The Journey to Visibility

Technology Options and Benefits

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Report from ChainLink Research

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Introduction

Visibility as a characteristic or condition of the supply chain has been sought after for almost two decades. First, we just sought to gain visibility across our own operations—from plant to plant and warehouse to warehouse. Suppliers were tied to the performance of the terms and conditions in the contract, so we did not peer too closely. But outsourcing changed all that, and we now see trading partners as an extension of operations. Together, outsourcing and globalization have heightened our awareness of supply chain risks. Knowing our fragility in this new world order, we have a new sense of urgency to create visibility across multi-tiered operations and with suppliers through much finer grain information.

The Internet has provided the first real hope of achieving visibility: there has been an explosion of cloud-based visibility solutions for the supply chain. The weak link is that most of the data comes from a series of partners. This source data can be unavailable or of dubious quality to begin with and then be propagated to others in the chain.

More recently the term "control tower" has emerged as a new product offering from many supply chain providers. However, *control,* which variously may mean to have command, have power, or be in charge, would be an elusive phantom, in ChainLink's opinion, and may not even be a desired goal.[1] Visible, real-time insights and the ability to influence outcome, where appropriate, may be a more realistic and achievable goal. Supply chain networks are becoming more complex, and attaining visibility, i.e., having a current picture, is a challenging enough goal.

Debatable though these goals may be, visibility can be of huge value and does provide concrete business benefits. But need we say that manual or semi-manual approaches still are the predominant approaches to trading partner communications with spreadsheets, phone, fax, email and EDI as the rule. Surely not scalable. New technologies have emerged to significantly enhance the chance of attaining visibility.

ChainLink has been looking at this issue since our inception, exploring the trends from networks, on demand, cloud, B2B integration, and location-based technologies to social collaboration. All those architectural approaches have become important in the last few decades and play a role in our ability to achieve visibility.

This report will cover the state of the visibility solutions market. Firstly, we will define what visibility is. We will walk through the evolution of the technologies from simple messaging to the current state. Then we will discuss several solutions providers and their approaches to visibility. We will look into emerging techniques and how they fit into the visibility footprint. We will conclude with benefits.

[1] There are many reasons why control is not viable. Strong brands will chafe at the concept; even large powerful retailers or OEMs may not seek 'control' due to financial or liability reasons. For mid-market companies, the best path is influence and responsiveness.

What Is a Visibility System and What Should it Provide?

Managing any process requires information. The characteristics of information today are not only the type of business data—order, plan, status and so on—but the *time state* of the data. The database should reflect data's time attributes, *temporal data,* i.e., whether we are looking at past or current real-time data. (See Appendix for discussion about data states.)

Visibility addresses the 'now' event and analyzes it as it unfolds. That event has dimensionality: the event's other attributes—exactly where is it occurring, how fast is it occurring? Why is it occurring? Hence, multiple streams of data are required to create the true picture.

Answering 'why' often means analyzing a series of events, so the visibility system needs event processors (commonly called Complex Event Processors, CEP) to process and analyze multiple events. Complex Event Processing[2] is another 'space' in the BI and Analytics market. Complex Event Processing leverages multiple streams of data and provides the ability to determine causal and provide predictive analytics. The CEP is an important addition to supply chain systems,[3] since it enables us to understand what is happening and why. A current supply chain system may provide an expected arrival time followed by the actual time (after the fact). From that information, we can determine that the delivery was late. But we want our system to alert us ahead of time that this might happen and why. And more importantly, we want to avoid that occurrence in the future.

Another critical element is the need to reduce inaccurate data due to dependence on manual data input. Of course for planning, humans are still best. But for visibility we now have the potential to rely on more automated sources—scanning, sensing, and location-based data—that can provide accurate item-level or global location information.

[2] http://en.wikipedia.org/wiki/Complex_event_processing

[3] Weather systems are examples where complex event processing is used. Risk Management systems are other examples.

The above is not just an academic discussion about data. Supply chain organizations are anxious about multi-tiered and far-flung activities that they can't see or control. Customer safety, supply chain performance, brand, and reputation are all at stake.

Visibility systems are based on the concept of current data. Often we use the term real-time, but in actuality, real-time data is hard to come by.[4] So we need a better definition of what a visibility system is and what it should provide.

A Visibility System definition: A system that provides a current picture of events as they occur. The data is continuously refreshed so the user gets the most current multi-dimensional picture of what is occurring. Further, the system should have methods with which to understand the cause of events and provide the ability to impact future outcomes.

Visibility Systems Provide:

- *Immediate data* with the appropriate richness required to create a complete picture of the current state.
- Complex Event Processing—rules and analytics to understand trends and patterns so upside potential can be captured or risk mitigated. CEP may be a rules and analytic engine that sits on top of the visibility data and/or done through integration with planning or execution systems.
- Alerting and other methods to take action based on user-defined rules and filters.

