Evolving toward Supply Chain Excellence

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Evolving toward Supply Chain Excellence

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Abstract

This white paper outlines a five-stage process for using data warehouse and analytic application technology to create a high performance supply chain. Significant value and return on investment can be realized from good execution during the early stages, particularly in the areas of technology and process development, making success possible later in the process. Organizational, operational and system readiness must be assessed at each stage in preparation for advancing to the next.

Introduction

Supply chain management is critical to providing customers with the right products at the right time. Most approaches to supply chain management involve local efforts such as inventory and transportation management, or narrow cycle-time analysis. Unfortunately, these isolated approaches tend to increase inventory levels throughout the supply chain without significantly improving customer service.

Advances in data warehousing technology provide the ability to store detailed goods and event information across the entire supply chain. Properly correlating and analyzing this data can result in improved customer service without increased costs and inventory – effectively trading information for inventory.

By pulling all the transactional data across a supply chain into a single view allows managers to improve processes and make informed decisions. As with many other endeavors, an organization must walk before it can run when putting in place a highly efficient supply chain. In the following pages, we describe the steps to implementing a best-in-class solution.

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Five Stages for Supply Chain Excellence

Five important stages are required to develop the infrastructure to support a best-in-class supply chain. Together, these stages represent a roadmap for realizing first where an organization lies in terms of current capabilities and then determining next steps toward optimum supply chain performance.

The five stages are:

> **Stage 1** – Supply Chain Reporting: "What happened?"

> **Stage 2** – Event Monitoring, Analyzing, Alerting: "What is happening?"

> **Stage 3** – Predicting Event/Issue Impact: "What will happen?"

> **Stage 4** – Identifying the Point of Cause and How to Address it: "What could happen?"

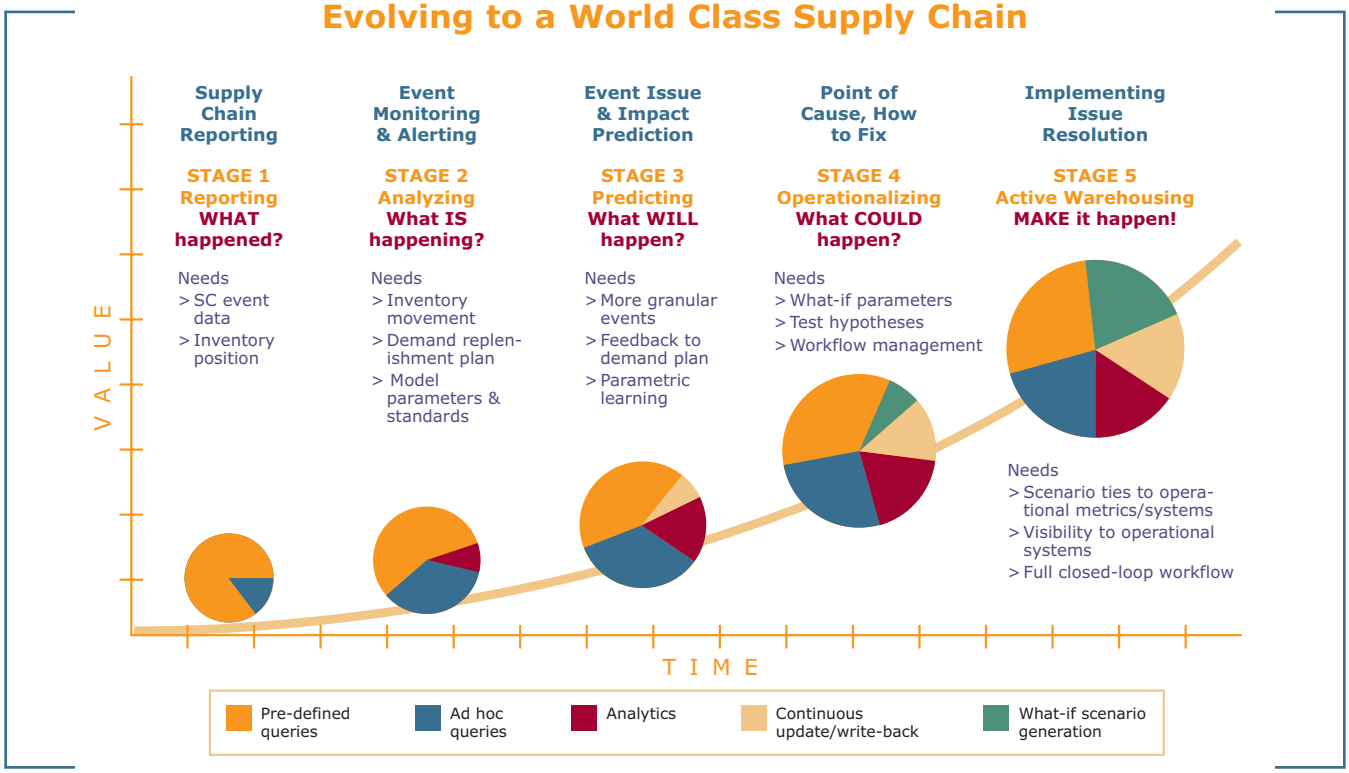
> **Stage 5** – Implementing the Issue Resolution: "Make it happen!"

