

# Overcoming the Challenges of Inbound Supply Chain for a US-Mexico Maquiladora

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# Agenda

- Overview of the inbound supply chain for Mexican maquiladoras
- Overview of TRW inbound operations
- Areas of improvement opportunities
- Current projects within TRW supply chain operations
- Conclusions

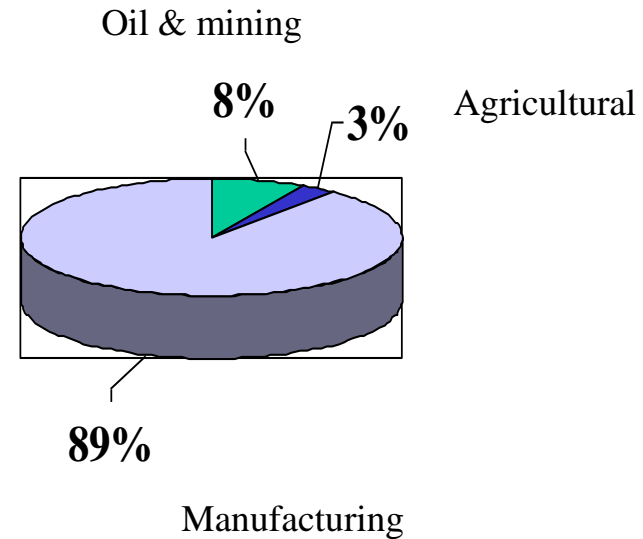
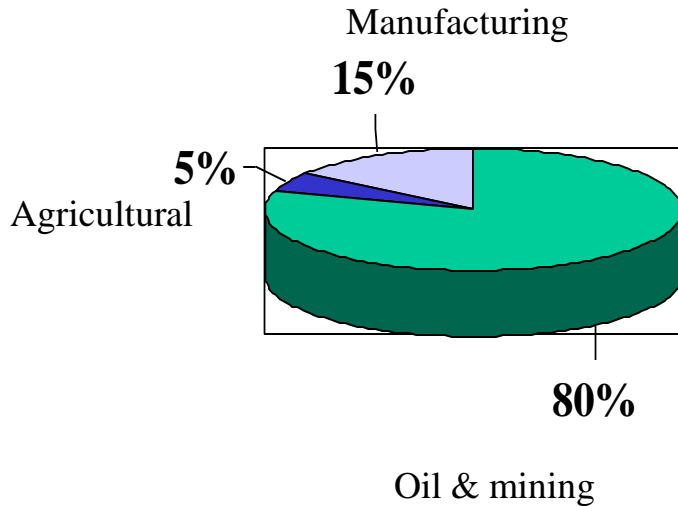
# Maquiladora

- A Maquiladora is a Mexican assembly or manufacturing operation that can be wholly or partially owned and managed by a non-Mexican company.
- A Maquiladora uses competitive priced Mexican labor to assemble, process or perform manufacturing operations.
- Maquiladora must temporarily import most components parts from the United States or other countries.
- Mexican law allows these operations to bring in most capital equipment and machinery from abroad.