This is a generic definition of visibility systems. Supply chain systems have multiple streams of information that have evolved over decades, as well as emerging sources of high-value data with which to address the visibility problem. In the next section we will discuss these approaches, their benefits, and limitations.

[4] A discussion of systems and their information states is discussed in *Transportation Systems Redefined*.

The Journey to Visibility

Our view is that the technology and markets have evolved in four spheres which are converging to provide the best dimensionality opportunity for visibility today—1) Messaging-EDI, AS2 and other B2B methods of transmission; 2) mobile, cellular, RFID and sensors; 3) Geospatial Information Systems,[5] satellite, geological mapping, and other temporal data; and 4) P2P (person-to-person) such as texting and social.

At each state of the technological evolution, supply chain management systems have exploited these improvements to improve visibility. Let's walk through these dimensions.

Dimension 1—Messaging

The foundation of most of the visibility systems on the market is messaging—that is EDI or AS2 messages from system to system. EDI is inherently latent, due to passage between firewalls and the need for translation—often multiple times—to harmonize proprietary data formats from a variety of constituents who are communicating with one another. Some of the sources of these messages are 'store and forward' EDI hubs that batch messages before they pass them to the recipients.[6] More responsive systems respond as feeds arrive, and translate and transfer the data to recipients as required, which reduces latency.

From a supply chain visibility perspective, notifications and status messages are sent from multiple sources either as transactions (purchase orders and acknowledgements) or status-like messages—ASNs, Receiving, even POS (point of sales data). This is much more reflective of an 'event.' These events reflect a move or change in some way. They are derived at a hand-off/choke point, which is usually a *scan* as assets move from location to location. Then these scans are batched, translated, and sent.

Visibility Dimension—Messaging
Messaging technology is system-to-system data. Though useful in transaction management, it has a low relationship to the physical item and its condition.

Solutions That Sit on top of Messaging

Descartes GLN[7] and GT Nexus[8] are message-based solutions. GLN is a multi-party hub, processing millions of transactions, EDI, ASD, documents, etc. GT Nexus's Control Tower, on the other hand, is designed and sold to support an anchor enterprise (large OEM or retailer). This centralizes data monitoring of inbound processes.

[5] Geospatial technology is visualization based on data received from multiple sources such as satellite, maps of geological data such as terrain and weather, sensors, municipalities, traffic/transportation systems. See references at the end of this report.
[6] As well, small companies log into portals at the end of the day and manually enter their transactions or upload spreadsheets.
[7] https://www.descartes.com/solutions/global-logistics-network-services

[8] TradeCard recently bought GT Nexus, allowing the extension of the transportation visibility into the source plant when that data is accessible. http://www.gtnexus.com/products-solutions/supply-chain-visibility/

A hub and spoke solution is the general approach that most big logistics cloud providers offer. Compliance and timing are huge challenges with these types of systems. Smaller organizations usually have no tools, not even EDI, and use spreadsheets or log on and manually enter their data to comply with a large customer's systems. This method increases latency. And that becomes a vicious cycle of delayed requests/responses. Descartes addresses this issue by providing some freeware to their partners to participate in transaction activities and community dialogue.[9]

ONE Network[10] provides a variant of this approach. They propose to solve the hub and spoke problem by providing usability and value to the spokes (suppliers). However, the solution is purchased and catalyzed by the big anchor (hub) firm who makes it a compliance 'duty' to provide data into the system. ONE's Control Tower attempts more distributed 'grid-like' value across the network.

Collaborative Supply Chain Applications

Another variant of solution is more of a supply chain application for planning and execution with a collaborative architectural approach that provides integration and sharing between the parties. Here we specifically refer to systems that, rather than being a multi-party network, focus on supply chain process data such as collaborative forecasts and orders. Examples are e2open,[11] Vecco, and Logility.[12] How they contribute to solving the visibility program is two-fold. Firstly, many end-users turn to them as their system provider to provide more real-time data. Secondly, their collaborative forecasting and procurement workflow aims to provide common data such as forecast data across multiple tiers. These are not open networks like a GLN. These are limited party interactions.

Integration Suites

Another approach, sought in the past, is the on premise integration approach such as that provided by Webmethods/SoftwareAG, Informatica, TIBCO, etc. Larger enterprises tend to work with these companies since they provide a flexible integration bus between systems. The challenge though is that the enterprises are on their own to acquire all the data needed. And there is very little value for the supplier with this approach. The work done is not leveraged to broaden the supply chain network. And latency is still an issue here with many layers of firewalls to traverse.