Through the careful, measured application of business process change and technology your supply chain can be improved to the point where it becomes a competitive weapon. These stages are incremental building blocks. You cannot skip stages, but you can move through them quickly by focusing on the key elements as you go.

The diagram below shows the different stages, the type of analytics available at each stage, the relative value garnered by that stage and the needs satisfied.

Stage 1: Supply Chain Visibility

This stage represents a starting point for characterizing historical network-wide performance. It is largely metrics-based and is the time when basic structures, data models and data integration work is established. At this stage, an enterprise identifies a solid foundation for data collection, while improvements made are of a CPI, project-based, one-time process change nature. Implementing process



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changes can require significant organizational change management, and sensitivity to culture and policy. Before engaging in this effort, it is important to have basic capabilities to understand the historical impacts of current processes.

Stage 1 organizations

> Find out about events first from customer phone calls
> Experiencing both stock-outs and overstock situations simultaneously
> Spend over 50% of their time collecting and collating data to make decisions
> Base most analysis on hard copy or excel reports
> Must piece together data from multiple locations
> Receive only weekly or monthly updates
> Understands supply chain performance
> Get reports in un-integrated pieces, on the basis of monthly averages
> Get reports as much as 1-3 weeks after events occur
> Do not have one, global view of the supply chain

Stage 2: Supply Chain Event Monitoring and Alerting

At this stage companies begin to require additional data freshness and reduced latency. An increasing amount of breadth is built into the repository of event and transaction data. It is essential now to have the capability to look at supply chain segmentation, and a data model that allows all events and movements to be cast on the same level. Segmentation modeling techniques are key to ensuring the organization's ability to grow its supply chain in size and complexity, while maintaining the ability to view and analyze it. Breaking the supply chain into segments allows for a highly focused method of analyzing a product from raw materials to the end customer.

Segmentation of the supply chain not only provides flexibility in modeling and analysis, but also is a key factor in reducing uncertainty. Standard inventory projection techniques (such as the economic order quantity) set safety stock levels based on variability, typically measured and averaged at local points in the supply chain. These techniques result in relatively large uncertainties when projected to account for possible worst-case/best-case performance. Segmentation of the supply chain also provides focused analysis, using incremental measurements within a segment. Collecting detailed history of supply chain events in Stage 2 allows for the organization to move to Stage 3, in which identified history will be used for prediction.

Early Stage 2 supply chains have simple event-level monitoring and alerting (e.g., the truck is late). Later Stage 2 supply chains allow for intelligent alerting (e.g., material that is critical won't get there on time). Standards and model parameter historical data begin to be established and tracked as a part of performance monitoring. At this stage, process improvement methodologies begin to take on a process control flavor.

