so many

variables influencing demand, a critical capability is [simulation](#). Simulation allows companies to evaluate multiple demand scenarios, then decide on one that suits their appetite for risk.

Another demand planning function supports the decision on where to stock product, which is critical for companies with multiple distribution centers.

Forecasting and demand planning systems are widely available, both from entrenched technology providers and a plethora of start-ups. The use of [machine learning](#) as a way of increasing forecast accuracy is widespread, but it's good to be cautious before jumping in since data quality can be a significant impediment in the journey.





## FREE TRADE ZONE (FTZ)

Depending on a country's specific rules and regulations, free trade zones (FTZ) may be available to assist an importing company with streamlining customs procedures and reducing, deferring, or eliminating duties and taxes. Technology platforms exist that help manage and coordinate activities through and within an FTZ.

These platforms can help a company with tracking and tracing goods into, within, and out of the free trade zone in accordance with the country's rules and regulations. They make it easier, and maybe even possible, to take advantage of an FTZ program without incurring unacceptable risk.

*FTZ systems prepare and file admissions, inventory reports, and exit declarations into and out of the zone*

In some cases, they may transmit data directly to government agencies for certain functions, create necessary declarations and reports, and perform other important FTZ management functions.

These platforms can provide an audit trail and can help with recording activities required by the specific country's trade laws and regulations. This allows its users to enjoy the benefits of an FTZ in a low risk, compliant environment, allowing them to concentrate on their company's core business. The principal benefit of an FTZ is, of course, being able to reduce or defer the

duties and taxes paid by the company for imported goods. That can lead to better expense and cash flow management.

To put it simply, an FTZ platform helps an organization to be compliant with complex import regulations, while allowing it to manage duty and tax costs efficiently. It is part of an overall supply chain solution for customers that will benefit from the use of such a digital tool. It is intended to be fed data from a customer's system and that data is used to drive the required Customs declarations based on activity (manufacturing, export, etc.).

Note: In the U.S. the acronym FTZ stands for "Foreign Trade Zone," however the terms are synonymous.







## FULLFILLMENT

As e-commerce has expanded to meet the growing demand for online shopping, so too has the need to fill those online orders and ship goods quickly and easily. Never have there been more solutions for automating the picking, packing, printing, and shipping that makes up modern fulfillment. No longer the exclusive domain of large distribution centers, today's solutions scale to whatever the size of your warehouse and the scope of your processes.

Fulfillment solutions start with a received order and then help you get those ordered goods out the door. This usually involves:

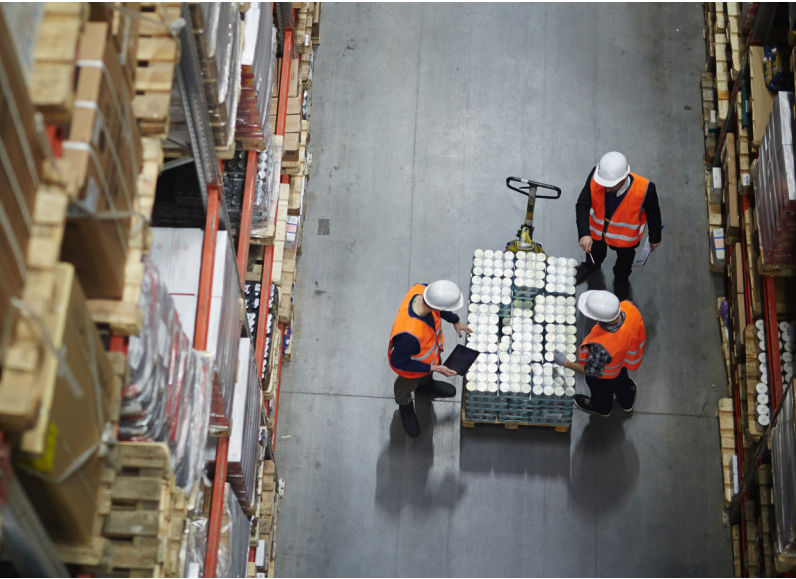
- Picking orders from inventory
- Packing the orders into boxes for shipping
- Printing shipping labels and postage
- Arranging pickup with a carrier

