



Supply Chain Execution In the Cloud Point of View

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Ascension Logistics is providing this Point of View as a diagnostic-like paper to guide our clients through the cloud when considering Supply Chain Execution systems vs. On-Premise. Supply Chain Execution Systems in the Cloud is a fairly new concept that to this space. Transportation Management Systems have been around for nearly 10 years while there are a smaller but growing number of users in the cloud specifically for Warehouse Management System.

Key Definitions and Terms:

Cloud Based – Software which is based and delivered remotely from the end user and is maintained on a remote hardware platform

SaaS – Software-as-a-Service – Software which is owned, delivered and managed remotely from the end user and is maintained on a remote hardware platform

Supply Chain Execution Systems – Outlined for this paper as the key operating systems required for distribution and fulfillment of products to end customers. These systems can be looked at as inside the four walls of a facility and outside the four walls:

- Systems outside the four walls typically include:
 - Transportation Management Systems – responsible for planning inbound and outbound transportation
- Systems inside the four walls typically include:
 - Warehouse Management Systems – responsible for planning and execution of warehouse operations including receiving, processing and shipping of goods to end customers

- Warehouse Control Systems – responsible for execution of complex material handling equipment including conveyors, sorters and other types of automated picking including pick/put-to-light and voice

In reviewing each of the systems below, we will examine where they fit in the cloud today and look at current and future applications of the solutions.

Typical benefits of Cloud based supply chain solutions applicable to all systems are:

- Little or no requirement for capital investment to enable usage
- Variable pricing based on consumption – buyers “pay-per-use”
- Rapid acquisition and deployment
- Lower ongoing operating costs that IT owned and manage in-house
- Programmable and adaptable in use

Major Opportunities for Cloud / SaaS based solutions for our clients include:

Transportation Management Systems

- All clients that have medium to complex transportation needs
 - Transportation is typically planned centrally
 - Transportation systems typically have a limited number of users
 - Transportation systems generally do not require sub-second to 2 second response time
 - Transportation systems via the cloud have been delivered for the last 5+ years and have built out robust solutions typically
- All global markets should be included since the capability to provide TMS in the cloud is relatively mature
 - North America
 - Europe
 - South America
 - Asia
- Ascension Logistics can provide the services to lead these implementations and can help find the Cloud based hosting environment for the infrastructure.

Warehouse Management Systems

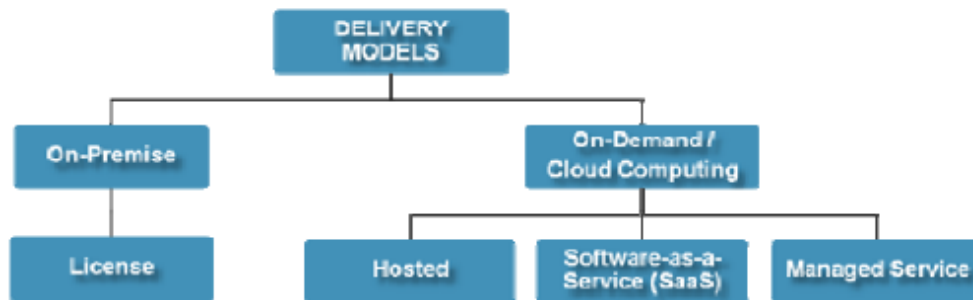
- Research has indicated this is a new and evolving opportunity for WMS providers
 - Only a limited but growing number of WMS providers have offered a cloud-based solution
 - Reasons why this is new and just beginning to be accepted / requested by Clients
 - Concerns with Security, Authentication and Access
 - Concerns with response time needs in the < 1 second to 2 second timeframe