For visibility, collaborative or large networks really are the recommended approach. The enterprise can tap into a working set of trading connections, there is mutual value in the network, and the *network provider is responsible for ensuring transaction performance.*

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[9] Read more about the Descartes Community

[10] http://www.onenetwork.com/supply-chain-management-solutions/real-time-value-network-rtvn/

[11] e2open and Vecco's Allegro look at collaborative forecasting and procurement http://www.e2open.com/, http://www.veccointl.com/solutions/allegro_inbound.htm

[12] http://www.logility.com/solutions/value-chain-collaboration/voyager-collaborate

Advantages and Disadvantages of EDI and Messaging

The above systems are based on decades of industry agreements pertaining to systems and data and standards. Buyers can rely on the foundational data to be integratable into a variety of systems and hardware in a fairly standard way.[13] There is also a system of records that gets created from this data, when intelligently used to feed transaction and reporting systems.

Networks or collaboration solutions with large subscriber bases[14] are at an advantage since they can sift through the data and gather insights for their customers. New customers can tap into these existing networks and begin gaining value with less start-up effort than if developing their own solutions by building unique integration to the many data sources. Processes that benefit most are demand-sensing solutions that tap into the distribution data—warehouse safety stock, on-shelf inventory, and recent sales—to provide a more accurate picture of demand.

Transportation tracking is another area of value since the multi-leg aspects of the delivery process need to inform multiple parties in a uniform way. Users can get a single version of the truth and can show the various subscribers—suppliers, logistics, customers—the transformation of the data through the supply chain. This can be very useful to the multi-constituent networks.

For many business applications, EDI may be sufficient. But messaging has large blind sides—there is no input *between* the choke points. These choke point delays can be days or weeks in duration; hence, the need for continuous visibility won't be met. So the ability to make decisions for a process in motion is limited. Another issue is the lack of precision in the data. Often the receiving data is not rapidly shared and the condition under which the scans took place and the condition of the goods is not known. Those who need condition data won't have that need met. Visibility is still limited, since these are all digital transmissions based on past events. And considering the number of disputes about product damage, lateness, etc., there is surely financial value in understanding these conditions.

Other Supply Chain Systems and Their Role in Visibility

CIM—*Carrier Information Systems*
SIM—*Supplier Information Systems*
These are discovery systems that can provide reliable data about entities and their business services and credentials.
Supplier Networks—*Although these don't provide visibility as we normally think about it, they should provide data about the current status of proposals, bids, ASNs.*

Dimension 1 data systems have limitations as far as visibility is concerned. In applications that require exactitude, this is truly problematic. For example, what is the actual vs. estimated time of arrival (ETA)? The exact arrival time is needed to coordinate all the other processes. Examples include inbound transportation management and scheduling of dock reservations, and consolidation or pooling of transit

[13] In the last decade much as been done to 'speed up' the transaction process with memory resident 'fast servers,' using MFT for EDI and AS2 transmissions, bypassing the multiple VANs so that senders and receivers can receive status updates in a more timely way.

[14] Such as the GLN from Descartes—with ~170,000 connections managing billions of transactions per year, or GT Nexus or ONE with about 30,000 each.

merges. In intermodal coordination, when will the ocean vessel actually arrive in port? And then, when will the cargo actually be available to load on the truck? Lack of coordination means demurrage, lateness, etc. One can often drive by rail stations, ports, or warehouses and see long lines of vehicles waiting to pick up or drop off shipments, an indication of the many companies that have extremely poor coordination due lack of visibility across the process from source through destination.

Messaging systems provide an ETA as the vessel gets close to port. ETA is useful for planning, but as the actual time of arrival nears, it falls short. Transportation carriers provide departure and arrival times, but no data about the conditions under which the freight moved through the chain. The data arrives far too late to address '*problems-in-motion.'* The time sensitivity of narrow appointment windows is another issue. Short-haul or outbound transportation such as direct store delivery, home delivery applications, and service response need situational information to manage routes in real time.

Another example is track and trace. Diversion, theft, and loss occur too frequently due to the lack of actual data about asset location. Post-delivery data feeds may help with government compliance or retrospective analysis, but they do nothing to help address and mitigate issues *as they are occurring*.

Another area in supply chain in which this single dimension is weak is in demand sensing. Demand planning systems are great for planning, but probably don't capture the continuous view required at the point of interest. Today, we want the opportunity to respond to upside demand opportunities.

In general, *the ability to do something about what you see is lacking in Dimension 1 solutions* (Figure 1).

Figure 1: Contrasting Visibility Methods

Dimension 2—Wireless: Mobile, RFID, and Sensors

Visibility Dimension—Messaging
Messaging technology is system-to-system data. Though useful in transaction management, it has a low relationship to the physical item and its condition.

The world is becoming sensor-rich. Estimates of the number of connected and unconnected devices vary, from sensors in your car or your toaster to equipment monitoring devices in warehouses and factories, to wireless,[15] but they number in the trillions at this point. RFID and sensors provide data about the condition of an asset by transmitting information to readers and to WiFi/internet, cellular, or satellite networks. GPS-based devices provide data about locations. If used concurrently, for example RFID and GPS, or RFID in sensor grids, they can provide dimensional information such as proximity, location, and speed of movement.