These solutions rescue you from managing all of this with spreadsheets, which is a win for productivity and peace of mind. The bigger gains come from integration with other business systems. Connecting this with your [order management](#) solution enables fulfillment to start without re-keying data or printing reports. Connecting this with [inventory management](#) systems ensures you know what is available and where it can ship from. And your customer expects visibility to fulfillment status and shipping notifications. Today's solutions can provide this automatically, or at bare minimum point them to the carrier's website for tracking information.

There are roughly four flavors of fulfillment solutions on the market today:

- **Picking and packing** – For larger fulfillment operations, automating the picking and packing processes cuts costs and improves accuracy in the physical parts of fulfillment. Many of these are physical machines that sort, pack, wrap, bag, or seal goods of many sizes
- **Parcel manifesting** – These solutions focus on working very efficiently with a wide variety of postal carriers so that you can print postage and shipping labels quickly no matter who is handling the actual delivery to the customer. See [Parcel Manifesting](#).
- **End-to-end order management** – There are both digital and physical options that handle both packing and manifesting. Digital solutions like Shopify integrate with upstream order processing and payment handling. Physical solutions take goods down a series of conveyors to sort, pack/wrap, label, and manifest with carriers.
- **Fulfillment as a service** – Finally, there are solutions that will do all the fulfillment work for you. Companies like Amazon, Fosdick, Walmart, and others will store your inventory, pick orders, pack goods, distribute to couriers, and provide visibility to customers. All you have to do is pay the bill. Financially, this option will also convert your longer-term capital investments in real estate and equipment into short-term operating expenses for others to provide fulfillment as a service. The balance sheet effects of this can be quite substantial for larger operations.





## INVENTORY MANAGEMENT

An inventory management system (IMS) is a software application, or suite of applications, that provides a business with visibility to its current inventory and locations of physical products that can be sold or utilized. It also provides information on the products that are on order or moving through the inbound logistics supply chain and expected to be available in the near future.

IMSs are amongst the oldest “systems” in business, having evolved from paper ledgers to a core application of early mainframe computing, to today’s modern enterprise software.

*An IMS answers the question of “What do we have?” to inform business activities such as sales or ordering*

IMS has applicability for any business that either sells or utilizes replenishable, physical items, whether those items are sold directly to customers, used as part of an assembly process to produce saleable goods, used to deliver services (like motor oil at a mechanic’s shop) or non-revenue items used to facilitate service activities (like soaps in a hotel). The common theme is that an IMS is able to manage available inventory of the physical items that are used to run the business. Note that an IMS is not the same as a fixed-asset management system, which is used to inventory and track the status of real estate, production equipment and other long-held physical plant items.

An IMS will typically include the following functionality and configurability:

1. Ability to store data about items at the stock keeping unit (SKU) level or even lower levels (such as serial number, date of manufacture, etc.) as required by the business for managing its inventories effectively.
2. Supplemental information about each product kept in inventory as required for sales, compliance or vendor management, such as supplier details, ingredient lists, place of manufacture, dangerous goods information, handling or storage requirements, etc.
3. Ability to manage transactions related to each unique item record to show inventory levels on hand, committed, quarantined, on order and in transit.
4. Accounting data to track when items were ordered, received into inventory and sold.
5. Ability to set minimum inventory levels that allow you to meet expected demand, while accounting for replenishment lead-times.
6. Reporting functionality on all relevant inventory activities either built in or produced through an enterprise reporting and analytics system.