- Concerns with heavy automated facilities that require milli-second response times between the WMS and automated equipment (WCS)
 - Concerns with reliable internet connectivity
 - IT driven projects vs. operations driven project tend to look for the SaaS model more often if the IT organization is more progressive. Operation driven projects are typically very risk adverse and look for a system that is guaranteed to work all the time
- Non-Government Organizations (NGOs) work with rapid disaster relief (Haiti Response Model)
 - Need ability to quickly set up operation in disaster area to process relief supplies
 - Need ability to track inventory but do not have sophisticated processing needs
 - Ability to plan and organize kit building can easily be provided
 - Quick access to internet (Satellite services) can provide information on supplies worldwide in a matter of hours if planned properly
 - Since WMS systems for cloud are relatively new, this is an easy way to provide a solution that can be received and utilized by almost all NGOs that provide disaster relief
 - Ascension Logistics can work with the NGOs to develop a rapid deployment solution and find the cloud hosting capabilities from a hosting company as well as provide the services associated with developing the solution
- 3rd World / Emerging Markets with limited infrastructure
 - Many of these markets do not require sophisticated distribution and/or are not operating heavily automated distribution centers
 - Markets do have a need for need to for distribution and are rapidly expanding
 - Example markets in the BRIC (Brazil, Russia, India and China) as location that are rapidly expanding and have access to internet connections or mobile communications technologies
 - Markets need to be set up to support the small store distribution with daily deliveries and can operate 24 hours per day
 - Ascension Logistics can provide the services for implementation in addition to finding the cloud hosting capabilities from a hosting company
- Multi-national Corporations (Fortune 1000) and International Organizations needing rapid expansion into new markets where the environments have limited infrastructure
 - As companies expand internationally into the emerging markets, the need to have distribution and warehouse space is critical based on government regulations and need to have a presence in the new counties
 - The cloud solution can provide a rapid method to set up smaller less sophisticated operations and processing requirements are not as complicated
 - Internet access can be provided via hard wire or a mobile communications solution which can include Satellite access
 - These facilities are typically <100K Sq. Ft. and generally have a limited number of concurrent users <20
 - Ascension Logistics can provide the services for implementation in addition to finding the cloud hosting capabilities from a hosting company

- Third Party Logistics Providers
 - Solution would work well in less sophisticated environment
 - Good examples included pallet in / pallet out operations where services are limited
 - Good for a multi-tenant environment that can allow for rapid set-up and introduction of new clients to the facility operations
 - Limited in capability for the dedicated facilities that have automation and large numbers of users needing high transaction response times
- Ascension Logistics can provide the services for implementation in addition to finding the cloud hosting capabilities from a hosting company
- Large Sophisticated Distribution Operation and Large Clients
 - Market place is not ready at this time for WMS in the cloud
 - Need for interaction with hundreds of users and heavy automation is not proven
 - Recommend this type of client need for SaaS be put on watch list but not immediate needed by clients as this is still evolving in the marketplace

Supply Chain Solution Delivery Models



Transportation Management Systems (TMS)

Transportation Management Systems have lacked maturity and unrealized growth in supporting Supply Chain globalization. TMS applications, packaged or internally developed have primarily focused on North America with limited international logistics. As Western Europe continues to expand, TMS vendors are “stepping-up” selling and supporting TMSs in multiple geographic markets adding multilingual, multicurrency and localization capabilities to plan and manage freight. This expansion opens up TMS for untapped markets in Asia/Pacific, Latin America, and Eastern Europe and in the low complex business environment, SaaS TMS providers will be the primary benefactors of this new market space.

SaaS TMS model allows rapid, inexpensive onboarding of trading partners to their platforms enabling these partners (carriers, suppliers and customers) through network portals to collaborate from source through settlement. SaaS TMS opens the market to smaller, less complex shippers through integration to large numbers of external trading partners (carriers, suppliers) making SaaS TMS a multi-enterprise



global platform enhancing its value because it enables users/organizations to more easily communicate with their trading partners.

Value Creation Example:

While this value creation is growing and emerging, Oracle and E2open have collaborated with E2open building a prepackaged carrier network integrating to Oracle Transportation Management (OTM). This exclusive beginning can lead to a separation of the network and the TMS application making it possible to switch TMS's while keeping the carrier network. Investors can benefit from additional revenue streams as SaaS TMS provide collaborative network trading 2.0.