From a visibility perspective, this is a great stride forward. Sensor information has been leveraged for decades in control systems *within* facilities. Now we have solutions that leverage these wireless devices to keep track of assets in motion. The attempt here is to obtain the actual situational data and feed that data into monitoring systems in the cloud.

When used in combination with other data—historical analytics that can derive important ranges and tolerances—they can provide alerts when an item is out of tolerance. Solutions like Intelleflex in the food industry, Savi Technologies in industrial/defense, or TAKE Supply Chain (TSC) for industrial and pharma companies can provide this type of tracking visibility. The use of these devices helps address some of the issues we mentioned earlier, especially in perishable product supply chains, or with products requiring more security. Also, unlike transportation systems that still tend to track just at the shipment/container level, these systems are oriented to item-level intelligence.

For applications that require location, GPS from the truck, vessel, or person gives us the actual location. Firms like INTTRA provide ocean container tracking data. The ocean carrier has GPS and will send these signals to INTTRA, who, in turn creates an EDI message and sends it to the subscribing system. Many of the TMS systems acquire their ocean data from INTTRA. Several of the ocean carriers will provide that data directly using end-user mobile access applications such as Maersk Line, Evergreen Shipping Agency, or APL. Users can get booking level, container level or vessel location data by subscribing directly to these systems.

[15] Here we are discussing mobile as a data source. Later we will discuss desktop and mobile as user platforms.

Advantages and Disadvantages

Sensor data is a step up from messaging systems. It provides the *potential* to capture data about the asset or item. But sensor systems are still limited because they still rely on a chokepoint (a scan location) as the integration point. When combined with active devices or with GPS to provide asset condition and location, they add an important dimension in our quest to ascertain real-time item and asset condition. Fortunately, GPS is quite prevalently used in the transportation industry.

Active RFID and GPS have become the technologies of choice for rail and ocean carriers for this reason. And many of the ocean carriers are now providing mobile apps for consignees, shippers, and freight forwarders to tap into the vessel location very close to real time.

When combined with messaging systems (ASNs), users can obtain shipper and carrier data and get a much richer picture of goods in motion. Frustratingly, most of the visibility hubs have eschewed tapping into these data sources, preferring to receive messaging from carriers. However, some power shippers are pushing back on that methodology to require better data. Track and trace is now on the top of the list of what companies want for visibility.

Logistics Service Providers are being pressured by their customers to provide more timely data to each other and to their customers. In fact, the transportation service market is so competitive that freight forwarders and 3PLs consider visibility a critical element in gaining and keeping customers. They have to stay ahead of the shipper/consignee when it comes to visibility in order to spot problems and attempt to solve them before their customers do.

The above techniques and technologies have taken us a long way, but we still don't understand the causal. They provide a limited vision of the environment that impacts the asset or process; whereas causal data is critical to preventing future problems.

Dimension 3—Geospatial

Visibility Dimension—Spatial
Geospatial temporal data provide environmental situational data, place people and assets 'at the scene' to understand the actual conditions in which they operate.

Geospatial Information Systems (GIS) are more than maps. Location-based technologies are becoming the must-have capability for a range of solutions from supply chain and healthcare to consumer apps.

GIS systems have been used in logistics for decades to design routes; in weather systems to inform a variety of applications such as road repairs, farm/agriculture, and logistics and transportation applications; recently, in demand planning to reformulate plans based on current weather conditions; and to manage all sorts of remote operations from defense logistics to construction and mining operations in remote locations.

Maps?

Base maps are available from many sources (some of which are proprietary) to form a visual and informational foundation for visibility solutions. But GIS is more than maps. GIS systems should go beyond mapping, using GPS to provide location data. But even here, GPS data is foundational. Location-rich, multi-dimensional data should provide a deeper context beyond "the truck is on the corner of 1st and Madison Avenue." Certainly that is a huge step forward. But we need to combine that with environmental data streams such as real-time weather, traffic, etc., so that a user can get a 3D and *continuous picture* of unfolding events.