A modern, effective IMS will integrate with the following systems to provide a business with a responsive, high-performance supply chain management practice:

1. Sales and order [fulfillment](#) systems to accurately update inventory levels based on what has been sold and fulfilled.
2. [Order management systems](#) to forecast, order and track inventory for replenishment.
3. Accounting and finance systems to recognize and account for inventory sold and on-hand.
4. [Warehouse management systems](#) to ensure safe and secure handling of inventories and to accurately track their location at and in a warehouse or other fulfillment locations.
5. [Transportation management systems](#) to populate shipment and documentation records to effect safe, secure and efficient transportation of items on inbound and outbound moves.
6. [Enterprise resource planning](#) systems that combine some or all of the above functions and also utilize IMS data to provide holistic business visibility and planning.





## MATERIAL REQUIREMENTS PLANNING (MRP)

The main job of an MRP system is to communicate a precise set of requirements for the availability of materials (component parts and raw material) needed to meet the production plan at a manufacturing site. In a just-in-time manufacturing environment, where there is little to no inventory buffer,

*MRP systems play a vital role in ensuring that production lines don't go down due to a lack of material*

An MRP system contains the **bill of material** for a finished good that is scheduled for manufacturing. Aside from monitoring which materials are already in stock and available for production, it has a list of prioritized suppliers available to source which materials from, lead-times to get them ordered and delivered, etc. It allows a planner to evaluate current inventory levels of parts and materials, then set appropriate quantities to order. It also allows for buffers to protect companies from risk, such as a supplier's on-time-performance, quality issues, etc. The main input to an MRP system comes from a [production planning](#) system. The main output from an MRP system goes to a purchasing system.

Companies involved in manufacturing need an MRP system to effectively support production planning. As a result, it's not really an option to have one, although for manufactured goods with very

simple bills of material, it's certainly possible to use manual means to create a material plan.

MRP systems have been around for a long time, and as such, have evolved considerably. Their functional reach has expanded more broadly into inventory planning, materials management and even some human resource planning (in the context of manufacturing).

The linkage between MRP systems and logistics management has historically been somewhat tenuous, but it's strengthening as companies invest in more "horizontal integration" – that is, digitally integrating business functions that have levels of inter-dependency. Since MRPs contain key data on a need-by date for materials, logistics leaders can leverage this in their transportation planning so they play their part in ensuring the timely availability of production materials.



## ORDER MANAGEMENT

Orders are the lifeblood of any company. They are used in managing the sale of goods to customers and the purchase of goods from suppliers. For many companies, a purchase order from a customer represents the shift from planning to execution.

An order management system (OMS) is used differently when selling versus buying goods. When selling, typical functions are:

- Capturing information from customer-issued purchase orders (PO)
- Checking whether goods ordered by the customer are in-stock and **available-to-promise**
- Verifying the customer's credit standing to make sure the value of the PO doesn't exceed their credit limit
- Creating a sales order (reflecting the company's commitment to fill the customer PO)
- Allocating inventory to the sales order (rendering it unavailable to commit to another customer)
- Triggering the fulfillment function (pull inventory and ship goods to customer)

On the buying side, it's used to create purchase orders placed on suppliers. Deciding what to buy, how much to buy, from whom to buy it, and how much to pay for it are decisions made prior to the creation of a PO.

Aside from the obvious use of an OMS, it is also a critical tool in managing cash flow, and the balance sheet overall. It contains accurate records of commitments on both the buy and sell side that influence capital needs and cash.

*As a core business system, having an Order Management System is not optional*

Although for very small companies, it's always possible to issue orders manually and do bookkeeping in Excel.

There are many OMS providers in the market. Many companies have OMS as a module in their enterprise system, while others opt for a discrete OMS from a provider specialized in the space. There are also many start-ups working to provide increased integration between supply and demand management systems and OMS functions.

OMS systems often send data to logistics providers for the purpose of tracking the whereabouts of orders and the items in them, adding richness to the tracking of shipments.