Stage 2 organizations

> Find out about some events quickly, but only after they happen
> Can react to events quickly, but often do not have readily at hand the data needed to assess the impact on other areas of those events
> Have a more granular understanding of supply chain performance, down to the segment level
> Still spend over 30% of their time collecting and collating data to make decisions
> Get daily updates on events, but not all information and impacts are included
> Get reports within a day of their occurrence
> To a large degree have a global picture of their supply chain, but it is a static one

Stage 3: Event Issue/Impact Prediction

At this point in the process predictive modeling becomes of utmost importance to the improvement of the supply chain performance. A predictive model is built using the event and performance history built during Stage 2. Projections are made based on known times and locations, using detailed models specific to the segment. Therefore, projected uncertainty is associated with the partial path left to complete and specific knowledge of the segment events. Parameters of the predictive model are honed over time, and tools are used to

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adjust model parameters to match history and identify parameters with the most deviation from history. Data outliers can be excluded from parameter updates.

Now the tools begin to "learn" from history. Prediction can now be applied to event monitoring, allowing for predictive alerts to be sent to those with the ability to avert the issue. Relevant details needed to help analyze and determine a solution accompany the alert. Performance increases by fixing problems before they happen and by fixing them earlier in the supply chain.

Predictive analytics combined with the alerting capabilities from Stage 2 provide the ability to prioritize workload involving critical daily business operations such as those surrounding future fill rates and available to promise. Intelligent predictions are incorporated that match supply and demand at the item level now and out into the future. By making such predictions, critical shortfalls can be identified, allowing the reprioritization of material flow through the chain at many touch points, not just at bi-weekly plan optimization runs. The organization by this time is increasing its touch points, level of granularity, and scope of visibility from supplier processes through to customer or consumer touch points.

The detailed parameters that give the predictive model its power are also fed back into advanced planning engines that produce demand forecasts or detailed replenishment plans. Metrics such as lead time and lead time variability by item, event and location are critical to the creation of a high quality demand plan. At the same time, the visibility needed to make mid-course corrections to a good demand plan ensure better execution of the plan.

Stage 3 organizations

> Predict the occurrence of most events within the timeframe where it is possible to prevent issues
> Have self-learning predictive models that improve their predictive power
> Use event data to refine and feed back to advanced planning system more accurate planning factors, such as lead time, lead time variability and deviations from standard
> Spend almost no time collecting data, or identifying problems, as this is done virtually automatically
> Spend 25% of their time analyzing problems, 50% time designing a corrective action and 25% implementing it
> Have a global, dynamic picture of their supply chain, down to an appropriately granular level, updated and recalculated on demand

Stage 4: Point of Cause, How to Fix

With a solid predictive model and finely tuned parameters in place, companies can begin the process of understanding point of cause, and potential solutions to problems. What-if tools now help them play in a "virtual sandbox." However, the tools must be integrated with the underlying data repository. In order to maximize the effectiveness of such tools, the user should not have to exit the world of actual performance and predictions in order to do the simulations, so that the tools use the same metric and parameter definitions the base analytic application uses.

Companies at this stage in their supply chain evolution can start to identify complex business rules and best practice resolutions and build those into the scenarios they build in the what-if tools. The scenarios can be saved, retrieved, adjusted, and communicated to others. This is essential to enable the next stage. A big jump in ROI occurs at this stage with the identification of the potential solutions

Stage 4 organizations

> Have collected the business rules and reuse the best practices of the best corrective actions from their stage 3 activities
> Simulate and test their corrective actions before implementing
> Can summarize and convey for approval the results of their "what if" scenario for implementation
> Spend less than 25% of their time analyzing problems and designing a corrective action. They spend 15-50% of their time monitoring processes that are operating more or less in compliance, and 25% ensuring corrective actions have been properly implemented
> Have measures in place that monitor the success of their corrective actions
> Have a global, dynamic picture of their supply chain, down to an appropriately granular level, updated and recalculated on demand

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to problems. How supply chain personnel spend their time shifts away from designing corrective action and doing the detailed follow-up to implement these action, and toward monitoring the corrective actions and the underlying processes.

Stage 5: Implementing Issue Resolution

This final stage focuses on the capability to automate problem resolution, and addresses information overload by automatically implementing corrective action for identified conditions. By integrating the analysis and transaction environments for predefined conditions, the benefits of the corrective action are realized more quickly. Additionally, knowledge workers are able to focus time and energy on the more complex issues that require additional human judgement.

