



Automotive Industry Action Group

IBP-1

Inventory Visibility and Interoperability Electronic Kanban Business Process

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IV&I Min/Max Replenishment Business Process - Future State



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FOREWORD

The work group for this project consisted of an international team supported by AIAG, OESA, and ODETTE. The initial business process to be defined was min-max, in which suppliers were allowed to view the customer's inventory data and make decisions to cover customer build and support internal operations. Keeping the scope narrow was intended to solve the interoperability issue among software providers in an expedited timeframe of six months. This solution will complement current EDI practices and should eliminate some of the current confusion around the Inventory Visibility and Interoperability (IV&I) practices. The NIST manufacturing test bed was used to test a proof of concept and eventually an industry pilot. The project objectives were the following:

- 1) define a model for general interoperability (business process and data models),
- 2) model the business process and create collaborations,
- 3) define the architecture and framework to support messages created from data model,
- 4) run a proof of concept to test solutions

This document covers objectives 1 and 2 above as performed by the business process and data modeling work groups. The information collected and summarized in this document relates to the forecasted future state of the inventory visibility tools and their intended use by the automotive supply chain. During the future state discussion and summarization of the members' needs and wishes, this work group has established its view of a "best practices" model of the business process. The output of the work group will be used by the Data Modeling, Infrastructure, Business Object Document (BOD) Development, and Proof of Concept work groups.

The overall view of this process was to allow the supplier to see (by item number) the customer's inventory level, the minimum and maximum inventory specifications, and other pertinent data to make a decision to ship or not ship. The business process team identified four messages it viewed as necessary to transmit data for this process:

The first was an inventory message containing the supplier number, item number, quantity on hand, minimum inventory level, maximum inventory level, and several other fields to allow the ship/not ship decision to be made.

The second message was an Advanced Shipping Notice (ASN) to allow the systems involved to see the "in-transit" quantities and to use the data to feed receiving systems.

The third message (considered optional) was a receiving advice to allow the customer to inform the supplier of the receipt of inventory and any discrepancies during that process (wrong item number, wrong quantity, no ASN, etc.).

The fourth message (considered optional) was a confirmation message to allow the receiver to provide positive and/or negative feedback to the sender regarding the status of the three messages above.

The description of the process flow, the data elements identified, and the UMM models are included in this document.

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1.0 INTRODUCTION

1.1 Business Opportunity

At the Automotive Industry Roundtable co-sponsored by NIST (National Institute of Standards and Technology) and AIAG, it was stated that there is a \$1 billion annual penalty for the lack of interoperability in the automotive supply chain. Our business case for IV&I takes a very conservative approach and examines only reductions in premium freight and the carrying cost of inventory. At a summary level for the industry, the business case points out that the annual savings of \$295 million that should be realized from the benefits of using inventory visibility tools will be eroded by an industry cost penalty of \$516 million if the interoperability problem continues.

1.2 Problem Statement

Currently, there are no standard global Min/Max Inventory Visibility and Interoperability models and related message sets that cover the replenishment of Inventory for Automotive Supply Chain Management.

1.3 Scope

The work group for this project consisted of an international team supported by AIAG, OESA, and with advice from ODETTE. The initial business process to be defined was to be Min/Max, in which suppliers were allowed to view the customer's inventory data and make decisions to cover customer build and support internal operations. Keeping the scope narrow was intended to solve the interoperability issue among software providers in an expedited timeframe of six months. This solution will complement current EDI practices and should eliminate some of the current confusion around the IV&I practices. The NIST Manufacturing B2B test bed was used to test a proof of concept and eventually an industry pilot.

This document addresses the future state of Min/Max as developed by the business process and data modeling work groups. The IV&I POC (Proof of Concept) utilized a subset of what is included in this document. For the results of the entire project and POC as demonstrated at Auto-Tech 2004, see the *Inventory Visibility & Interoperability Project Proof of Concept Phase 1 Summary (I-1)*.