## PARCEL MANIFESTING

When you handle large volumes of small packages, it is easy for small problems to incur large costs. Conversely, every small act you make to improve efficiency and reduce cost is magnified by all the packages you ship. Parcel manifesting systems combine many of the steps of parcel shipping into a single location and interface. The same station can automatically weigh a parcel, confirm its size, connect with carriers to pay for postage, and produce labels.

More advanced solutions can offer rate shopping across various carriers, including interactions with pre-paid online postage accounts, and provide guidance for insuring freight. Some solutions will work offline, but most will connect to carriers over the internet for the latest postage rates and automatic updates.

Almost all solutions will need to integrate with an [order management system](#), either directly or through shared files/databases. Many come with their own printers for labels, but you may need to provide your own.

The benefit to a dedicated system for parcel manifesting is consistency. Every minute saved preparing a package for shipping is a minute better spent serving more customers' orders. You eliminate a lot of manual data entry to route, label and manifest the parcel correctly. This avoids dealing with misrouted or returned packages due to incorrect information.

There are a variety of vendors providing parcel manifesting solutions.

- **Web-based Software** – While you can find solutions that are purely software, you will still need to procure the hardware that makes it run. Odds are you will still need to accept some manual data entry. You will get to choose your printer brand and size, but make sure to check for compatibility. Your software vendor will often provide this on their website.
- **Dedicated Stations** – This solution will include all the hardware you need, from scales, computing, touch screen displays, and printing all in one desk. Your vendor should tell you how their solution is designed to scale, either through adding more of the same desks or providing discrete functions at different desks (e.g., one stop for all weights, but several for postage selection and printing)

You may also find parcel manifesting solutions as part of a larger [fulfillment](#) system.





## PRODUCTION PLANNING

*Production planning systems are indispensable tools for companies who manufacture goods themselves*

For our purposes, the term “manufacturing” includes fabricating, machining and assembly, etc., using a combination of machines and people.

As its name implies, a production planning system is used to plan specific production runs for a set of products being manufactured or assembled in a production facility. The system takes into account the desired output of a finished good, its associated bill of material (component parts that go into the finished good), machine and human capacity, and produces a schedule by which the finished good will be produced.

Production planning systems are designed to optimize the output of all production capacity, while considering the constraints that influence it. Those constraints may relate to quality (managing defects), maintenance, the need for human supervision, shift lengths, etc. The outputs of production planning systems become the inputs of **manufacturing execution systems** embedded in production lines.

Production planning systems typically deliver tangible economic

benefits to companies that use them, especially when the inputs to those systems (demand planning or actual customer orders) are constantly changing.

The market for production planning systems has many providers competing for business. Typically, these are not the large enterprise systems companies, they are smaller companies who understand the dynamics of manufacturing.

Production planning systems may be linked with logistics systems, like a TMS, but those links tend to be infrequent. Production planning systems operate in a narrow sphere; other systems further upstream or downstream are usually more closely connected to logistics.





## SALES & OPERATIONS PLANNING (S&OP)

S&OP systems are relatively young when compared to other systems being used in the field of supply chain management. They were created to address what has typically been the manual process of aligning demand planning, supply planning, finance, and operations. Many companies still perform this function using spreadsheets and face-to-face meetings to forge an optimal supply plan.

Because of the high number of variants in how companies manage their planning functions, S&OP systems tend to be extremely flexible in terms of how they are used. A typical set of inputs to an S&OP system might be:

- Forecasts
- Demand planning outputs
- Supply data (costs, lead-times, constraints, etc.)
- Current inventories
- Risk tolerance or appetite

The system takes in all this data and runs simulations that address various scenarios with the goal of landing on one that has the right balance between reward (profit) and risk. It should be noted that, depending on the dynamics involved on both the demand and supply sides of a company, S&OP can be a monthly, weekly, or even daily process. A common practice is to do it on two horizons, such as a quarterly one (for planning) and a weekly one (to execute against).