Once solutions are identified, knowledge workers need to be able to summarize scenarios, communicate through an approval process and, once approved, implement solutions. This will likely involve building enterprise transactions that are executed within various operational systems to drive this implementation in the supply chain. Such messages will trigger the operational system to, for example, place a purchase order for missing goods, expedite a critical shipment through EDI to the 3PL partner, or promote a batch of material to high priority in the production process. Automating this process provides further responsiveness to changes in the upstream supply chain, and better execution of plans in a changing world.

Stage 5 organizations

> Are setting the pace for best business practices in their industries

> Not only summarize and convey for approval the results of their "what if" scenario for implementation, but then can automatically put those actions into effect

> Spend half of their time monitoring processes that are operating more or less in compliance, ensuring corrective actions have been properly implemented

> Spend 50% of their time creating the business rules and automated processes that continue to improve the business performance

> Continue to improve on measures in place that monitor the success of their corrective actions

> Have a supply chain that senses issues, brings them to management's attention, suggests solutions, and implements the corrective action, potentially with no management intervention

At this stage, the organization has a truly world-class supply chain that senses issues as they happen, brings them to attention according to pre-set criteria, guides management to the appropriate corrective action, and implements the fix, potentially with little or no hands on intervention by management.

How to Get Started

The place to start on the road to supply chain excellence is to first build a solid foundation. This foundation is based on the following key building blocks.

> Supply Chain Segmentation, Dimensions and Metrics

> Enterprise Logical Data Model

> An Enterprise Data Warehouse Covering Key Supply Chain Areas

> Start Small and Keep Your Eye on the Road

Supply Chain Segmentation, Dimensions and Metrics

Supply chain logistics involves planning, implementing and controlling the flow of materials from the point of origin to the point of consumption. Typically, materials undergo value-added steps (i.e., manufacturing) and/or integration with other materials at several points in the chain. In addition, temporary storage locations may be used to improve efficiencies or to provide a buffer against unexpected variations. Products are moved between these locations by transportation links.

Evaluation of the supply chain shows that activities can be classified into two distinct categories:

Inventory

These locations hold semi-finished or finished goods inventory (warehouse, distributor, retailer), perform value added steps (manufacturing) or provide integration services (integrator, packager).

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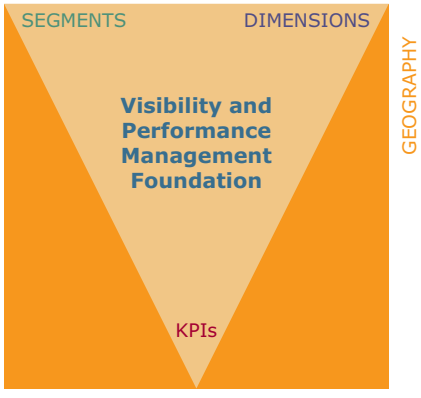
Transportation/Transformation

This operation includes ordering, packaging, receiving, stock-keeping and shipping of materials between locations. Alternatively, it is the transformation of a material good through a creation, production, assembly or packaging process, into a finished good, while potentially also undergoing a value, or unit-of-measure change, or location change.

These functional divisions suggest that the supply chain may be divided into multiple segments defined by a starting inventory location, a transportation/transformation link and an ending inventory location. These segments can then be combined to model any path of arbitrary complexity within the supply chain.

As stated earlier, segmentation of the supply chain not only provides flexibility in modeling and analysis but also is a key factor in reducing uncertainty. Standard inventory projection techniques (such as the economic order quantity) set safety stock levels based on variability typically measured and averaged at local points in the supply chain. These techniques result in relatively large uncertainties when projected to account for possible worst-case/best-case performance.



Segmentation of the supply chain provides focused analysis, using incremental measurements within the segment. Using detailed models specific to the segment projections can be made based on known times and locations. Therefore, projected uncertainty is associated with the partial path left to complete and specific knowledge of the segment events.