1.3.1 Planning Phase

The planning objectives were to: 1) define the preconditions that must exist before the Min/Max process can be implemented; 2) provide a list the data elements required for the data model team

1.3.2 Execution Phase

The business process objectives are the following:

- 1) Define the model for general interoperability,

- 2) Model the business process and create collaborations,
- 3) Define the messages required to support the business process, and
- 4) Provide support for the other work groups to ensure the transfer of knowledge gained during the work group sessions.

1.4 Boundaries of the Domain

Actors

Buyer:	The Customer. The party that buys / acquires goods or services.
Seller:	The Supplier. The party that sells / provides goods or services.
Carrier:	The party that provides the transportation (conveyance) for the goods.
ERP/MES/ Ship systems:	The systems in which inventory items and data are stored.
IV Tool:	The system/module used to view inventory, make decisions, provide alerts, etc.

1.5 Stakeholders' Needs

Customer Expectations

A trading partner agreement must be established. This includes the criteria that establish when to ship, what logistics to use, when to expedite, and who will be responsible for freight costs.

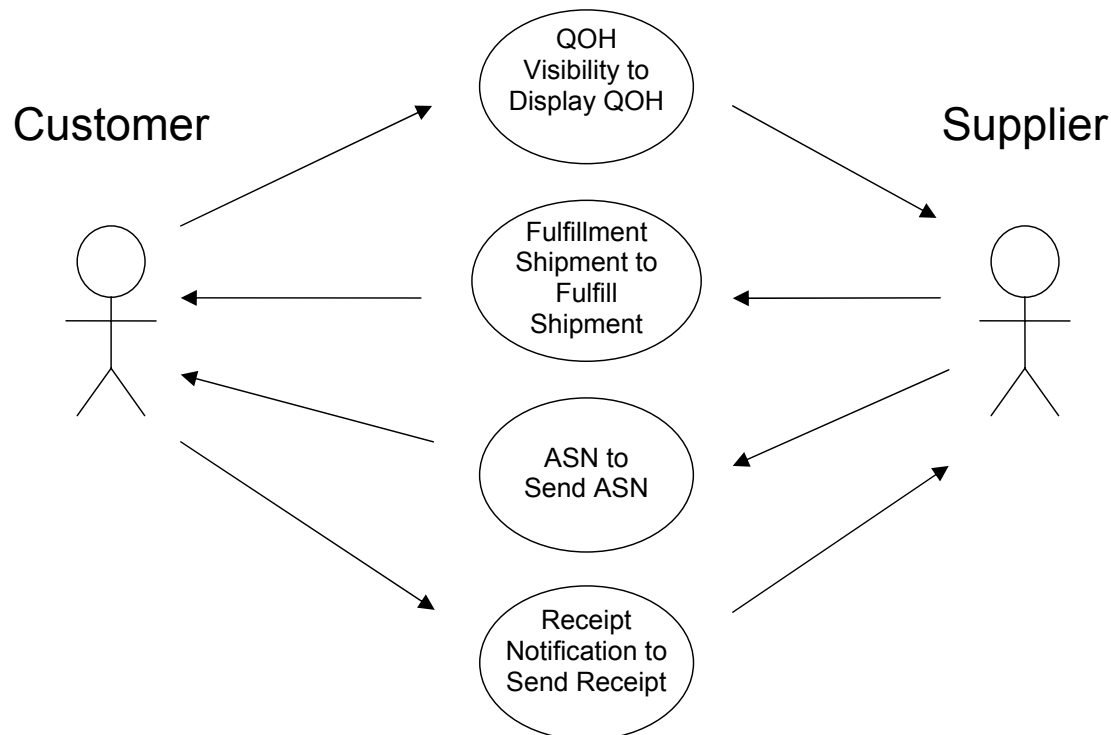
Supplier Expectations

A trading partner agreement must be established. This includes the criteria that establish when to ship, what logistics to use, when to expedite, and who will be responsible for freight costs.