*It has been widely proven in the market that automating S&OP results in higher order fill rates and less excess inventory*

As such, the ROI on the technology needed to support S&OP tends to be strong.

The market for S&OP systems has grown substantially over recent years, as an increasing number of companies embrace digitization and automation. For the most part, S&OP systems are available from technology companies specialized in that domain (as opposed to ERP providers).





## TRADE DATA MANAGEMENT

If you're in the import or export business, you know how challenging it is to stay on top of trade compliance with all of the regulatory requirements and changes that affect your organization globally. Shippers are responsible for adhering to a multitude of trade requirements, and they face great risks if they fail to do so. To name just a few, you need to get trade data right in areas like harmonized tariff classification, US export controls, restricted parties lists, security controls like **C-TPAT** and **AEO**, and food and drug regulations. To add to the regulatory dangers, you must also make sure you understand the duty and tax costs of the products you trade-in. In this environment, it can be hard enough to keep your company out of trouble, let alone turning understanding and compliance to your advantage.

Trade data management systems are designed to identify, collect, and share this information at a granular level, such as an item number. At the core of such systems is a parts list with as much data about the item as possible, such as the supplier, country of origin, unit cost, material composition, etc. With this "master data" trade management systems can help you screen new business partners, classify products, determine duty rates, and identify other requirements like **antidumping/countervailing duty** cases, **FDA** or other **PGA** regulations, etc. Once identified and collected in an organized database.

*Trade data management systems facilitate collaboration with freight*

*forwarders, customs brokers, and other business partners*

The benefits of using trade data management systems come in two broad categories: risk mitigation and added value through compliance. On the former, the goal of these systems is to create a trade compliance net to catch errors before they happen and prevent you from making a costly mistake. Violating trade regulations, even unintentionally, can cause financial damages, loss of trading privileges, and even criminal penalties. On the latter, understanding duties, taxes, duty-free programs, and trade regulations, in general, can give you the knowledge to make the most profitable (and compliant) decisions about what to source, how to manufacture, and where to distribute. Knowing the law, down to the item level, gives you the tools to make the most cost-effective supply chain decisions.

Trade data management systems on the market generally consist of standalone commercial software, available online in secure cloud-based applications, or purpose-built software modules that integrate with existing enterprise systems. Commercial applications are available from a variety of vendors including software providers, as well as knowledge providers such as customs brokers or trade consultants. Both standalone and modular applications will integrate with enterprise software.

[Tradeflow](#) is a trade data management solution offered by Expeditors





chain-related data from [Enterprise Resource Planning \(ERP\)](#) systems – including order data, carrier rates, and lead times – and by the growth of [Electronic Data Interchange \(EDI\)](#) that facilitated sending defined data between organizations to initiate or receive transportation-related activities. They were further enabled by the increased availability of wide-area networking, allowing multiple offices to collaborate and work off of centralized TMS systems. In the early days, TMSs were exclusively the domain of large organizations with significant IT budgets that allowed substantial customization of the software by in-house engineering teams and external consultants. Small and mid-size organizations largely relied on manual or Excel-based solutions until the mid-late 2000s when greater interest in small and mid-size customers by TMS vendors opened up new options for TMS expansion beyond the traditional large enterprise customer base.

Modern TMS implementations have evolved to become requisite software for organizations that produce, ship, buy or manage freight, and is commonly segmented into the following markets:

## TRANSPORTATION MANAGEMENT SYSTEM (TMS)

Transportation Management System (TMS) refers to a software application or suite of applications that is utilized by an organization to coordinate and manage freight transportation activities, either across that organization's entire supply chain or a specific segment of their supply chain. TMSs are also utilized by transportation service providers (carriers) to manage their customers' freight shipments and related activities moving through their networks.