Vendors in the TMS SaaS market include:

E2open, Integration Point; JDA (i2); LeanLogistics; Management Dynamics; Manhattan Associates; QuestaWeb; RedPrairie; Synchron; Wesupply Sterling Commerce, Lean Logistics and Descartes, i2, FreightMatrix, JDA, MercuryGate. Red Prairie and Manhattan Associates offer less "pure-play SaaS" but subscription model. TMS consolidation continues in the marketplace as evidenced by Sterling Commerce's acquisition of Nistevo, HighJump acquisition of Pinnacle and Oracle's acquisition of G-Log.

TMS SaaS Characteristics:

- Hosted, off-premise application
- Multiple tenant, web-based architecture
- Single code base, managed across all user organizations
- Subscription and/or transaction-based pricing model

TMS SaaS users can rent or subscribe to TMS functionalities on-demand and pay as they use the software. The pay-as-you-go model minimizes upfront costs and is gaining SaaS traction in the down economy. By providing shippers an array of TMS capabilities: planning and optimization, tendering and booking, freight payments, and track and trace without the traditional large upfront costs of on-premise TMS implementations, business case benefits can be achieved faster with much lower investment in money and project implementation labor. Additionally, a key differentiator of SaaS TMS is the vendor's "pool" of a "pre-on boarded" carrier network providing shippers electronic access to a large population of freight carriers. With SaaS TMS, users can theoretically tender shipments to carriers on the network.

Candidates for TMS SaaS

SaaS TMS opens the market to a wider array of shippers including companies with less than \$25 million in annual freight, fewer than 50 shipments per day and parcel shippers. Shippers with less than \$100 million in freight spend, low complexity and low sophistication of their transportation management technologies can benefit. SaaS TMS offers automation in carrier communication, freight audit, and payment all benefiting small and midsize businesses (SMBs). Large complex shippers require robust transportation planning and execution capabilities remaining in the on-premise TMS market space. However, larger organization are moving toward the TMS SaaS model as the marketplace expands capabilities and services to reduce IT and operating costs.

Total Cost of Ownership (TCO) for SaaS TMS is measured on an expected life span of less than five years. SaaS TMS users understand the trade-offs between the rich functionalities of the on-premise TMS -





higher upfront costs, combined fees for software license, infrastructure, and ongoing maintenance and the lower upfront costs of SaaS. An additional cost variable for SaaS TMS users is the increase of transactions as volume increases. Few licensed TMS vendors have annual scalable pricing based on shipment volumes.

Barriers to SaaS TMS

- Quality access to the internet

SaaS TMS Summary

In summary the market and opportunity for cloud based TMS solution will continue to grow both in North America and worldwide as solution costs continue to be reduced by the TMS vendors.

TMS is a stable and tried solution with rich functionality and should be offered as a regular solution.

SaaS Model vs. Traditional Solution

Category	SaaS Model	Traditional Solution
Software Agreement	User based typically	License or user based
Implementation Timeline	Short due to reduced hardware and infrastructure build time	Requires additional time for hardware and infrastructure
Initial Implementation Costs	Lower due to reduced infrastructure costs	Require on-site space and infrastructure
Capital Costs	Lower as service may be classified as expense	Higher as infrastructure will be require as a capital investment
On-going Maintenance / Support by Vendor	Same – Annual fee typically	Same – Annual fee typically
Return on Investment	Higher initially but can be lower in years 5-10 of using the solution as the subscription fees last into later years	Lower initially but may be better solution in longer term uses such as 5-10 year life span of solution
Feature Functionality	Lower as these are typically newer solutions to the market (WMS specifically)	Higher as these are typically more mature solutions (WMS Specifically)
Configurability / Flexibility	Typically, highly configurable for a multitenant environment	May have less configurability depending on the vendor packaged solution approach
Customization of Solution	Handled by vendor and impacted by whether this is a single client solution or multitenant solution	Extremely flexible as this is typically a single client packaged solution



Category	SaaS Model	Traditional Solution
Data Security	Full security only possible on private cloud network	Highly secure and typically behind LAN firewalls
IT Organization Requirements	Lower due to less reduced infrastructure requirements. Functional solution support is required	Higher due to infrastructure and functional solution support
Integration with other on-premise solutions	Same but depends on type of integration required	Same but depends on type of integration required
Standardization of business rules	Single source for setting up business rules	Rules may vary by facility running the on-premise solution

Warehouse Management Systems (WMS)

Warehouse Management Systems have typically not been looked at as a cloud-based solution due to issues with response time and criticality to the operations. Many WMS systems are the final point of delivering the product to the end customer and often are considered mission critical solutions that cannot be missing in action for even a single hour as this can have a major financial impact to an organization.