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2.0 BUSINESS PROCESS MODEL

2.1 Overview



2.2 Business Decision Process for Using Min/Max

2.2.1 Customer decision process for using Min/Max

As part of the end deliverable for the IV&I Business Process Team, we reviewed the questions that must be answered before starting a Min/Max fulfillment system. The items below do not dictate what to do, but the answers to the questions will lead to the optimal use of the tool in your company.

Preconditions:

- A Trading Partner Agreement that defines Min, Max and Reorder points on a per part basis plus normal fulfillment processing and exception handling requirements.
- Implement an IV Tool that allows access by all trading partners or provides interoperability messaging with all IV Tools used by Trading Partners.
- All Trading Partner staffs' must be properly trained in the use of the IV Tool and the Trading Partner Agreements supported by the tool.
- IV Tool implementation must accurately reflect current inventory levels in a timely manner to insure proper responses by Trading Partners.
- All Trading Partners monitor implemented IV Tool(s) at the staffing level required to insure timely action to meet normal demands as well as exception processing.

A decision process must be in place to determine if your company should use Min/Max and, if so, for which parts. There are varied answers as to what is the "perfect" part for Min/Max. Much depends on the requirements of your company and what the end goals are for using Min/Max. Listed below are some of the prerequisite questions to using Min/Max fulfillment in a company.

- **Is there a consistent part flow?**
 - If there is sporadic demand or intermittent requirements, Min/Max may not be the best method for managing replenishment.
- **Is there a system to feed data to the Min/Max tool?**
 - Min/Max systems work only with a steady and consistent flow of data.
- **Is there a need to communicate faster and electronically with your suppliers?**
 - Min/Max fulfillment with online tools will satisfy OEM requirements for electronic communication and speed data to suppliers.
- **Is there a business case and funding?**
 - Since Min/Max is usually implemented on a site-by-site basis within a company, there needs to be a justification for the funding and funds available.
- **Is there willingness on your company's part to trust, share, and give up some control in your company's fulfillment process?**

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- Implementing Min/Max requires that the customer give to the supplier some control that has typically been with the customer. Suppliers will be allowed much more data than have typically been given.
- **Is your company willing to change its business processes for fulfillment?**
 - Min/Max is a major change to many company's fulfillment processes. There must be a willingness to reengineer these processes.
- **Is your company willing to review internal material management processes?**
 - Min/Max quickly shows inventory changes and transactions. It is very important that the internal materials management processes are reviewed to ensure that data inventory is kept accurate. When using Min/Max, there will be additional eyes reviewing the data.
- **Is your top level management willing to support Min/Max?**
 - Without the support of upper management, a Min/Max project can quickly become a failure. Implementation requires the support of many areas within the organization. Because of the amount of support required and the changes involved in internal (and external) business processes, upper level support is required.

How your company answers these questions will indicate whether it is time to start a Min/Max process change. When changing to a pull-based system like Min/Max, there is a requirement to change many of the business processes that are currently in place.

1) Analyzing Your Parts

Once the decision is made to use Min/Max, part characteristics must be reviewed. Some parts may fit into the fulfillment strategy, and some may be better suited for other fulfillment methods.

a) Characteristics to consider for each part or supplier:

Supplier's distance from the plant or warehouse
Part lead time
Shipment frequency
Part shelf life
Part criticality to production
Forecast stability
Part complexity
Part uniqueness
Part cost
Part size
Variable lot quantity
Special handling parts (hazardous materials, quality issues, etc.)

After these characteristics are reviewed, a strategy should be formed. For example, your company may want to start with all high-cost, short-distance, and low-complexity parts first and not include parts that are more than five days in-transit. Since no two companies are alike, the strategy for using Min/Max will differ among companies. Variable lot size parts are ideal for Min/Max fulfillment. Since it is almost impossible for the suppliers of these parts to hit an exact quantity, traditional measurement systems penalize these suppliers. The strategy your company chooses can change over time based on the overall materials management goals that are set. Remember: there are other pull and push strategies that may be more appropriate for some parts.

b) From the customer side, the following processes need to be reviewed before starting Min/Max:

i) Forecast data accuracy

Without accurate forecasting, suppliers will see differences between the amount they produce and the amount your company requests for shipment.