The functional areas that TMSs provide for generally include:

- Orchestration and managed execution of transportation functions utilizing standardized and governed business rules and **master data**
- Management and governance around transportation providers, rates and service levels
- Compliance with applicable legal, trade and internal regulations
- Creation of required transportation documentation
- End-to-end visibility of all transportation related activities and events
- Integration with internal and external sources of data to facilitate accounting, billing, inventory, compliance, forecasting and other ERP functions
- Automation of transportation management activities using above functions

TMSs as software products came into being in the 1980s, driven by the need for more effective planning and tracking across corporate supply chains as offshore production opportunities opened up in Asia. They were enabled by greater digitalization of supply

- Large enterprise TMS that can manage an entire corporate supply chain and includes relationships between multiple geographies and business units and deep integration with one or multiple ERP systems and hundreds or thousands of external parties.
- Mode-specific TMS that focuses on all aspects of a single mode (often trucking).
- Carrier-focused TMSs that are marketed to asset and non-asset -based carriers to manage customer freight.
- Cloud TMS offerings that contain minimal options for customization and configuration but some or all core and necessary functions for basic transportation management, usually to facilitate better visibility. These systems are fast to implement but may have limited integration options to other enterprise systems and data without additional expense and effort. These are typically marketed to small or mid-size organizations.
- Enterprise-grade TMSs that have broadly applicable logic and optimization capabilities and can manage supply chains that span a broad range of modes, sourcing models and complexities. These systems require more upfront investment, typically around configuration, and minimally around software development, but provide more opportunity to achieve desired business outcomes.





## WAREHOUSE MANAGEMENT SYSTEM (WMS)

Warehouses are the beating hearts of any supply chain, continually pumping freight across the world. Keeping them running well requires systems for receiving shipments knowing where to store them, and coordinating picking and shipping at the right time. On top of that, each warehouse must have measures in place to ensure goods are stored and handled correctly, both by company policy and for certification by government and international regulatory bodies. The Warehouse Management System (WMS) is where all this comes together.

Every WMS should ensure the essential warehouse management processes are executed correctly:

- Receiving & put-away
- Inventory tracking & control
- Picking & shipping

Additionally, your WMS may cover adjacent needs, such as warehouse layout design or labor management.

The best-run warehouses today do more than minimize the cost of shipping. They leverage data about the facility, inventory, orders, and staffing to optimize operations and turn logistics into a company advantage.

Integrating your WMS into other supply chain systems lets you extract the most value from your investment. Pulling in data from your [order management system](#) ensures each purchase is shipped quickly. Including [inventory management systems](#) will give you more data about when to expect goods to become available to ship. And your WMS should provide you with analytics to understand how efficiently

you are operating, what your near-term forecast is, and where errors are occurring.

When evaluating your WMS options, consider if you want to own your WMS and run it **on-premises**, or if you want to subscribe to a WMS as a service. SaaS (Software as a Service) options get automatic upgrades and require no up-front hardware purchases. But if you lose your internet connection, or their service goes offline, then your warehouse stops. Running your WMS on your own hardware gives you control but also responsibility for upgrading and patching. When it goes down, you have to restore it.

Beyond that, you need to know if you want just a WMS, or if you are going all-in on an [ERP](#) with WMS as a component. The market trend is away from large ERP installations towards choosing smaller, best-of-breed options and [integrating](#) them through APIs.





## YARD MANAGEMENT SYSTEM (YMS)

The function of organizing and coordinating a container yard is a process of growing interest for supply chain organizations, who may already use [Transportation Management Systems \(TMS\)](#) or [Warehouse Management Systems \(WMS\)](#), and are looking to further improve efficiency and reduce costs. Yard Management Systems (YMS) are designed to coordinate activity in the space between TMS and WMS controlled environments. This activity is still handled manually for the most part, which leads to excess cost, wasted time, and a loss of visibility to what's going on in the trailer or container yard.