As networks and infrastructures are improving over time, the viability of the cloud-based WMS or SaaS model is becoming more of a reality. This is being proven out as vendors are now starting to offer cloud-based solution in the last year or two. Prior to this time, organizations have been wary of putting such mission critical systems at risk of relying completely on the internet.

Facility size and types of automation are a prime consideration for cloud-based solution. The less complex the operation and fewer people with lower response time requirements allow the cloud solution with base WMS functionality to support the overall business requirements. As facility size grows along with processing complexity and staffing requirements; the need for more sophisticated WMS functionality and typically increasing requirements for faster response times. Cloud based solutions can still meet the business requirements.

The functionality found in the cloud-based solutions currently is not as rich as functionality found in the on-premise tier 1 WMS offerings.

Vendors in the WMS SaaS market include:

JDA(RedPraire), HighJump, Manhattan Associates, Deposco, Snap Fulfillment, Amitivis and a growing number of smaller providers

WMS SaaS Characteristics:

- Hosted, off-premise application
- Single tenant, web-based architecture
- 3PL model may be best with multi-tenant operation with simple processes and low volumes





- Single code base, managed across all user organizations depending on whether shared environment or dedicated environment
- Subscription and/or transaction-based pricing model

Candidates for WMS SaaS

- Simple distribution operations such as pallet in / pallet out
- Limited number of users requiring 2-3 second response time for transactions
- Limited interaction with automate equipment
- Not for the high transaction rapid response time users at this point in time

WMS Capabilities Comparison – Generic

	Hosting Platform		On-Premise (Tier 1)
	Public Cloud	Private Cloud	Local Site
System Architecture	Multi-tenant: one instance of software in which all customers operate	Company-specific instance with IT management outsourced to the cloud provider	Company specific with IT resources from the internal organization
Upgrades and Customization	All customers are on the latest version of software and limited customization available	Customizable to the organizations needs and requirements	Customizable to the organizations needs and requirements
Process Capabilities			
Core capabilities (receiving, storage, picking, shipping)	Ideal for storerooms, satellite warehouses and simple distribution environments	Good for small to medium sized distribution environments with limited to no automation	Good for large complex facilities with light to heavy automation
Advanced Capabilities (Labor, Yard Mgmt, Task Interleaving, 3PL Billing, Automation Interface)	Little available in relation to advanced options	Most Tier 1 capabilities available but very challenged in relation to heavily automated facilities	Full solution capabilities and works well with automated facilities
Implementation	30-90 days implementation with Application/ IT infrastructure already in place for use. Focus on configuration for specific uses	90-120 days implementation with Application / IT infrastructure already in place. Focus on setting up primary instance and setting up satellite connections	120-240 days implementation with focus on setting Application / IT infrastructure followed by application set-up and configuration.
Costing Model	Subscription based acquisition model with Software / Hardware included as part of subscription. Implementation and training fees additional.	Mostly subscription based with some hybrid license / subscription agreements. Significantly lower implementation fee compared to traditional WMS approach	License based solution with options for corporate, user and site-based agreements. Most expensive and most flexible implementation model