ii) Level of inventory accuracy

A high level of inventory accuracy is a must. The saying “garbage in, garbage out” will be very apparent to both you and your suppliers if the data elements are not correct.

iii) Container/Lot quantity

Suppliers are asked to ship based on an upper and lower limit. If the case pack size is too large, it will be very difficult for the supplier to stay within the limits set, or it will increase the customer’s inventory.

iv) Inventory data update frequency

With Min/Max tools, reaction times are greatly reduced. For decisions to be accurate in this type of environment, data must be refreshed on a consistent basis as the demands are placed on your suppliers. If data elements are refreshed only once per day, then your supplier will only be given a “view” into your system once a day. The more often data elements are refreshed, the more accurate are the “views” your supplier gets into your system.

Note that the business process changes made with Min/Max will have an equal effect on both the customer and the supplier. Input on these changes from both sides is highly recommended.

2) Evaluating Your Supplier’s Min/Max Capabilities

When reviewing which suppliers to add to a Min/Max replenishment process, three main areas should be considered:

a) How receptive will the supplier be to change and how accepting of new processes?

Suppliers that are “set in their ways” may need education on the business process changes that will occur with Min/Max fulfillment. This can help speed up the implementation process and quickly clear up misunderstandings.

b) Which suppliers are EDI-capable?

Suppliers that are currently using EDI with a customer may not see the need for Min/Max fulfillment. They may also be concerned that the process will become less automatic. This should be discussed with EDI suppliers before the implementation. Two key items to review are that EDI can still be used and that Min/Max includes exception- based management.

c) What is the supplier’s performance (good/bad)?

With Min/Max fulfillment, added trust and additional responsibility are given to suppliers. This does not mean that only “good” suppliers should be used with Min/Max. Since Min/Max tools have exception-based alerting, monitoring marginal suppliers becomes much more proactive. Both good and marginal suppliers are equally suited for Min/Max. With marginal suppliers, the use of Min/Max fulfillment may actually improve their performance.

3) Communicating the Min/Max Processes

Clearly the most important element in a successful Min/Max implementation is to communicate the business processes both internally and externally. While Min/Max may seem simple in execution, there are many items that need to be defined and clearly communicated. Failure to address this part of the implementation will reduce or eliminate any gains your company achieves.

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- a) **Within the customer's locations the following items need to be identified and in place:**
- i) **Consistent business process rules across all locations**
Asking suppliers to service customer plants differently from the same location can cause additional work and confusion to the supplier. Also, materials management processes should be similar between locations or else identified before the Min/Max process is implemented.
 - ii) **A clear definition of what the customer "On-Hand" inventory figure includes**
 - (1) In-transit
 - (2) WIP
 - (3) Inspection (conforming/non-conforming)
 - (4) Off-site (warehouse, storage trailer, sub-process supplier)
 - (5) Raw
 - (6) Returnable
 - iii) **Material handling of non-conforming parts**
Handling non-conformance parts quickly and accurately within the customer's systems is important. Since suppliers have a view into the customer's inventory systems, there must be a consistent and timely process to handle these parts.

The definition of which inventory to include can vary by customer location. Systems should be reviewed before implementation to ensure that each location can show the correct inventory.

- b) **Communicating your company's expectations and policies to the supply base is critical for a successful implementation of Min/Max. Since this might be a new process for both your company and the supplier, the following items need to be taken into consideration:**
- i) **Supplier contact information**
Since alerts are critical to the use of Min/Max fulfillment, accurate contact information must be maintained.
 - ii) **Which side will be responsible for costs/savings**
With Min/Max fulfillment, there will likely be costs and savings that occur. Who is responsible for the costs and who benefits from the savings should be outlined with the supplier ahead of time. The main areas where there could be significant costs or savings are these:
 - (1) Increases/decreases in shipment frequencies
 - (2) Premium freight instances
 - (3) Line shutdowns or scheduling changes
 - (4) Excess inventory at both the supplier and the customer
 - (5) Cost of using the Min/Max tool
 - (6) Training
 - (7) Staff additions or reductions due to the Min/Max process
 - iii) **Performance requirements and expectations**
How suppliers will be measured and what service levels will be expected must be defined. Since Min/Max is a change to the fulfillment business process, performance measurements with traditional push systems will not work.