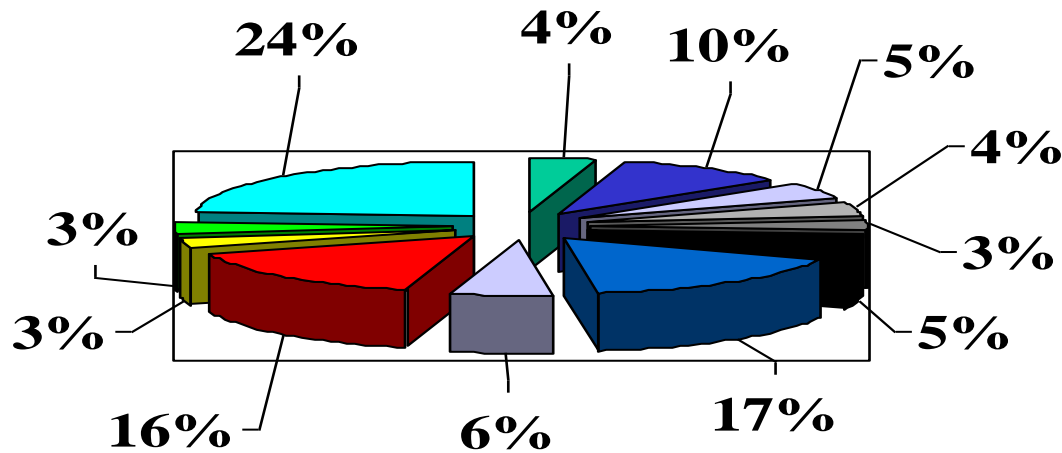
# Mexico's Exports

1982

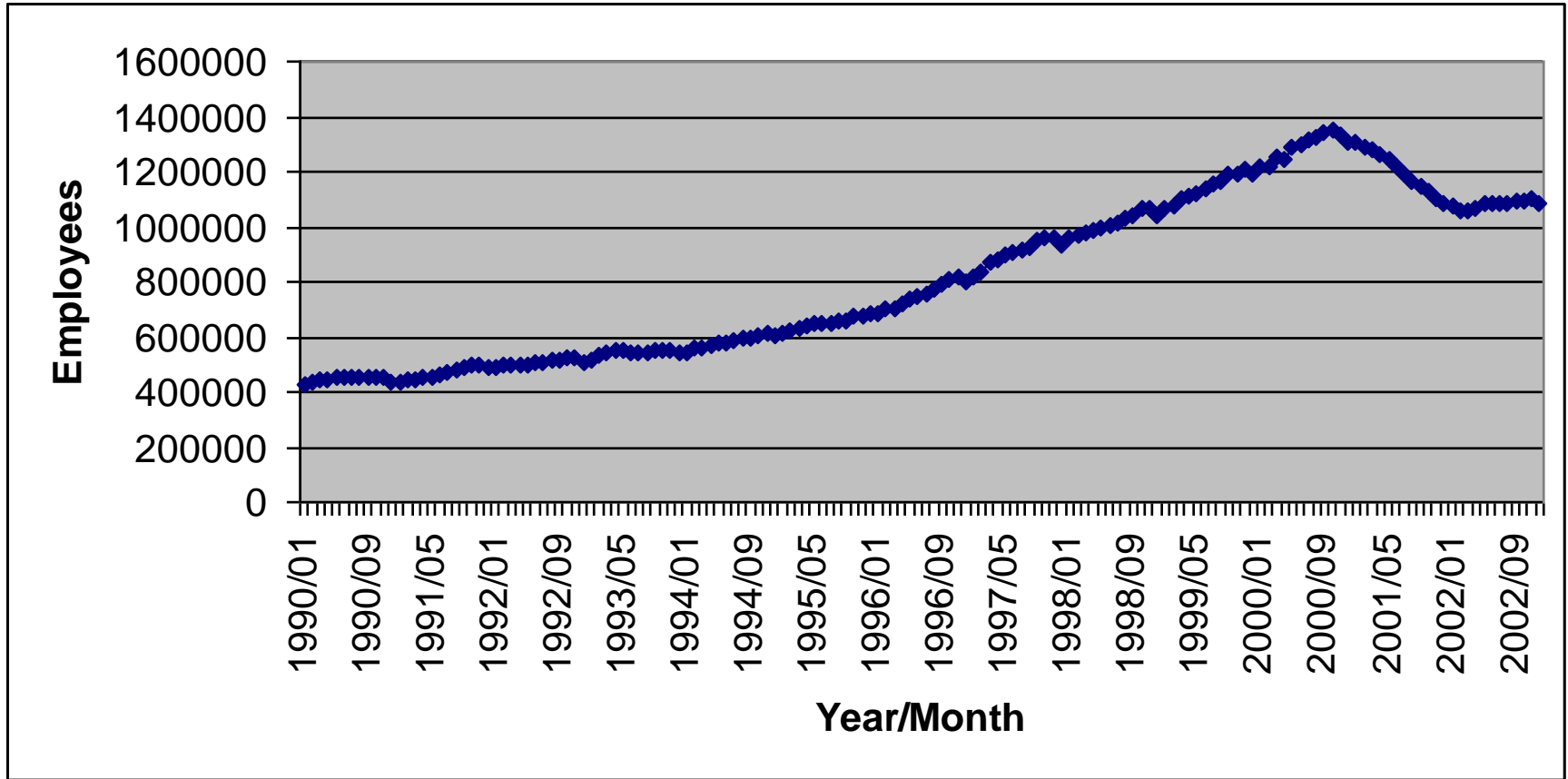
2002



# Maquila Market Share

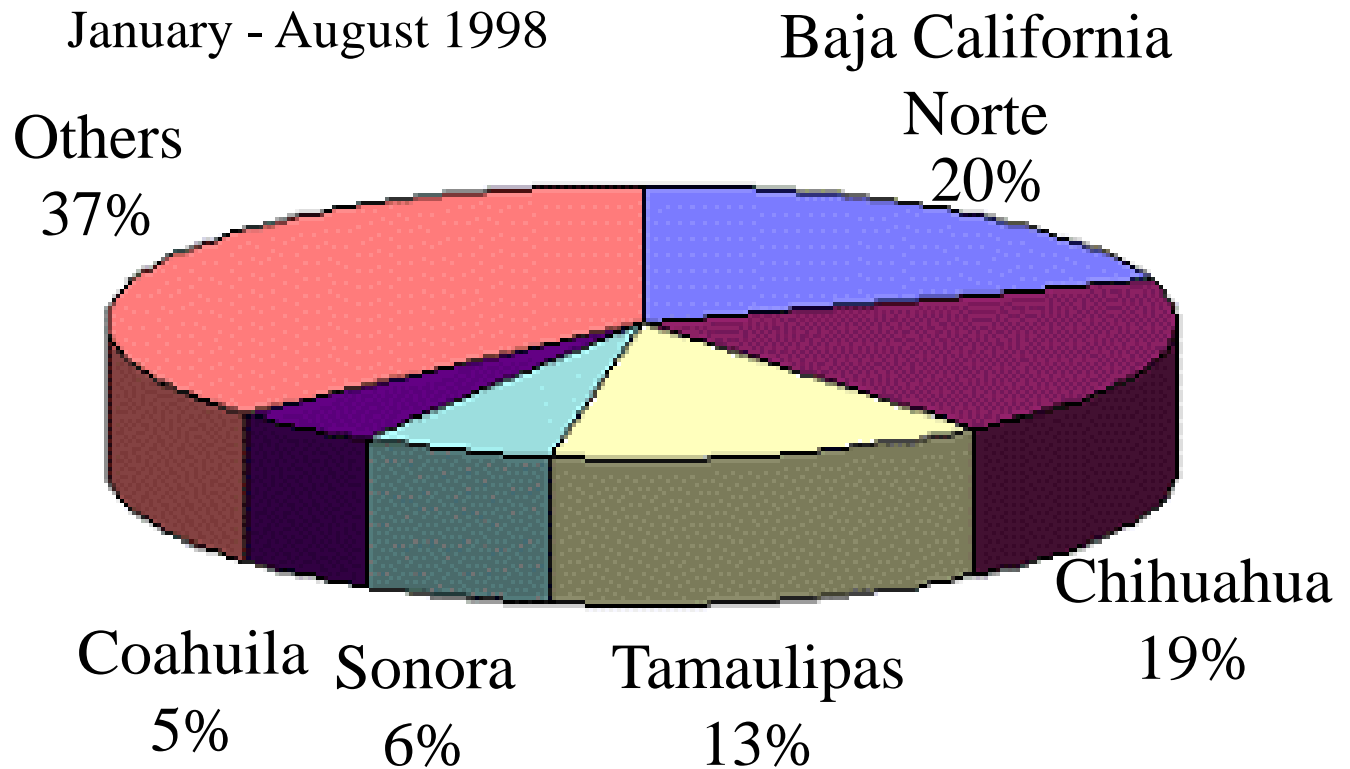


# Total Employment Maquiladora Industry



Source: INEGI

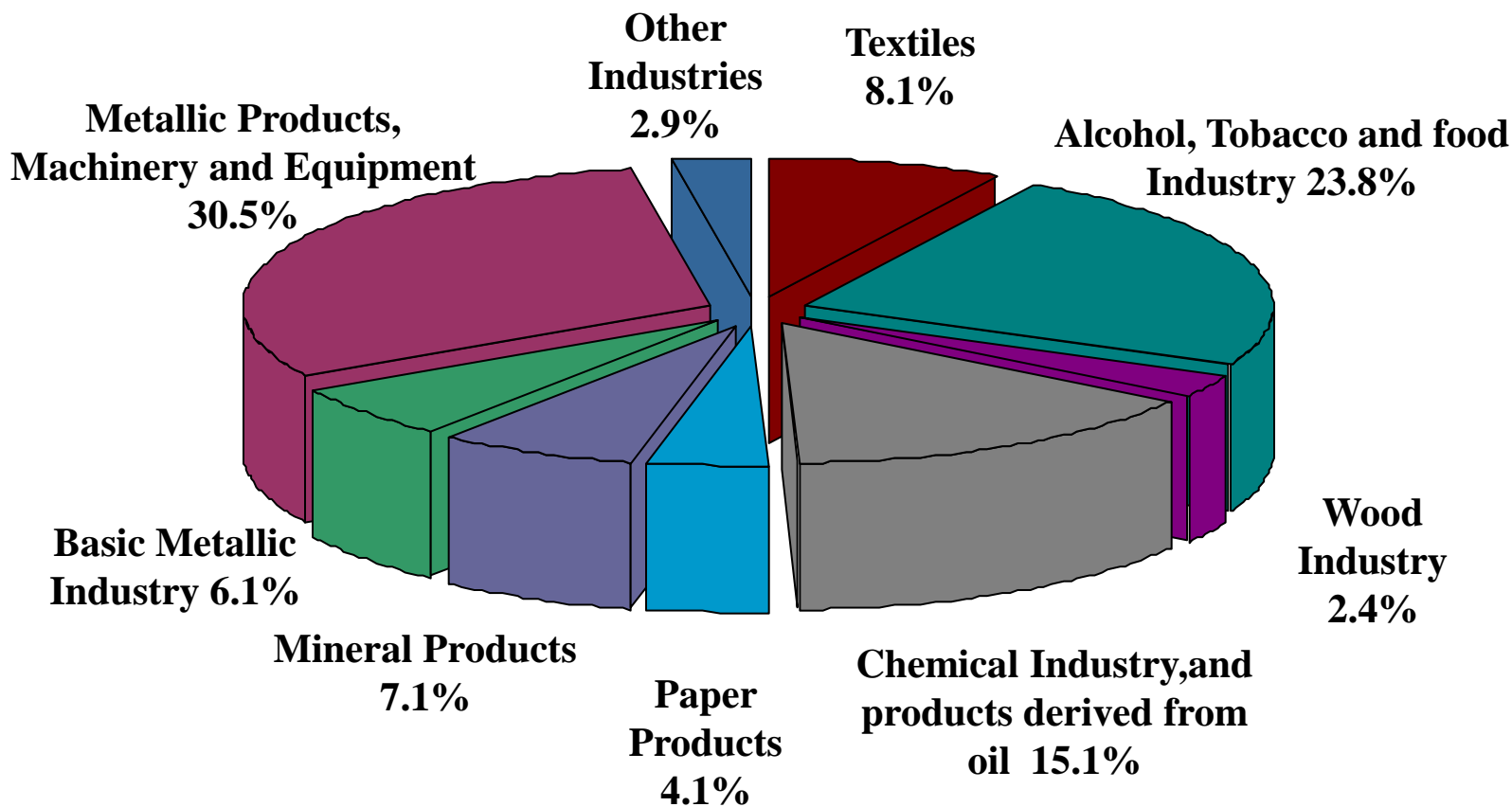
# Main Maquiladora States



**Total Maquila Exports  
33,500 Millions of Dollars (1998)**

# Most important segments of Manufacturing

March 1998





# Plants by State



# Statistics of Maquiladoras

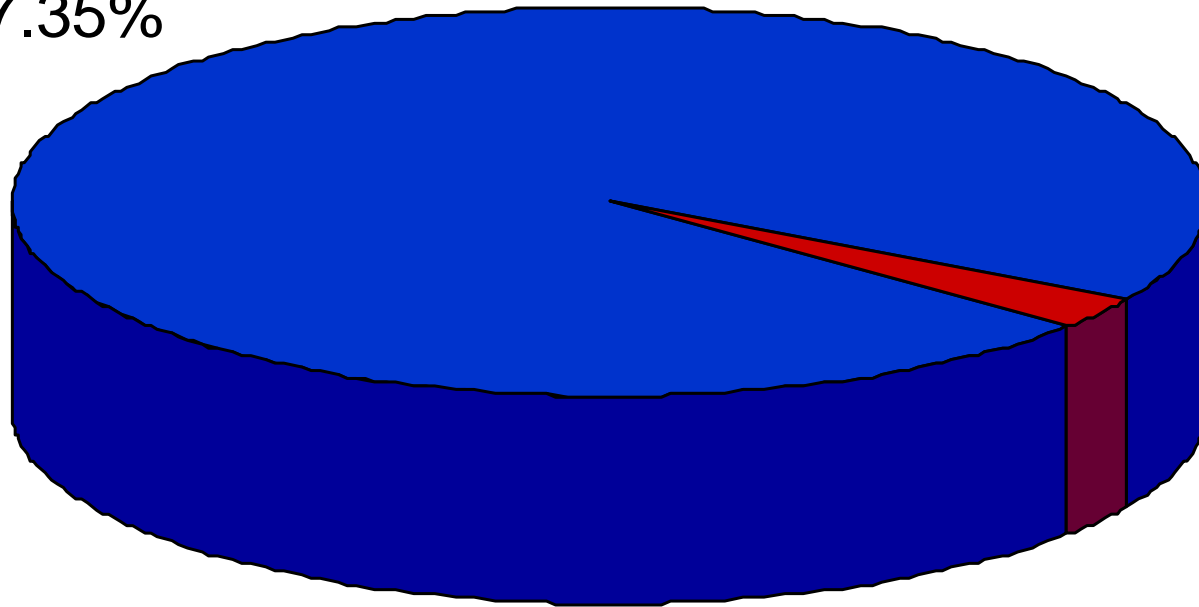
Item	1990	2000	2002 P/
Total Number of sites	1703	3590	3251
Number of sites on Border States	1523	2686	2362
% on Border	89.43%	74.82%	72.65%
Employees	446436	1291232	1081678
Operators	360358	1045401	860 04
Technicians	53349	153392	138020
Administrators	32 729	92439	83354
Supplies Used (000 pesos)	\$29,958,614.00	\$521,139,822.00	\$539,042,007.00
Supplies Imported	\$29,445,060.00	\$505,147,039.00	\$518,721,573.00
Mexican Supplies	\$513,554.00	\$15,992,783.00	\$20,320,434.00
Added Value (000 pesos)	\$9,918,504.00	\$163,414,471.00	\$181,758,729.00
Local Content	1.71%	3.07%	3.77%
Added Value wrt to supplies	33.11%	31.36%	33.72%