Barriers to WMS SaaS

- Quality access to internet whether via hardware or mobile

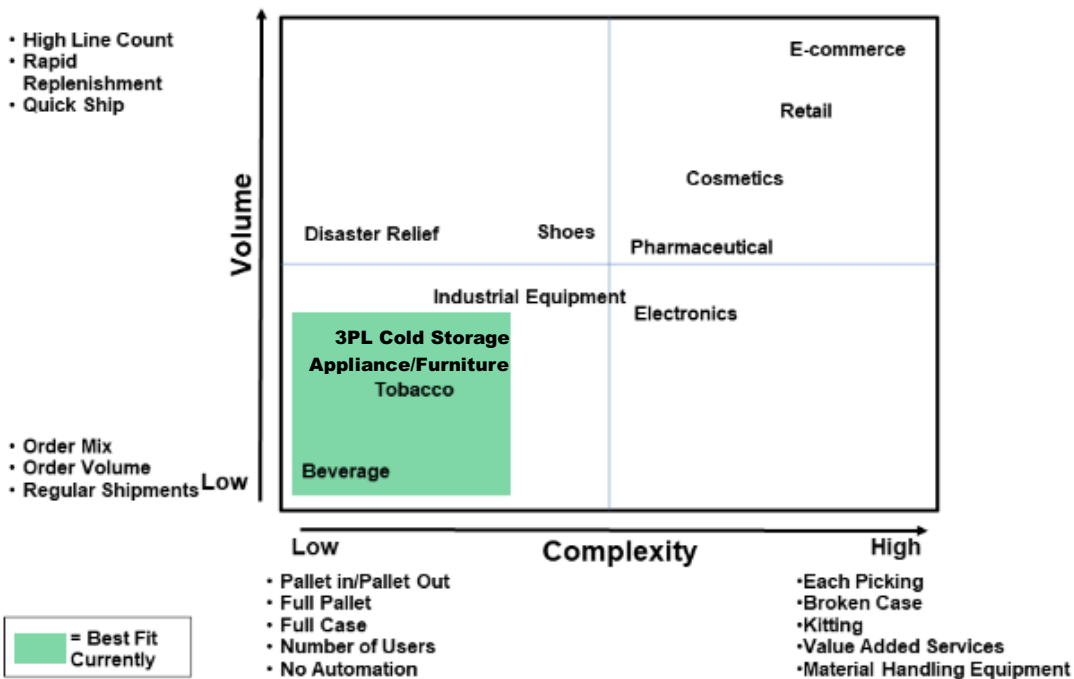


- Complexity of processing requirements
- Level of automation and response time requirements for automation

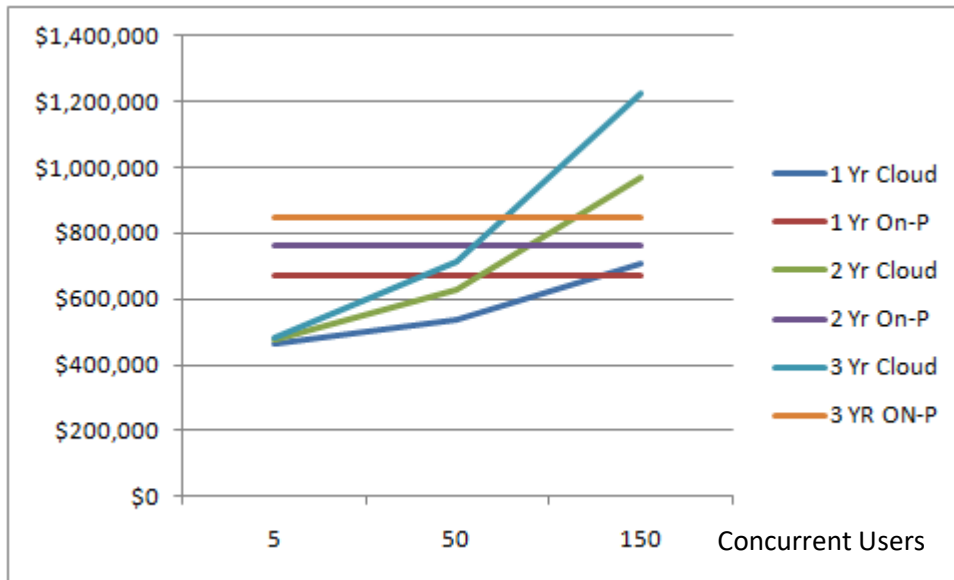
What Industries are ideal for WMS SaaS or in the Cloud?