State-of-the-art GIS does go beyond base mapping, using real-time data from other streams to provide content-specific applications. Google users are used to static older generational maps. Using the paradigm of a book, Generation 1 maps are merely digital renditions of static maps. Generation 2 maps allow for drill down and fine tuning of maps, but they are not dynamic, either. They still cannot display the many activities occurring in any given geographic location *at the current time*. An example of a Gen 1 map is Rand McNally and Gen 2 maps are Esri's ArcGIS. They provide a good foundation upon which the end-user's (an Esri customer or partner) application overlays more dynamic data to plot current conditions. SAP, for example, will use ArcGIS base maps and overlay specific location data of equipment, or manufacturers' or retailers' sites and provide performance data about assets.[16] A firm like PC*MILER will combine base maps with specific route optimizing requirements to create/design routes. Most TMSs today from Descartes, MercuryGate, Cheetah Software and others have these types of route optimization as well as last mile solutions. A Descartes solution has telematics that will leverage all these components to create a turn-by-turn solution based on current routes.[17]

These systems have very specific execution capabilities. But if we are trying to look at broader issues, that is, understand multiple moving parts, we need to be able to analyze multiple data streams to view events and determine their context and causes, not just to provide transportation use cases. Weather, people, geopolitical activities, labor strikes and slow-downs, local news such as holidays, fires and more all impact supply chain performance.

The user-specific data streams and rules provide the real value—the geospatial complex event processing. Over time, by collecting and analyzing data we can get a clearer picture of what and why things are happening. We can then build rules—if this happens, then we may need to take a specific action. These advanced analytics help us make better decisions, avoid unpleasant results, and embrace the upside.

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[16] See some interesting YouTube videos here from SAP that show advanced visualization: http://www.youtube.com/watch?v=tWGwJzaDNY0&feature=youtu.be

[17] This is not a report about telematics solutions. These are just mentioned to provide positioning. If users have these systems, they may make good inputs to the CEP.

Additive Technology Enhancing Visibility	Dimension 1 Messaging	Dimension 2 Wireless/ Sensors	Dimension 3 Spatial	Dimension 4 P2P/ Social
Data Collection	Barcode System-to-system	RFID, sensors, mobile	Data streams from a variety of services (weather, traffic, geological, etc.)	Mobile Web Social networks
B2B	EDI APIs Fax	Connected to cloud solutions GPS Cellular networks	File transfers Media XML/HTTPs	Search, sentiment, and statistics
P2P	Phone Email	Phone Email	Phone Email File Transfer	Social Networks Chat Texting
Benefits	Standards-based communications	Anywhere-to-anywhere Location-based Remote locations	Visualization of location Environmental and geographical context	Move beyond business systems to direct engagement with consumers, populations
Limitations	Lack of location, conditions monitoring, and lack of causal data	May lack business context Reader/sensor network unavailable Lack of causal data	Flat mapping is limited. Needs real-time events to create relevance.	Lack of opt in Lack of relevance
Analytics	Post-transaction assessment of data and order compliance	Real-time condition monitoring of items and assets Discover out-of-tolerances	CEP analytics can assess multiple streams of context /environmentally aware data	Impact of people and their tendencies as individuals or groups. Provide personalized 'judgments' and recommendations to individuals

Note: These technologies are often used for visibility, but on their own they have limitations. In combination with an advanced rules engine and CEP, users can obtain a relevant current picture and actionable intelligence.

Figure 2: Technology Dimensions to Visibility

Dimension 4—People-to-People: Social, Mobile/LBS, MMS/SMS, etc.

Another set of important data streams that may be used in certain applications is people data. In transportation systems, understanding density can help city planners, for example, respond with more trains and busses when the 'big game' gets out. Traffic flow can help retailers determine where to locate a store—and on which side the entrance should be.

Here is where the upside opportunity can really kick in on the demand-side. Already, realtors are working with retailers and using aggregate social data to plan shopping malls, store size, and design. ROI data already exist to support the claim that traffic and sales improve due to improved facility planning and location of new facilities.

Telematics systems can help drivers avoid traffic density. Roadside repair services can locate a specific customer. Work crews and drivers can alert one another to issues in weather, impassable roads and delays, or recommend better routes. Weather alerting has been used in retail, road repair and maintenance for a decade. Now crowd-sourcing data can be used to enhance expertise and communications. Social data can also be used by municipalities to pinpoint crime scenes and requests for emergency response, repairs, etc.

In retail, having customer visibility allows retailers to inform customers about promotions, available products, and the closest place to find them. Community activities such as fairs, road races, concerts, etc. can be promoted to bring people together, enhancing the community experience, and perhaps creating retail opportunities.

Visibility Dimension—Social
Social interactions and sentiment provide information about the impact of people on environments and processes, as well as the impact the environment may have on them.

From an individual/consumer perspective, mobile users want environmental data so that they can better plan their day, from bringing an umbrella to more critical data such as using an inhaler due to high pollen counts.

Home healthcare is another area in which P2P combined with location data can help the homecare provider deliver services, as well as helping patients better manage their own care.

This is not a treatise on the benefits of social communications, but rather a perspective on how social can enrich our understanding of the picture and thus, visibility, as well as provide feedback to the social network about the benefits of sharing information.