YMS tools are designed to optimize yard operations – the access, movement, and storage of containers and trailers inside the enclosed space adjacent to a manufacturing or distribution facility. Some of the challenges a YMS can help address are:

- Lack of visibility to the location of trailers, loads, or shipments
- Excess costs for equipment, labor, space, demurrage, and detention charges
- Wasted time looking for trailers or containers

Benefits of a YMS include increased throughput, reduced cost and wasted time, improved safety and security, and coordination of yard activities with other processes. YMS systems can also record and generate metrics to analyze for continuous improvement. Finally, good YMS systems make a shipper easier to work with as a customer of carriers, leading to better relationships and, potentially, better rates and service.

Several different types of YMS are available to help shippers optimize yard activities. The choice of which is best depends on factors like

volume, complexity, budget, and the job that needs to be done. They range from simple apps to schedule and record movements in the yard to complex systems with loading bay optimization, refrigeration monitoring, [RFID](#) (radio-frequency identification), visual locator drones, and more.

Here are some examples of the type of YMS available in the market to help manage your yard:

- Add-on modules or functions of an established WMS, TMS, [ERP](#)
- Comprehensive stand-alone solutions which may be able to integrate with other applications
- Vertical-specific systems for industries with special needs like food, retail or automotive
- Niche providers for specific yard scenarios like electric or automated yard vehicles
- Managed programs, blending technology and service
- Systems specifically for individual yard activities such as loading bay scheduling





# THE FUTURE OF TECHNOLOGY

At the risk of speculating, we can offer some perspectives on the direction of technology in the world of supply chain management, since many of the evolutionary paths are already underway.

The most over-arching theme we see unfolding is “cognitive automation.” By that, we mean automation that not only has computer intelligence underpinning it, but is also able to raise its intelligence, and therefore its effectiveness, by learning (therefore the use of the term “cognitive”).

Many futurists talk about autonomous operations in the world of supply chain management. While the idea of completely autonomous operations may seem like a step too far in our collective thinking, it is certainly easy to believe that a great many supply chain functions might be candidates for either complete or at least a high degree of automation.

When you think about routine supply chain decisions that are more data and math-driven, the cognitive aspect might be less useful. For decisions where more nuance is involved, and therefore more reasoning, it’s hard to imagine **artificial intelligence** matching the capabilities of experienced people.

There is another branch of the same tree that seems to be collectively agreed by those who seek to predict the future, aptly termed “human-machine mutual augmentation.”

In such a situation, artificial intelligence tools, backed by **machine learning** (where the cognitive capabilities are developed), may provide a substantial level of automation, but a human may be inserted into the equation before finalizing a decision that triggers

a subsequent process. Their role would be to either affirm the suggested choice of the machine or to change it.

The machine augments human intelligence by providing analysis that might include the financial impacts of, say, three choices for how to move forward. It’s easy to imagine the human short-circuiting the analysis due to lack of time, data, or both.

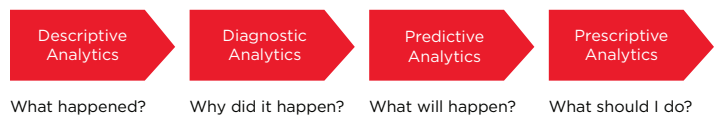
The choice made by the human is recorded in the data used by the machine learning algorithms, effectively making the artificial intelligence “smarter.” This is how a human would augment a machine.

Two big prerequisites for any degree of autonomous operations are:

- Ubiquitous integration between systems (it’s more common to have a decision that has a dependency on data that’s in multiple systems, some of which may belong to trading partners)
- Accurate data (error free, with little to no latency)

In both of these areas, we are a long, long way from where we’d need to be to see autonomous operations. So instead, what we see are narrow applications of this capability.

This is a framework you may be well versed in:





To ground you on how this topic fits, it's in the "Prescriptive" phase, including an augmentation.