iv) Terms and conditions of contracts

Does the use of a Min/Max tool require a change to the terms and conditions of current contracts?

v) Logistics requirements

- (1) Returnables (use and replenish)
- (2) Ship frequency
- (3) Change in carrier

vi) How Min/Max quantities are calculated

How the limits are set and the calculations that derive them should be clearly communicated to suppliers. Having the supplier do a “reality check” is essential.

vii) Weekend/Holiday/Shutdown ship schedules

Suppliers must be given clear instructions on how to handle exceptions to the plant’s normal schedule.

viii) ASN requirements, timing, and adherence

Suppliers should be made aware if there are window times for ASN entry and how that could affect their performance rating. Since this process may be new to many of the non-EDI suppliers, a clear instruction should be given.

ix) Ship quantity

The supplier should know exactly what to ship and when. This may seem simple, but with Min/Max there can be different strategies on when the supplier ships and how much. With a pull-based system, this is much easier for the supplier to understand. With Min/Max, there is a lot more flexibility and uncertainty on the supplier side.

Many of these items may appear to be clear on the customer side, but they will most likely be misunderstood by suppliers if they are not clearly explained. With Min/Max fulfillment, there are different requirements placed on the supplier versus traditional push-based fulfillment. Unless clear policies have been created, with input from suppliers, problems will occur very quickly.

4) Exception Alerts

One of the biggest changes with Min/Max is the exception-based management capabilities. When certain thresholds are reached, most tools will send an alert to the supplier and customer. With this comes the possibility of “alert overload.” Care must be taken that suppliers (and customers) are alerted only when something critical has happened. What constitutes “critical” will have to be defined within each company. There must be a clear guideline communicated to suppliers as to the process of handling alerts. Areas to cover are the following:

a) Alerts that will be used

What critical limits need to be reviewed

b) Required response time for alerts

Suppliers must be given instructions on the time fence for responding to alerts. Also will there be a requirement to respond to every alert or just critical ones.

c) Supplier contact information maintenance

The ability and the responsibility for the supplier’s contact information must be given to the supplier. Since alerts are sent for critical events, it is important that the message is sent to the correct person.

Appendix A outlines many of the alerts (or exceptions) that can be monitored in a Min/Max process.

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5) Performance Measurement

Performance measurement is critical with any process but is even more critical with Min/Max fulfillment. With Min/Max, suppliers are required to react much faster than with a typical push-based process. Therefore, measuring a supplier's performance is critical to identify problems quickly- before there is an effect on the operations of a plant or warehouse. Using a performance measurement that is in place for another replenishment method will not work. Since there is not an exact quantity required for shipment and suppliers do not ship to forecasted releases, a performance measurement that takes these items into consideration must be in place.

With a push-based process, the measurement is based on whether a release, or order, quantity is receipted on the date requested by the customer. This does not necessarily reflect whether the customer needed the part but rather complies with the date and quantity sent by the customer to the supplier. With Min/Max and other pull-based systems, the requirement from the customer is based on actual usage. Therefore, failure of the supplier to comply could directly affect production at the customer. Since Min/Max tools are designed to alert when a critical limit is reached, a performance measurement system based on this critical limit is essential.

a) There are currently three main alerts that are available in current Min/Max tools:

- i) Inventory below minimum level
- ii) Inventory above maximum level
- iii) Update of part release/order

Selecting which alerts are necessary for the strategic goals of your company will yield the performance measurements you require. The list in Appendix A covers most, if not all, the critical events in Min/Max fulfillment. After the critical events are selected, measuring the exceptions to those events will illustrate the performance of the supplier in that process. Measuring the exceptions can be done several ways:

b) Occurrence based

Measuring the number of times events happen over a given time, i.e., the number of times a part hit the Maximum level.

c) Time based

Measuring the total time parts are in a given event, i.e., the amount of time a part spent below the Minimum level.

d) Response based

Measuring whether there was a response to an event, i.e., confirmation of schedule release.

e) Criticality based

Added weight given to very critical events, i.e., stock-outs given more weight than below-Minimum events.