This is based on complexity and volume of operation. The best current candidates for the WMS SaaS/Cloud model include beverage, appliance/furniture and tobacco manufacturers as well as 3PL and Cold Storage as the products generally move in pallet and full case quantities to the wholesalers. Many types of CPG products have moved out of this model, as e-Commerce and Omni-Channel have pushed order processing down to the manufacturer. As mentioned previously, the specialized requirements for speed to implementation also allow for a good fit for the initial months of disaster relief programs and pop-up warehouses.

The green shaded area below shows good potential for WMS SaaS/cloud as the levels of complexity and distribution requirements fit available capabilities for WMS software currently in the SaaS/cloud marketplace. As mentioned above the industries in this area are still moving full pallets or unit loads with a relatively low order mix.



WMS Cost Comparison of Cloud / SaaS vs. On-premise solution



The above chart is based on number of application users over time and compares the following cost impact categories:

- On-Premise
 - Initial software purchase
 - Annual software maintenance and support
 - Staffing – Operators
 - Training
 - Consulting / Implementation support
 - Off-site storage for disaster recovery
 - Server lease or depreciation
 - Server maintenance
 - Space and facilities
- Cloud / SaaS Solution
 - Training
 - Consulting / Implementation support
 - Cloud hosting fees including software, maintenance and support

Note that the number of users and timeframe for the solution has a direct impact on the ROI and breakeven point for the solution decision.

SaaS WMS Summary

The SaaS WMS model is steadily maturing at this time. The market has been starting to accept the idea of a cloud-based model as evidenced by several WMS providers starting to offer a cloud-based solution. Based on finding, the best opportunities at this time include less sophisticated, low user, acceptable response time solutions that do not require high response interaction with automated equipment.



Warehouse Control Systems (WCS)

Another key system inside the larger more complex facilities using Supply Chain Execution Systems is the Warehouse Control System (WCS) of which several components of the solution are prime candidates for cloud-based solutions. Warehouse Control Systems typically interact with the Warehouse Management Systems (WMS) and are responsible for controlling mechanical equipment and more complex order picking systems. Mechanical equipment can include conveyors, carton and unit sorters and packaging equipment. Order picking systems controlled by the WCS can include pick/put-to-light (PTL), Radio Frequency (RF) Picking and voice picking solutions.

The components of the WCS solution that can easily be handled as part of the cloud solution include dashboard, reporting and diagnostics modules based on discussions with several leading WCS providers. The physical solution components that will remain on-site include conveyors, sorter and PTL due to system response time requirements. Conveyors and sortation equipment require 2-3 millisecond response times for decision making and interaction with physical equipment.

The WCS solutions are becoming more sophisticated and adding functionality typically found in the WMS solutions including put-away, order planning (Waveless), picking, cubing, cartonization, label printing and shipping processes. This is an opportunity for smaller facilities with medium levels of automation. As more WCS providers add functionality, the need for milli-second response with the WMS solution may be phased out.

Based on discussion with leading WCS providers, the only area not typically slated for part of the expanded solution roadmap is the controlling of inventory and the system of record for inventory. Therefore, the cloud-based WMS may be more acceptable as the functionality in the warehouse is more controlled by WCS than the WMS solution.

This can allow for faster implementation times based on having only one solution inside the 4-walls and a cloud-based WMS with minimal interfaces required. The WMS may also be replaced with direct integration between the Order Management system and the WCS.

Industries where the WCS solution may be a good fit with the cloud-based WMS include companies requiring distribution operations in multiple countries with sophisticated material handling and order picking solution. For example, many cosmetics companies utilize pick-to-light solution (like Fast Fetch) for order fulfillment and have a distribution center in multiple countries on a single continent such as South America.

Richard Barnes, a principal for Ascension Logistics, is a supply chain expert and master black belt with extensive leadership experience and a strong background in applying people, process and technology to streamline supply chain operations. Richard can be contacted at rbarnes@ascensionlogistics.com or (630) 338-6005.