- "What should I do?" – This is answered by a system providing a recommendation and/or calculating the impacts of a series of possible choices. You might call this decision support.
- The step beyond is the natural evolution; decision automation

For decades, it was common for technology to constrain imagination. Either the technology didn't exist, it was too expensive to implement, or the data on which it depended was inaccessible.

Today, it may well be the case that imagination is the constraint. Even in today's environment, technology may be more capable of performing tasks that we have yet to imagine it performing.

As you explore and learn more you will often hear about emerging technologies that appear promising, and in some cases very trendy. Concepts like **blockchain**, **edge computing** and machine learning, which may have commercial applications or may be more theoretical, come up often in conversations about technology. The key thing is to remain curious and open to learning about new developments, while staying grounded in the jobs to be done right now. Keep an eye on the horizon for new breakthroughs in technology but only invest time and resources in capabilities or functional applications which can help you get those jobs done today. So, the next time you read about **autonomous vehicles**, artificial intelligence, or **natural language processing (NLP)**, take a practical approach and always ask what they can do for you.

***What can we do for you?***

***You'd be surprised how far we'll go for you.***

***[Click Here to Connect with an Expert.](#)***



# GLOSSARY

**AEO:** An Authorized Economic Operator is a party involved in the international movement of goods in whatever function that has been approved by or on behalf of a national Customs administration as complying with World Customs Organization or equivalent supply chain security standards.

**Antidumping/countervailing duty:** Are extra import duties imposed on goods in addition to the normal duties that apply. These duties apply to imported goods that are sold in the US & EU at prices substantially lower than their normal value.

**Artificial intelligence (AI):** Refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions.

**Autonomous vehicles:** Is a vehicle that can drive itself without input from a human driver.

**Available-to-promise:** Is the projected amount of inventory you have left available to sell, not including allocated inventory.

**Bill of material:** A bill of material is a detailed list of raw materials, elements, components, sub-assemblies, pieces, and anything else needed to make the finished product.

**Blockchain:** Is a shared, immutable ledger that facilitates the process of recording transactions and tracking assets in a business network.

**Business intelligence (BI):** Is software that ingests business data and presents it in user-friendly views such as reports, dashboards, charts and graphs.

**C-TPAT:** Customs-Trade Partnership Against Terrorism is a voluntary supply-chain security program led by U.S. Customs and Border Protection focused on improving the security of private companies' supply chains with respect to terrorism.

**Digital twin:** A digital twin is a digital representation of a real-world entity or system.

**Edge computing:** Is a distributed computing framework that brings enterprise applications closer to data sources such as IoT devices or local edge servers.

**FDA:** The Food and Drug Administration is a government agency that regulates certain food, drugs, cosmetics, and medical products.

**Geofencing:** The use of GPS or other technology to create a virtual geographic boundary for an object, enabling software (or a user) to trigger a response when a mobile device enters or leave a particular area (or route).

**Internet of Things (IoT):** A collection of physical devices or objects, with sensing and transmitting capabilities, that connect to one another via the internet, and convey data to users through an interface.

**Machine Learning:** Machine learning is a branch of artificial intelligence (AI) and computer science which focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy.

**Manufacturing execution systems:** Is a comprehensive, dynamic software system that monitors, tracks, documents, and controls the process of manufacturing goods from raw materials to finished products.

**Master data:** Is a set of identifiers, that provide important information about a piece of business data, which can include item number, supplier, customer, location, description, compliance information, cost, price, etc.

**Milestones:** A recorded event, linked to a shipment in transit, such as Booked, Departed, Arrived, or Delivered. Milestones provide visibility to significant events in the life of a shipment of goods, helping the user to determine its location or progress.

**Natural language processing (NLP):** Is the ability of a computer program to understand human language as it is spoken and written.

**On premises:** Refers to IT infrastructure, hardware and software applications that are hosted onsite rather than remotely or in the cloud.

**PGA:** A Partnered Government Agency is an agency under the United States federal government that regulates the import of certain products.

**RFID:** Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects.