Data Data Everywhere—How to make it Relevant

Acquiring all the data you may need in a timely way is just the foundation. The challenge is to refine and make the data relevant, presenting you with exactly what you need. Thus the need for the CEP. How can this continuous information be used for decision-making? In order to accomplish that goal, analytics must sit on top of these data streams. For example, a firm like TransVoyant, a supplier of a geospatial complex event processor, gathers streams of data about supply chains plus geospatial data and processes them according to user-driven rules to support decision making on one platform. There are CEP and analytics providers who offer various features discussed in this report as tool kits.[18]

[18] SAP, TIBCO specifically come to mind here.

Rules, Alerts, and Analytics

Much attention has been paid to the alerting capability of many supply chain systems in the last decade. Most of these have been governed by simple rules such as: alert me when a certain customer's order has been shipped, or when a certain threshold has been reached. Pretty basic stuff. These systems rely on a human to acknowledge and then, if they choose, to manually respond.

Why is the rules engine important in the visibility solution? *The rules engine allows for a real-time output that initiates or provides a course of action for an end-user or application.* The problem with a manual response to alerts is that not much cultural or system knowledge is built up about these events and their meaning, nor is there an automated system for response.

Developing more advanced rules does take deeper expertise and a system that allows for it. This is why we include in our definition of a Visibility Systems discussed on page 3, "*the system should have methods to understand the cause of events and the ability to impact future outcomes."*

A word about Information-as-a-Service

Various services from weather, social, POS data from retailers; demographics, consumer trends, crowd and traffic data and more have become part of the information necessary to visibility systems. Temporal in nature, these data are ever changing, so today's information systems need the capability to absorb and analyze streams of structured and unstructured data.

Most of the visibility systems do a decent job of collecting basic business data, as we discussed earlier, but a poor to no job of rule creation. Firstly they do need the capability of CEP to understand the casuals. Once users understand various events and why they happen, they can begin to build their own rules. We don't intend to do a dissertation on rules engines and the methods for building. But we are advocating that a rules engine be included in the visibility system. A rules engine allows for highly relevant communications rather than the nuisance or 'so what' alerts most of us are used to.

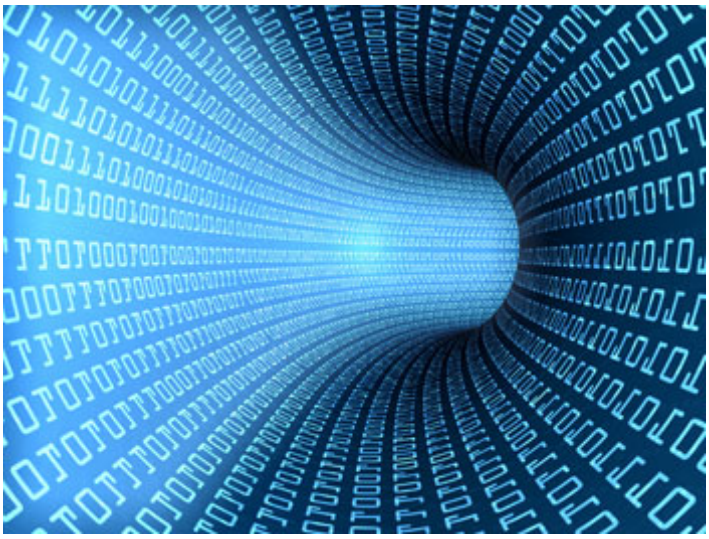
Advanced rules engines can be integrated to allow the visibility system's conclusions to become data sources for other systems, enhancing the value of the visibility system. This is something they are not called upon to do today.

Solutions and How They Compare

Our initial recommendation for companies is to just get started. Spreadsheets will not provide inter-enterprise visibility. Blind sides will not be reduced without methods for trading partner integration—giving and receiving important visibility information.

For small companies some level of automation, such as EDI, is important since you get leverage from your investment. Rather than just logging into your customer's system and manually inputting data (for which you then have no further use), use a cloud EDI system. You can use this information for your own reporting and have a 'system or record' of your transactions and customers' responses.

Of course, for larger firms with many trading partners and many process touch points between them, the sheer amount of data and potentially unplanned events from change orders, lateness, etc. can all be managed with automation.



There are a variety of solution options with both data and industry focus (food markets, auto networks, retail supply chains, and so on) from which companies can gain value. In addition, more advanced solutions provide the richer context we discussed earlier. Rather than just providing the *"current picture,"* they add the "*ability to impact future outcomes."* Figure 3 shows classes of solutions options.