Source: INEGI

# Supplies Used by Maquiladora

Imported Supplies

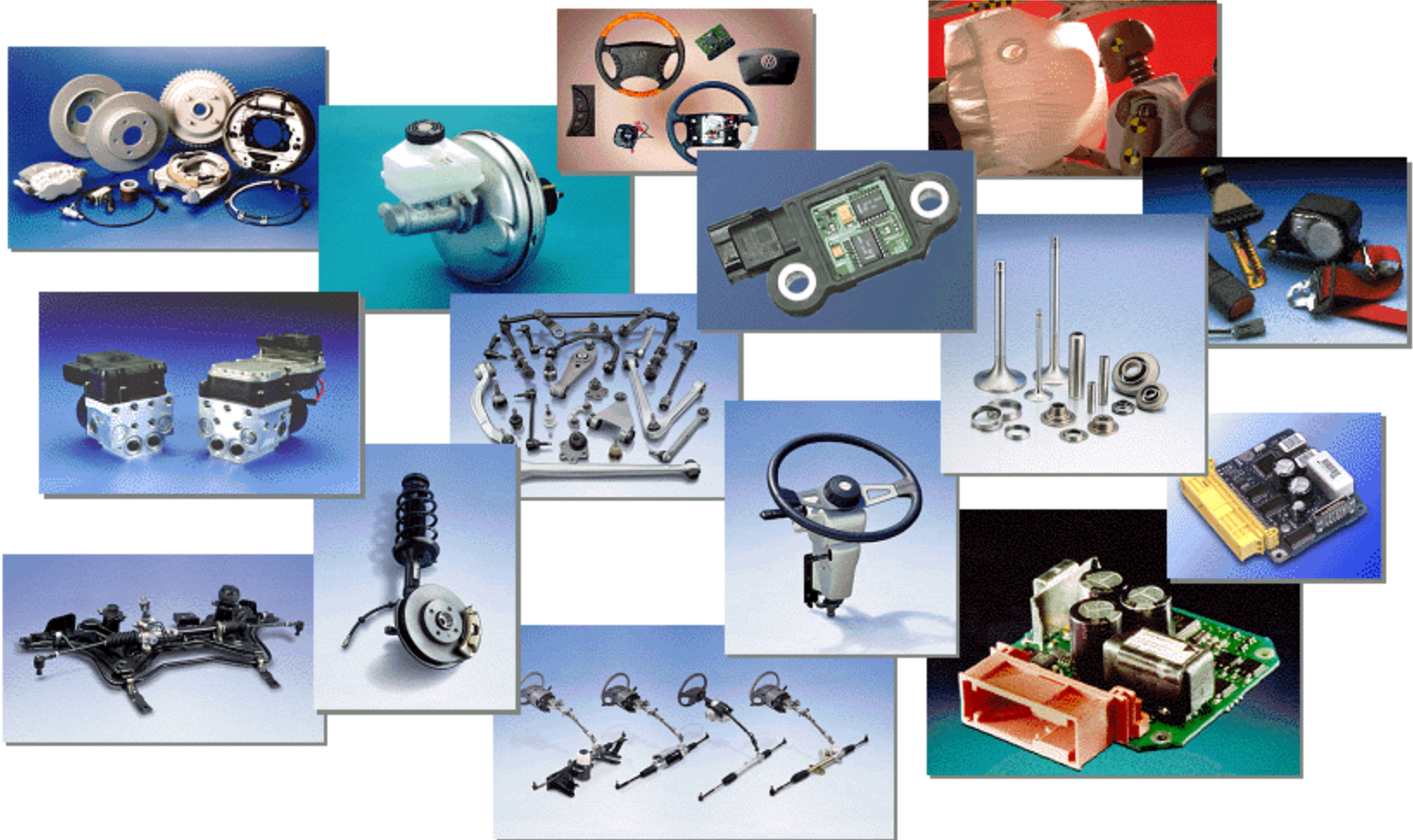
97.35%



Mexican Supplies

2.65%

# TRW Automotive – Current Products



# OUR CUSTOMERS

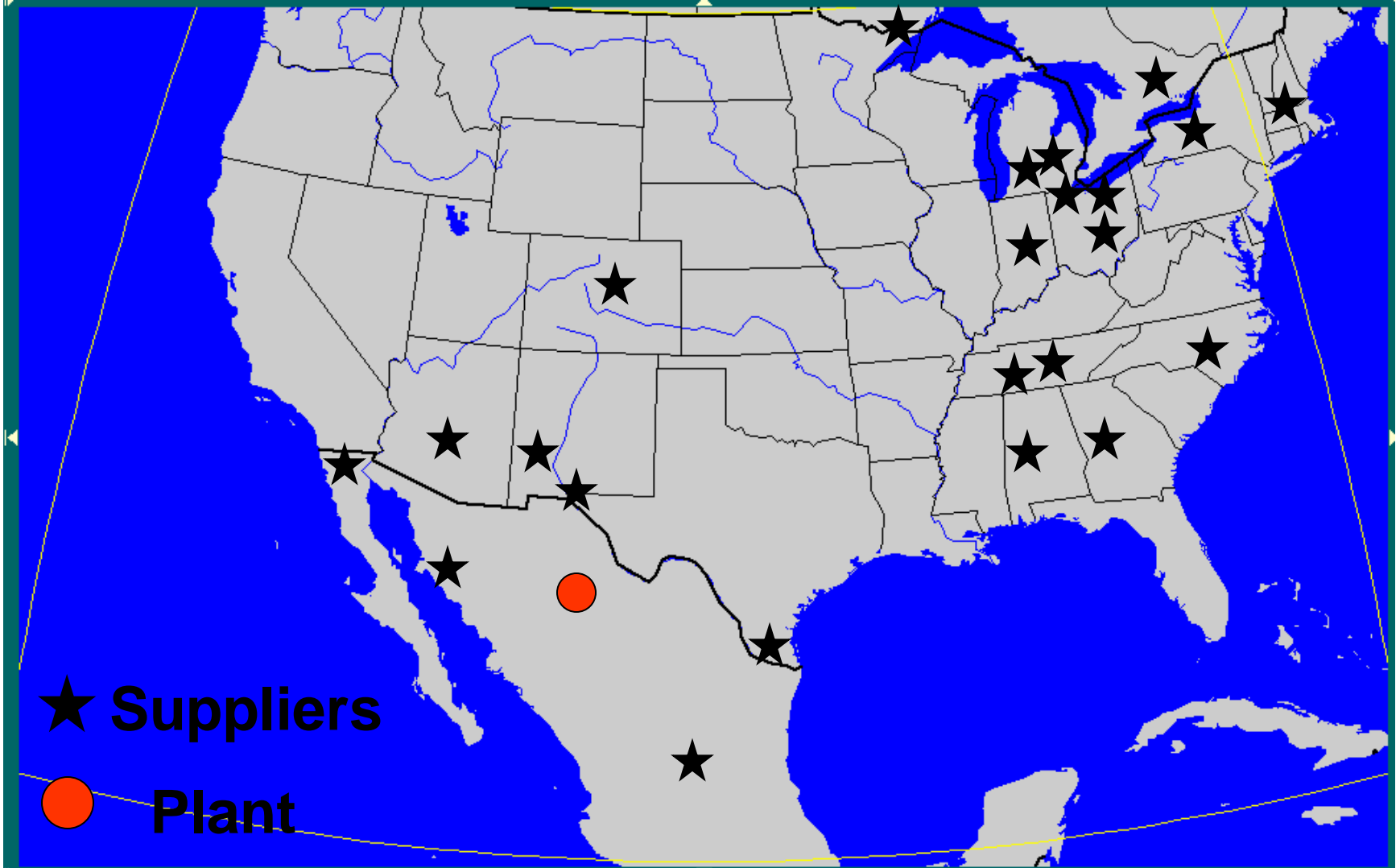


# TRW Plants



# TRW Occupant Restraints de Chihuahua







# ★ Suppliers

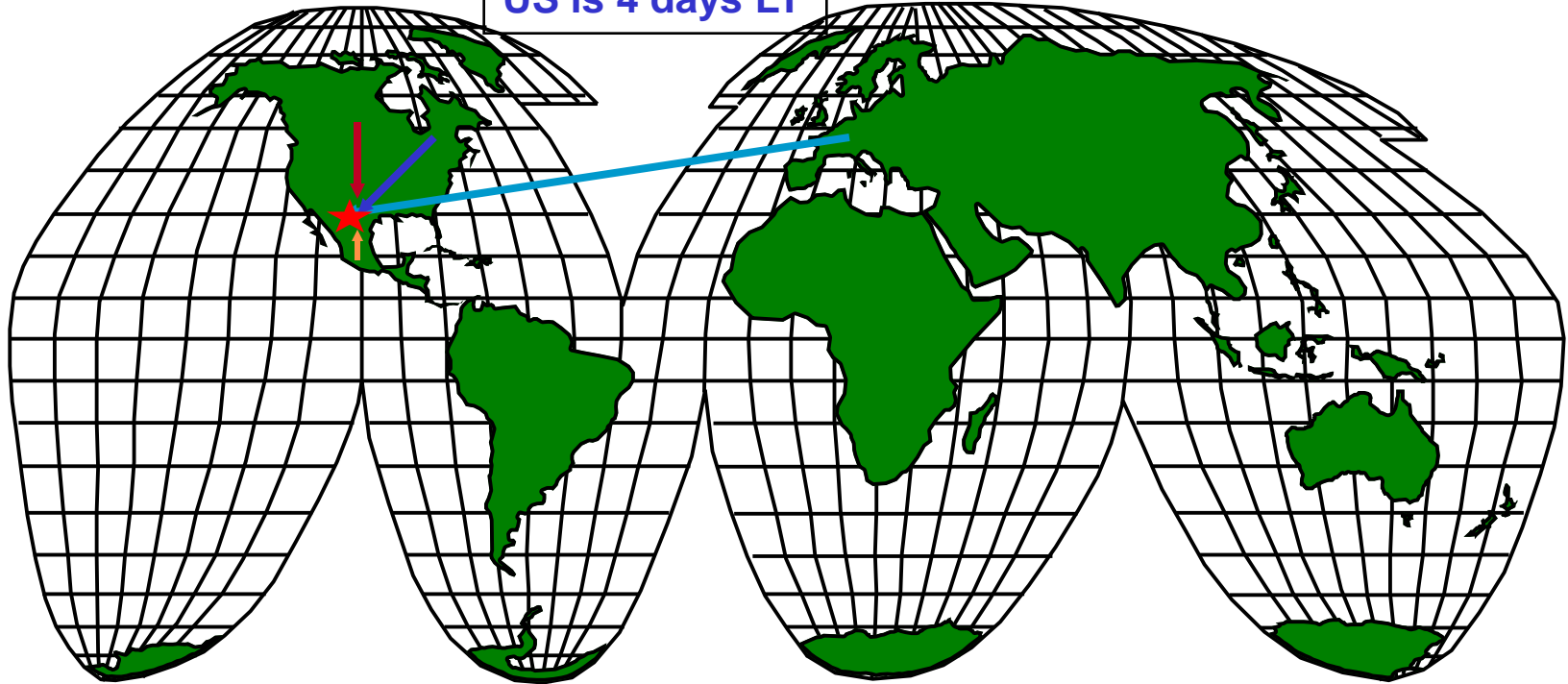


# Our Customers LT

From Canada takes 8 days

Europe: 30 days in transit = 1 million dollars

US is 4 days LT



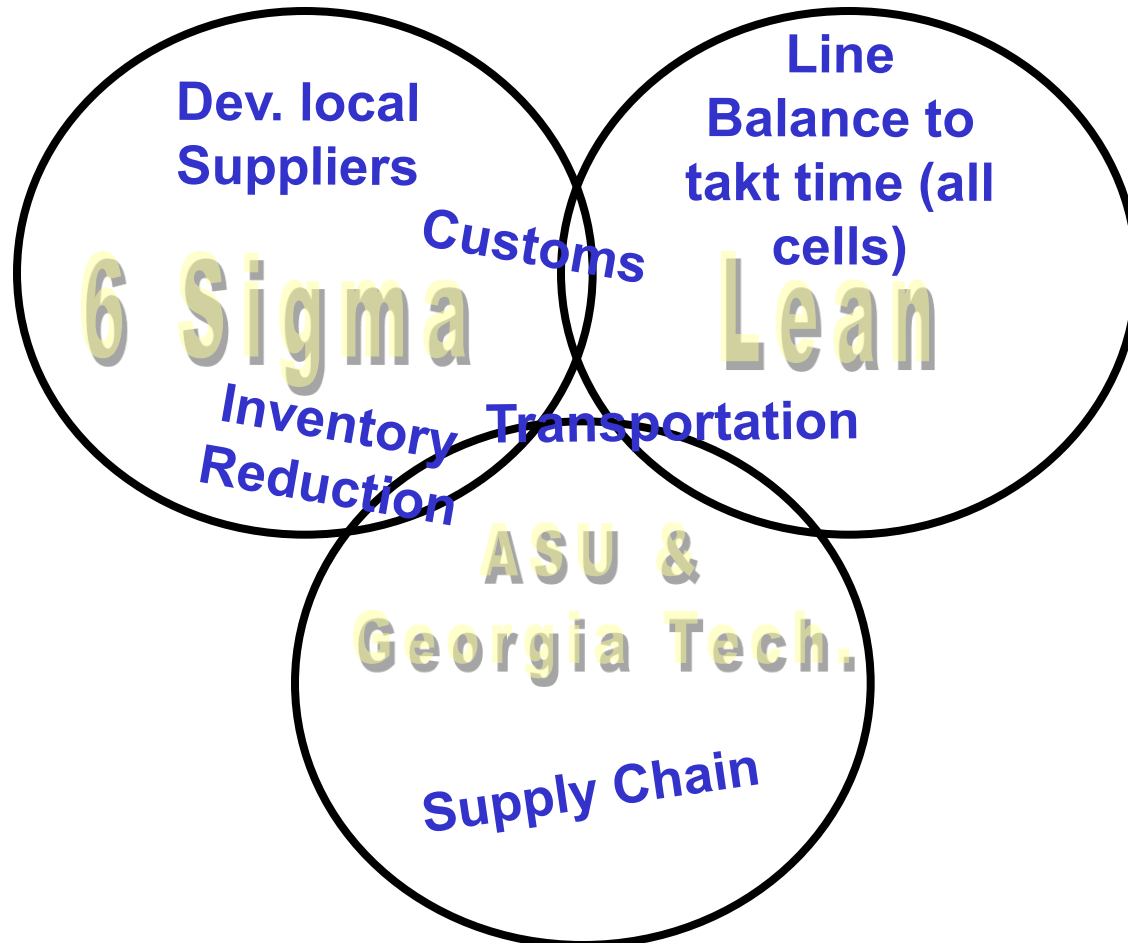
1 day from Mexican Suppliers

# The Question?

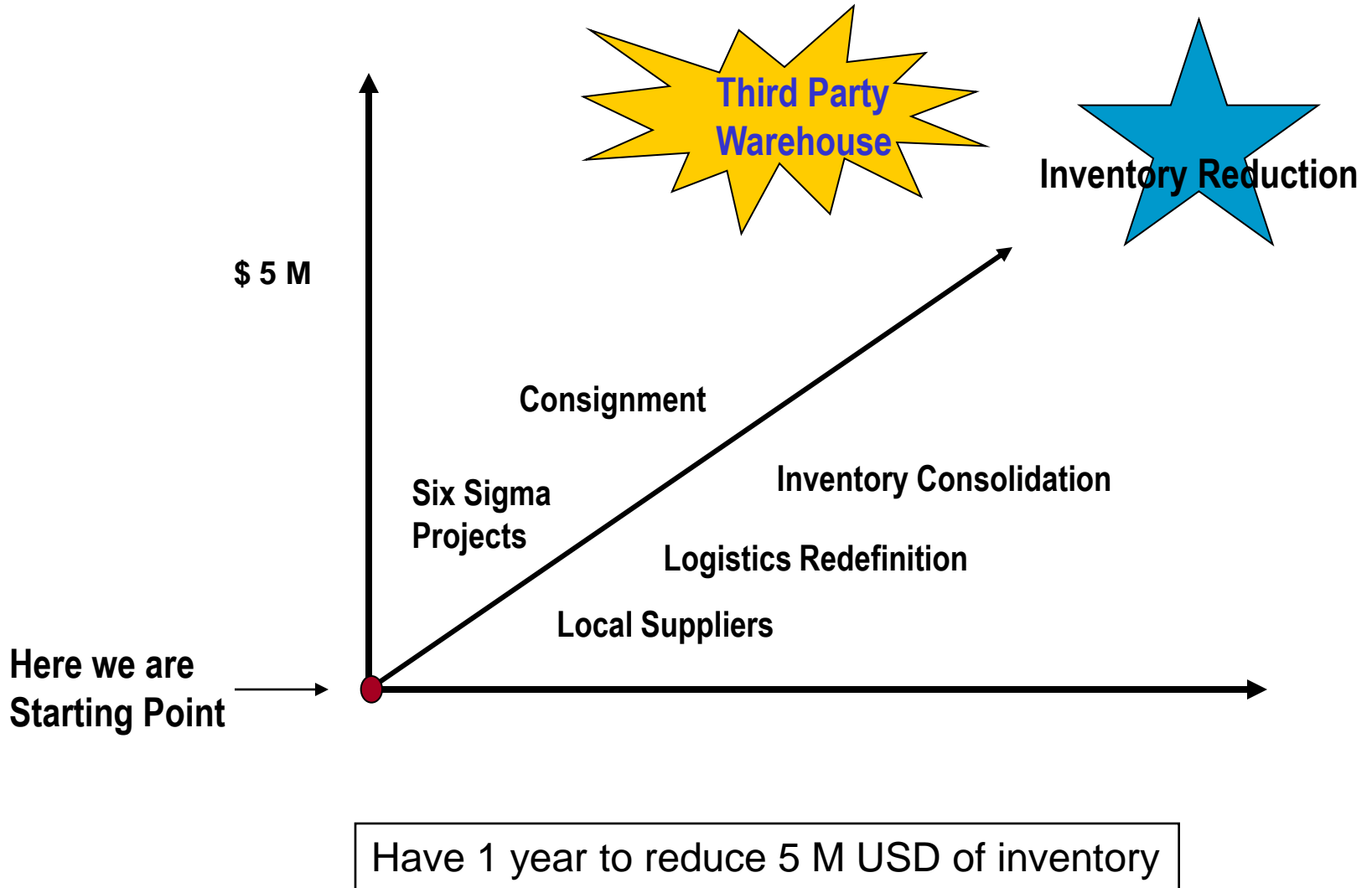
**Inventory or Freight ?**

**Answer: Both**

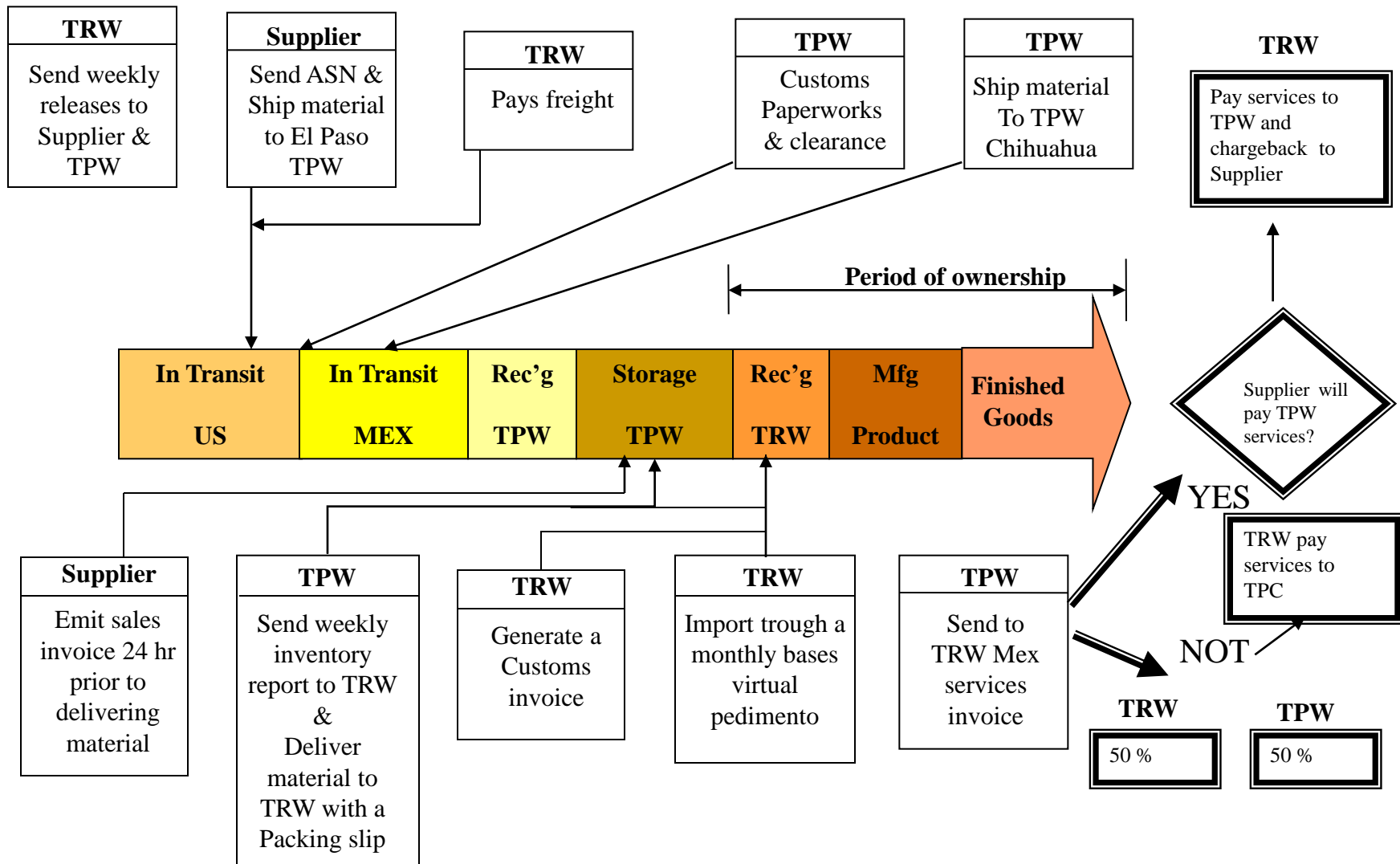
# Strategies to meet TRW Goals



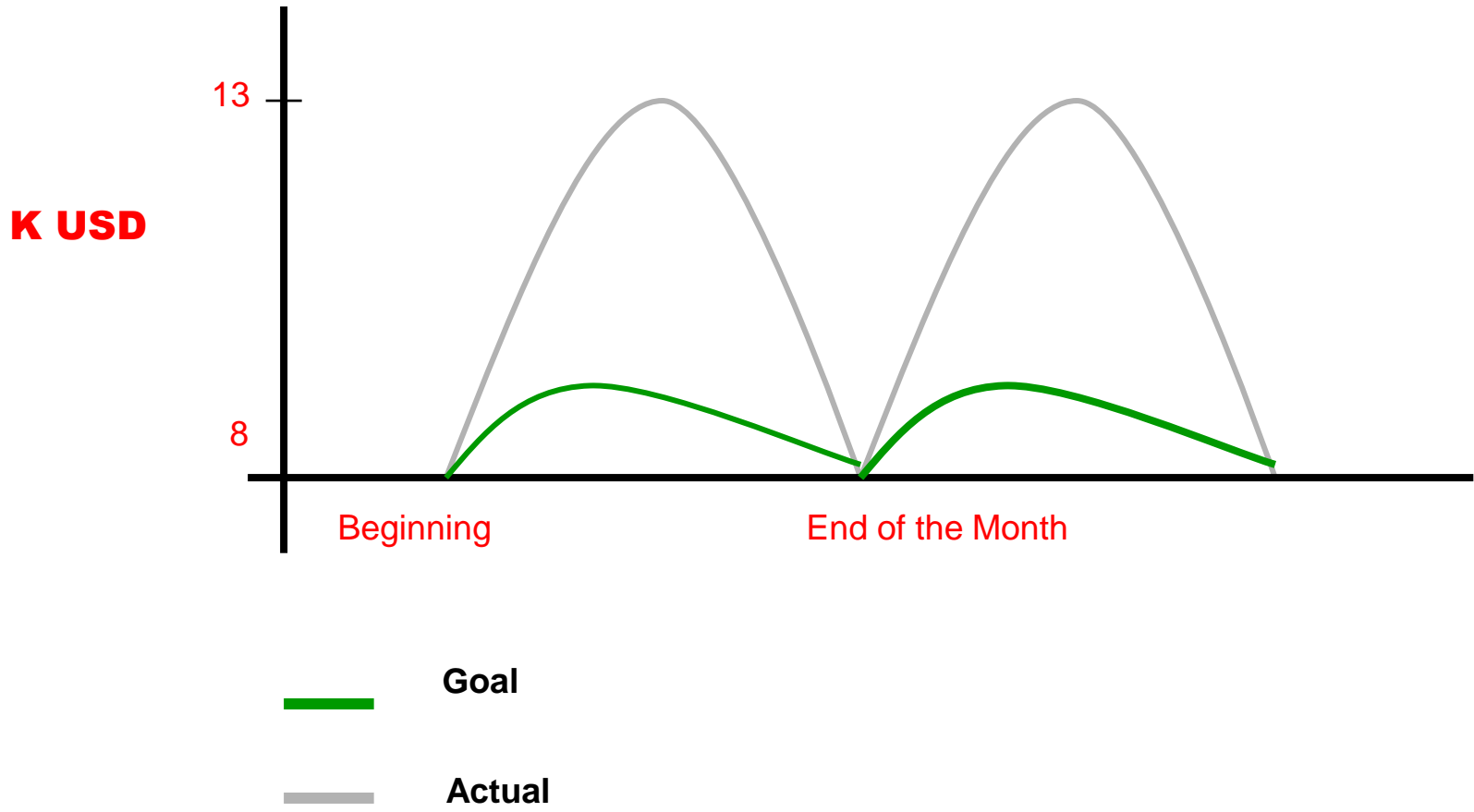