Last, by capturing attributes about each segment, we allow the detailed dimensional analysis of the supply chain segments so that performance information can be analyzed at the crossroads of any of these dimensions.

Enterprise Logical Data Model

The concepts of segmentation, dimensions, and KPIs must be supported within a data model used by the performance management system. The Teradata® Manufacturing, Transportation Logistics and Retail Logical Data Models (Teradata Industry LDMs) are comprehensive and flexible blueprints depicting how data organized within a Teradata Warehouse supports business insight and intelligence. They provide the structure to address the business questions needed to manage relationships with data across multiple business areas.

The Teradata LDMs diagram the relationships of data extracted from disparate operational data sources to provide an enterprise-wide view of the business – in areas including purchasing, sales, marketing, customer service, accounting, financial and the supply chain. As the foundation for developing business intelligence applications, Teradata LDMs are the first step toward building a powerful and flexible Teradata Warehouse.

Using proven modeling methodologies, the Teradata LDMs incorporate Teradata's extensive knowledge about data relationships, expertise in building large, enterprise-wide data warehouses, and vertical industry experience. The LDMs can help jump start a data warehouse implementation thereby saving time and cost.

An Enterprise Data Warehouse Covering Key Supply Chain Areas

Most companies have a tremendous amount of detailed operational data, but key business analysts and decision makers still can't get the answers they need to react quickly enough to changing conditions. Why? Because the data are spread across many departments in the organization or are locked in a sluggish technology environment. An enterprise data warehouse that includes data on shipments, forecasts, vendor purchase orders, logistics events, warehouse activities, store activities, shelf movement, returns, etc, helps a company centralize that data to make better decisions faster and less expensively, and get answers to questions that previously went unanswered.

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Start Small and Keep Your Eyes on the Road

The goal is to not be overwhelmed with the task at hand. Supply chain excellence cannot not be achieved overnight, but it is critical to get started quickly given the benefits and conversely the competitive threats. Just as we need to segment the supply chain to identify and address the most critical issues, it is also best to first focus on those supply chain projects that will drive return. By understanding the roadmap to achieving supply chain excellence, you can ensure that each project brings an organization toward a goal while obtaining significant ROI at each stage along the way. Additionally, standards and key metrics according to SCOR need to be instituted to ensure an objective measure of progress and improvement.

Technology Roadmap

> Enterprise data warehousing from Teradata provides the data foundation needed to build incrementally through these stages.

> Teradata Solutions for Supply Chain Intelligence (SCI) provide an integrated data model, best practice metrics, scorecarding/dashboarding, parameter management, predictive model and scenario analysis, all geared to enable the right kinds of analysis, actions, benefits and return on investment as you move through these stages.