Visibility Solutions	Descartes	e2open	GT Nexus	Logility	ONE Network	SAP	TAKE Supply Chain	TransVoyant	Vecco
Business Data/Applications	Transportation	Demand Procurement Materials	Global Trade Transportation	Demand Materials Transportation	Demand Materials	Demand Procurement Transportation	Procurement Materials	Transportation Service Mgmt Government	Demand Materials
EDI, AS2/HTTPS	Y	Y	Y	Y	Y	Y	Y	N	N
Streaming/ Unstructured data	P	N	N	N	N	Y	N	Y	N
Item-level RFID	Y	N	P	N	N	Y	Y	P	N
Instrumentation and sensor data	P	N	N	N	N	Y	N	Y	N
GPS/Location data batch or real-time	B	N	B	N	N	Y	N	B,R	N
Spatiotemporal	P	N	P	N	N	Y	N	Y	N
CEP/ Predictive analytics	N	N	N	N	N	Y	N	Y	N
Rules engine	Y	N	N	P	N	Y	N	Y	N
Social supply chain	Y	N	P	N	N	Y	Q1	N	N
Social media monitoring	N	N	N	N	N	Y	N	Y	N
Delivery architecture	Multi-tenant	Multi-tenant Private cloud/ Single instance	Multi-tenant Networked cloud/ Single instance	On Premise or Hosted cloud deployment	Multi-tenant	On premise or Cloud	On premise or Cloud	On premise or Cloud	Multi-tenant
Multi-party network or trading partners (TP) only	170,000	30,000	25,000	TP	30,000	TP	TP	Hybrid: TP + Multiple Multi-party Networks	TP
Notes	Native collaborative community		Social through partnership with Chatter			Tool kit; Some visual features in TMS v9.1		All features in one decision platform	

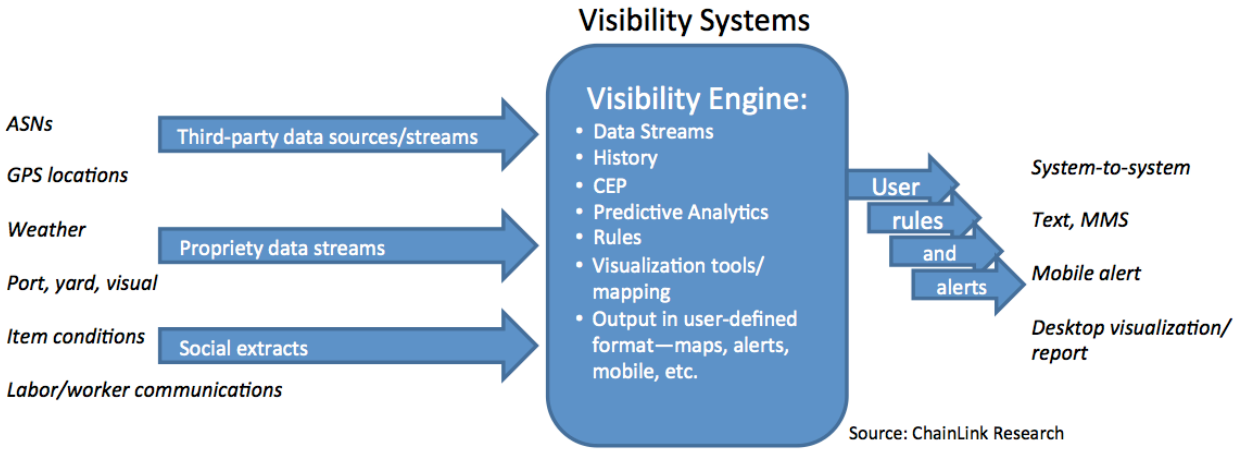
Key
Y- has functions
N- no capability
P- through partner

Source: ChainLink Research

Figure 3: Supply Chain Visibility Solutions

The Power of Now! State of the Art in Visibility

Our new opportunity in multi-dimensional visibility combines multiple, real-time streams of spatial, business, social, sensor and other data to form a real-time multi-dimensional picture of events as they unfold. *It's the power of Now!* Visibility is not a latent system. It builds on the multiple data streams (some or all of the other streams we mentioned above) from your customer and when they expect the shipment, your truck, your driver, and the melting ice-cream shipment in the truck, for example (all visually represented) and tells *why those conditions exist.*



These systems go further to provide predictive analytics for embracing opportunity or avoiding risk. For instance, the system can determine that damage in transit often occurs when a certain route is taken; ice cream is more readily consumed in this location at 3 p.m., and so on.

Conclusions:
Increasing Sales, Reducing Risk, and the Cost Benefits of Visibility

Reduction in supply chain costs, but, more importantly, improvements in logistics such as more leverage of resources (consolidation of truck loads) and better customer service (such as on time) were most often cited as the quantifiable returns on visibility systems.