# Strategies to Meet Materials Goals



# Third Party Process



# Cash Flow, the target



# Projects with ASU/Georgia Tech

- During the Summer of the year 2002 an analysis of the in-bound logistics procedures was performed and the following areas of opportunities/projects were identified
  - Improvement of inbound transportation strategies
  - Consolidation center closer to suppliers
  - Vendor managed inventory
  - Integrated decision systems for transportation/inventory decisions
  - Development of metrics to monitor and improve in-bound logistics



# Preexisting Transportation Situation

- The raw material from the different suppliers is consolidated in El Paso, TX
- Around 13 different milk runs used to pick up raw materials
- Most of the raw material suppliers located in the mid west
- We estimated that the average truck utilization (excluding fabrics) for the milk runs is around 60%
- The average utilization for cross border transportation is over 80%
- Problem: TRW was paying a lot of money to move “air”
- TRW using a third-logistics party. Question: is this company doing a good job?

# Analysis of in-bound Logistics

- Possible problems:
  - Inventory/ordering decisions drive movement of material without regarding transportation costs
  - Milk runs that do not take into consideration inventory trends/policies
  - El Paso might not be an efficient consolidation point (too far from gravity center)
- Some Possible solutions
  - Use an integrated supply chain policies (devise an ordering/milk run scheduling policy that minimizes total cost)