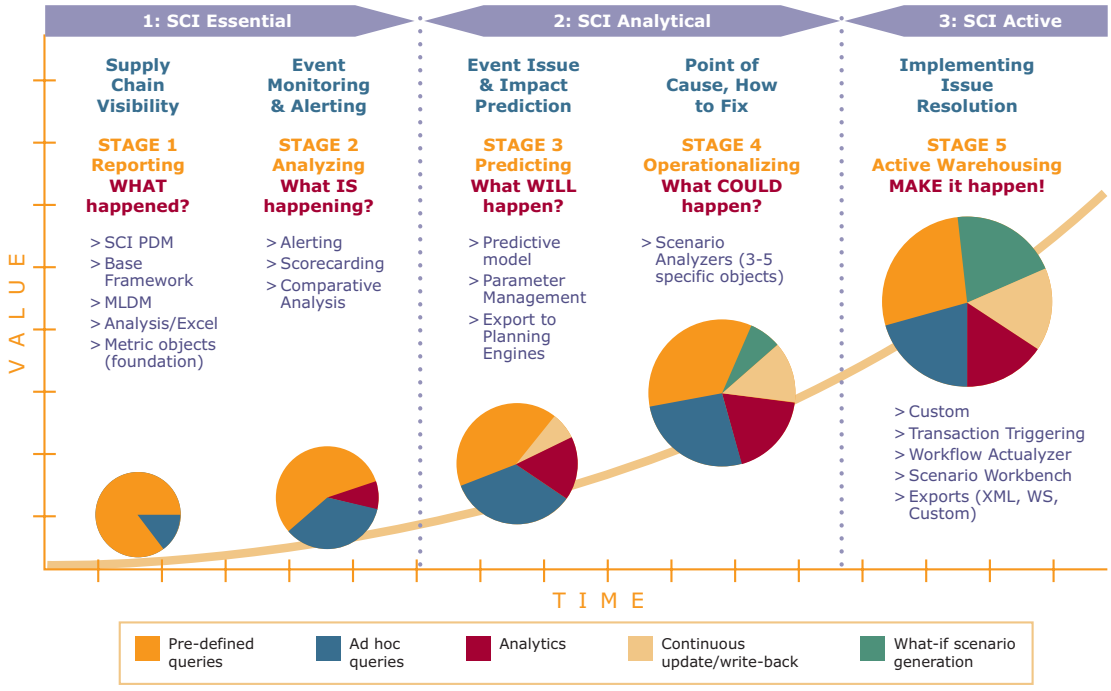
Stage 1 Offer: Supply Chain Visibility

This stage provides visibility into "what happened" within the supply chain. The foundational components of the offer include:

SCI Physical Data Model

SCI's architecture is structured specifically to enable customer data model and analytic extensions. The database and

Teradata SCI Component Offers – by Stage



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analytics are all exposed to support easy configuration in a customer's environment. In addition, the infrastructure provides an object-oriented interface to add new tables and new algorithms as required to extend out-of-the-box capabilities. Using these features, clients can easily extend supply chain information with engineering and product parametric data providing earlier warning of issues with an even higher degree of accuracy.

SCI Base Framework

The SCI Framework provides a platform for developing and running customized client applications or for developing and running SCI applications. The platform is optimized for a Teradata Warehouse and its utilities, but is also independent of the DBMS or database operating system. It manages the administration, operations and infrastructure of the analytic applications as an entire end-to-end solution.

Logical Data Model

An industry-specific logical data model (e.g., manufacturing, transportation or retail) provides a blueprint for designing an enterprise data warehouse that reflects your business model and objectives. A logical data model provides the underlying structure necessary for the successful implementation of a data warehouse needed to pull together the information from the disparate transactional systems in the supply chain. The Teradata industry logical data models provide an integrated subject-oriented model of key business information that serves as a single source for decision support and analytical environments. It represents an enterprise view of your business and all the key relationships needed to understand what's driving your supply chain performance.

Foundational Objects

These objects include some of the foundation reporting capabilities needed to support this phase. These include Excel objects that enable power users and administrators to upload Excel spreadsheets that have defined automated populations with data from the SCI database. Analytic objects include a result (from an SQL query), an analysis (grid or graph), or a scenario (combination of objects).

Stage 2 Offer: Event Monitoring and Alerting

This stage builds on the previous stage by providing alerting, scorecarding, and comparative analysis. The emphasis is analysis of "what is happening now."

Alerting

Advanced alerting systems capable of automatically sifting through massive amounts of data can convert data into information, and information into intelligence, by using advanced analytics and business guidelines. These systems will compare actual observations to desired business goals and automatically alert appropriate individuals when the criteria are or are not met. Alerting systems provide an invaluable asset to the business enterprise through:

- Automatic conversion of data into information
- Background analysis of all areas of supply chain data
- Immediate identification of key business issues and opportunities
- Evaluation of the issue or opportunity on the corporate bottom line
- Early identification of issues to allow a more proactive response
- Direct notification of responsible parties with decision-making authority
- Backup notification of secondary involved parties to assist in resolution
- Automated escalation of issues not resolved
- Use of dynamic alerts to automatically adjust levels based on contributing factors
- Implementation of custom analysis techniques appropriate to the specific information
- Direct linkage to supporting data and calculations to enable drill down/data mining
- Monitoring of supply chain information for continuous improvement

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Scorecarding

This capability enables you to better manage vendor/supplier and key process performance through the use of detailed scorecards that measure and score based on the associated sales, gross margin, operational execution and profitability of each vendor, supply chain partner or process area. Scorecarding will add the ability to measure performance based on scores calculated from key metrics, metrics that are critical indicators of business performance.