More advanced users of technology, though, are gearing up for more profound benefits. From discussions with end-users in the evaluation phase of these projects, here are some key goals:

- Demand Management in consumer markets—understanding consumer markets better and being able to precisely respond to local conditions
- Increasing demand for products in industrial markets—embedding visibility in services and products to enhance the functionality
- Service Management—supporting road crews and service of remote operations

- Supply Chain Risk—In A Parallax View—Supply Chain Risk, we feature several articles and case studies about Supply Chain Risk Management. In the last few years, managing risk has moved from being talked about to actively being embraced due to the high number of incidents, their costs, and the losses due to these unfortunate events.
- Logistics—probably the most compelling and direct use cases such as:
    - Actual location of equipment. Rather than latent messaging, get live streaming location data about your vessel, truck, employee, or asset in a spatial context. This provides a picture that is very close to what is actually occurring.
    - Reduce incidents of traffic accidents and increase driver safety
    - Reduce diversion—lack of adherence to routes may be simply driver inattentiveness, but may also be an indication of bigger problems such as theft, personal use of company equipment, etc.
    - Weather and other event alerting to improve safety and time to market
    - Intermodal/in-transit coordination—precise, dependable times of arrival to manage handouts, saving resources and time and reducing errors
- Precision Logistics—worthy of its own category, there are applications that require exquisite precision such as transport of perishables, donor organs, or other lifesaving processes.
- Inbound Manufacturing—multi-stage and lean manufacturing, especially when components are arriving from distances. Many manufacturers have poor visibly to inbound status in the short term and a poor handle on actual cycle times, leading to excess inventory or shortages.

And investments are not just being done by the 'richer' sectors such as automotive, high tech, and luxury brands. The Food and Beverage sector, that does use web-based trading and transportation systems, is turning to these solutions providers to provide more visibility from farm to fork.[19]

Managing a supply chain today requires responsiveness not expected in the last century. We are global and we have to confront those challenges that globalization has brought us. Just as your sensors provide a continuous refresh of everything you see around you in multiple dimensions, so should your visibility solution. Possessing this multi-dimensional dynamic visibility can enable the responsiveness required to operate successfully, empowering users with early warning information, enhancing our perceptions, and guiding the way forward to achieve much better outcomes.

[19] Read research on the Food sector in Supply Chain Brain and Freshness Wars at ChainLink's site.

Appendix

System Processing

This discussion is an excerpt from *Transportation Systems Redefined*.

The following characteristics are crucial to understand as you look at software companies and the buzzwords they often toss out:

Batch—much maligned these days is the term batch processing. Batch processing is an efficient method for storing and then forwarding messages or transactions to support a business schedule, such as monthly bill payment or daily proceeds. Examples here may be messaging systems. When shipping many orders from the warehouse, all the ASNs can be batched and launched at once. Or the export and compliance documents can all be batched and sent at once. Payment systems, as well, can be batched and sent. Why does batch still have relevancy? First, it supports people's work activities and schedules. People want to 'settle-up' and close out a grouping of work. It also is a handy method of segmenting processing so the activities that need to fast track through the systems are not slowed down. The less time-sensitive transactions, then, can be batched.

Continuous—we use this term instead of real-time or in conjunction with real-time, since *real-time is too often and inaccurately used*. Today, when people say real-time they often mean 'really fast,' but their systems may still be in batch paradigm. An example of this is analytics or optimization on a separate server. Batch data is fed to the processor, which then feeds the emerging data to support other systems. A continuous system, however, is one that is sensing and monitoring at all times—think air traffic control, heart monitors, track and trace, and real-time or continuous geospatial CEPs.

In this environment, we are looking at time-critical activities that have a need for high throughput, as well as unexpected patterns that need to be evaluated. Contrast ocean container tracking where daily or hourly updates are sufficient with air traffic control, where every second might count. In track and trace applications, we also want to understand sudden changes in factors such as temperature, diversion, etc.

Vehicle telematics *turn-by-turn* is another example of a continuous system. We want the systems to 'know' at all times where we are, the conditions under which we are operating, and tell us the next correct/optimal move we should make.

Responsive Systems—you don't often see this term, but it is important in the transportation industry. These systems 'wake up' when a change of state occurs. An ordering system is an example. It can be almost dormant (of course we hope it is not), until an activity is requested of it. Then we want responsiveness, i.e., immediacy while we are transacting, say, in scheduling/confirming/agreeing to a shipment pick-up, but we don't need the system flashing at us every three seconds thereafter.

Information services such as load boards are another such example. We want them to be *current and always accurate*, of course, but they don't have to be continuously flashing.

Driver or delivery mobile is another example of a responsive system: specific communication actions such as scanning a proof-of-delivery or referencing instructions from the scheduling and routing systems are examples. Now why is all this important? Because it helps you to understand the variety of systems, what you can expect from them and the impact they have on your business activities and decision-making.

References

Geospatial Revolution—Penn State http://geospatialrevolution.psu.edu/episode1

Transportation Systems and Their Meaning

Supply Chain Platforms

Cloud

Social Networking in Supply Chain

Supply Chain Risk Management

Supplier Risk Solutions Market Overview

RFID, Mobile and Location-based Services

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