The events and the method of measuring those events are up to each company. Performance ratings can be created for both suppliers and customers in the process. Performance measurements should not be set up for events that are not part of the process or that cannot be measured. Suppliers should have as much visibility of the measurements as the customer. The measurements used should be clearly communicated to both suppliers and internal users along with expectations of service levels.

6) Continuous Improvement with Min/Max

With Min/Max implementations, there is generally an initial cost savings due to the increased visibility between supplier and customer. This visibility allows safety stocks to be reduced on both sides. Many feel this is the only savings seen with Min/Max fulfillment. Fortunately, there are more savings if a continuous improvement approach is used. Once Min/Max is implemented at a location, several things become very clear:

- a) **Which parts have too much inventory**
This is reflected in excessive carrying costs, high obsolescence costs, and excess use of space.
- b) **Which parts have too little inventory**
This is reflected in premium freight costs, line shutdowns, unplanned schedule changes, and overtime.
- c) **Which suppliers are consistently maintaining the correct inventory levels**
This is reflected in supplier performance measurements.

When a continuous improvement approach to Min/Max is adopted, reviewing these items will affect Key Performance Indicators (KPI) that, in turn, affects the entire operation. Min/Max essentially puts in place an upper and lower control limit on inventory levels. When the exceptions to the levels are reviewed, carrying costs, obsolescence costs, floor space utilization, line shutdowns, and overtime costs can be reduced. When the performance levels of suppliers are reviewed, capable suppliers can be identified. With these suppliers inventory limits may be adjusted lower since there is a confirmed confidence in their capabilities. Because of the added visibility given to suppliers, they are allowed to add their insight into the process. Their ability to see the forecast and the daily usage by the customer will quickly give visibility to forecast issues. A customer that moves to Min/Max fulfillment and does not solicit input from suppliers is doomed to failure.

Min/Max fulfillment is not a process that runs on autopilot. By using alerts and exception-based management, Min/Max tools do help reduce the reactive side of material fulfillment. However, there are potential pitfalls with a Min/Max implementation that should be taken into consideration.

- a) **Lack of maintenance on Min/Max levels will cause inventories to rise or fall below** acceptable levels. The data given to suppliers will be conflicting. Ship quantities will be higher or lower than the forecasted quantities. Either way, costs are increased.
- b) **Performance measurements must be reviewed on a regular basis. Without regular reviews of** the supplier's performance, improvements and corrections cannot be made.
- c) **Costs in other processes must be reviewed on a regular basis. Min/Max fulfillment changes** can affect other areas. Good examples of this are freight, administrative, and piece costs. Any increase in these costs due to the use of Min/Max must be viewed as an offset to the savings from Min/Max.

7) Future Functionality

Since Min/Max is a part of the execution process in supply chain management, activities in several areas can be combined to improve savings or reduce time. Here are a few examples:

- a) **Auto ID processes (bar code generation, RFID)**
This can greatly reduce the time required to receive parts.
- b) **Tracking of containers/returnables**
With the visibility greatly increased for incoming parts, returnable containers could be added to the items monitored.

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c) Generating the Bill of Lading at the supplier

Min/Max tools direct the supplier on what to ship and allow the sending of an ASN. Since the data required for this process are very similar to the data used to create a Bill of Lading, the process can be streamlined.

2.3 Scenarios

Table 1. Business Process Use Case Actors

Main Actors	Possible Roles
Customer	Planner function Inventory transaction entry/update function Receiving function
Customer database	Repository of customer information Generation of QOH message Generation of receiving message
Visibility tool	Repository of visibility information Generates alerts based on criteria
Supplier	Fulfillment function Shipping function
Supplier database	Repository of supplier information Generation of ASN message
Carrier	Transporter of goods