Comparative Analysis

This capability supports the comparison of actual measures between common dimensions. For instance, performance measures could be between plants or processes, or over some time dimension. The analysis is purely a historic comparison, and includes the ability to perform quantitative analysis and view via box-plots. SCI makes it easy to monitor and manage critical planning assumptions, while providing context-based drill down to detailed data.

Stage 3 Offer: Event Issue/Impact Prediction

In the previous stage, the goal is to provide notification of an event that has occurred enabling you to quickly react to the situation. Stage 3 moves the supply chain from a reactive to a proactive environment via event prediction and possible impact analysis. It enables you to get out in front of the business, instead of just trying to keep up. The components of this solution are Predictive Modeling and Parameter Management. Also provided is the capability to export to results sets to planning engines, improving future planning runs.

Predictive Modeling

Taking advantage of detailed historical data, processes or events can be modeled to predict the occurrence of supply chain issues. By providing advanced notice, action can be taken to avert potential over or under stock situations.

Parameter Management

This capability provides the user some basic capabilities to build a scenario analysis tool. The analysis included in Teradata Solutions for SCI is set up to analyze the parameters used in the logistics analytical model. The end user is allowed to experiment with two of the four input variable types that drive the analytical model: cycle time and cycle time variability.

Stage 4 Offer: Point of Cause, How to Fix

For this stage we provide tools to assist with scenario analysis. Using "what-if" tools, various supply chain parameters can be adjusted and the corresponding impact on the supply chain will be simulated. Supply chain planners can explore various options and gain insight into their impact before taking the risk of implementing potential changes. Complex business rules can be built into the scenarios, to improve the accuracy or scenario results. Integration with email and other workflow tools offer the ability to summarize and communicate corrective action plans to accelerate the speed and timeliness of implementing the fix.

Stage 5 Offer: Implement Issue Resolution

By Stage 5 the data warehouse has become instrumental in the supply chain strategic decision making. Now the data warehouse moves to the next phase of its evolution – the active data warehouse (ADW).

Active business intelligence is at the heart of any smart enterprise. That means using business intelligence systems as active (rather than passive) tools in performing the business of the corporation. Active data warehousing produces tangible impact to the quality of day-to-day business transactions and creates real differences in serving customers, delivering products, manufacturing goods and securing supplies across the entire value chain.

The ADW extends traditional data-warehouse functionality into the realm of tactical decision making. Tactical decision support (DSS) leverages integrated warehouse data by deploying timely, cleansed information to decision-makers company wide. People who interact with customers and suppliers will have information-based decision making at their fingertips. Further leverage can result when the ADW provides information directly to customers and suppliers.

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The business requirements for an ADW introduce service-level requirements centered on three basic characteristics:

> Performance service levels in an ADW are typically measured by a few seconds. Queries must get in and out quickly to address tactical DSS needs. Moreover, the ADW must scale along multiple dimensions: data size, number of concurrent queries, and workload complexity.

> Availability service levels in an ADW are typically at the same level or, more likely, even more stringent than for strategic DSS implementations. The ADW expands the scope of a traditional data warehouse to include tactical DSS queries. Without access to the ADW, the business can't operate optimally.

> Data freshness requirements for an ADW demand getting data much closer to when the event took place. The typical overnight, weekly or monthly update patterns for a traditional data warehouse are not acceptable for an ADW. Data a few minutes old would be more typical for most ADW implementations.

Specific analytics at this point would be custom or joint developed; however, the prior four stages put in place the environment and infrastructure needed to move to an active data warehouse environment.

Teradata Facts

Teradata is the leading developer of software for the intelligent analysis of the global manufacturing enterprise. Our web-based applications measure, monitor and analyze supply chain functions, product performance, and service operations, enabling visibility and alerting across the extended supply chain – from suppliers' suppliers to customers' customers. Through the use of Teradata products our clients achieve increased profitability and operational excellence.

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