  - weekly/monthly dynamic generation of milk runs
  - Investigate the economic feasibility of a consolidation center closer to the the center of gravity of suppliers that will ship directly into Mexico
  - Investigate the economic/technical feasibility of multimodal transportation

# Transportation vs. Holding Costs

## Single Product Example

Demand (Yearly)
1,291,200
Cost per Part
\$18.01

Inventory On hand (\$)	Holding Rate	Holding Cost per Year
\$353,354.53	20.00%	\$70,670.91
Cost of Materials	Transportation Costs	Transportation per Year
\$23,254,512.00	3.50%	\$813,907.92
Transportation vs Holding Costs <b>\$743,237.01</b>		

# Transportation Efficiency

## Sample of Trucks Hired in April 2002

Efficiency	\$ / (52 Loads)	Trailers Demand	Cost per month	Savings
59%	\$ 2,367.69	64	\$ 151,532.06	\$ -
60%	\$ 2,360.31	64	\$ 151,060.00	\$ 472.06
70%	\$ 2,023.12	64	\$ 129,480.00	\$ 22,052.06
80%	\$ 1,770.23	64	\$ 113,295.00	\$ 38,237.06
90%	\$ 1,573.54	64	\$ 100,706.67	\$ 50,825.39

- Possible Savings by increasing efficiency.
- Sample of 107 trucks (April)

# Transportation Efficiency Examples: Consolidation

City	Weekly Demand (Pallets)	Current Route (to El Paso)	New Routes
CLEVELAND	25	A	1
BROOKLYN	8	A	1
CELINA	3	A	1
BLACKSTONE	4	B	2
SOUTH HILL	8	B	2
GRAND BLANC	11	C	3
ARCHBOLD	6	C	3
BOWLING	2	C	3

## Current Routes

Route	Occupation	Number of Pallets	Cost per Route	Cost/Pallet
A	69.23%	36	\$2,238.00	\$62.17
B	23.08%	12	\$2,200.00	\$183.33
C	36.54%	19	\$1,926.26	\$101.38
Total cost per week			\$6,364.26	

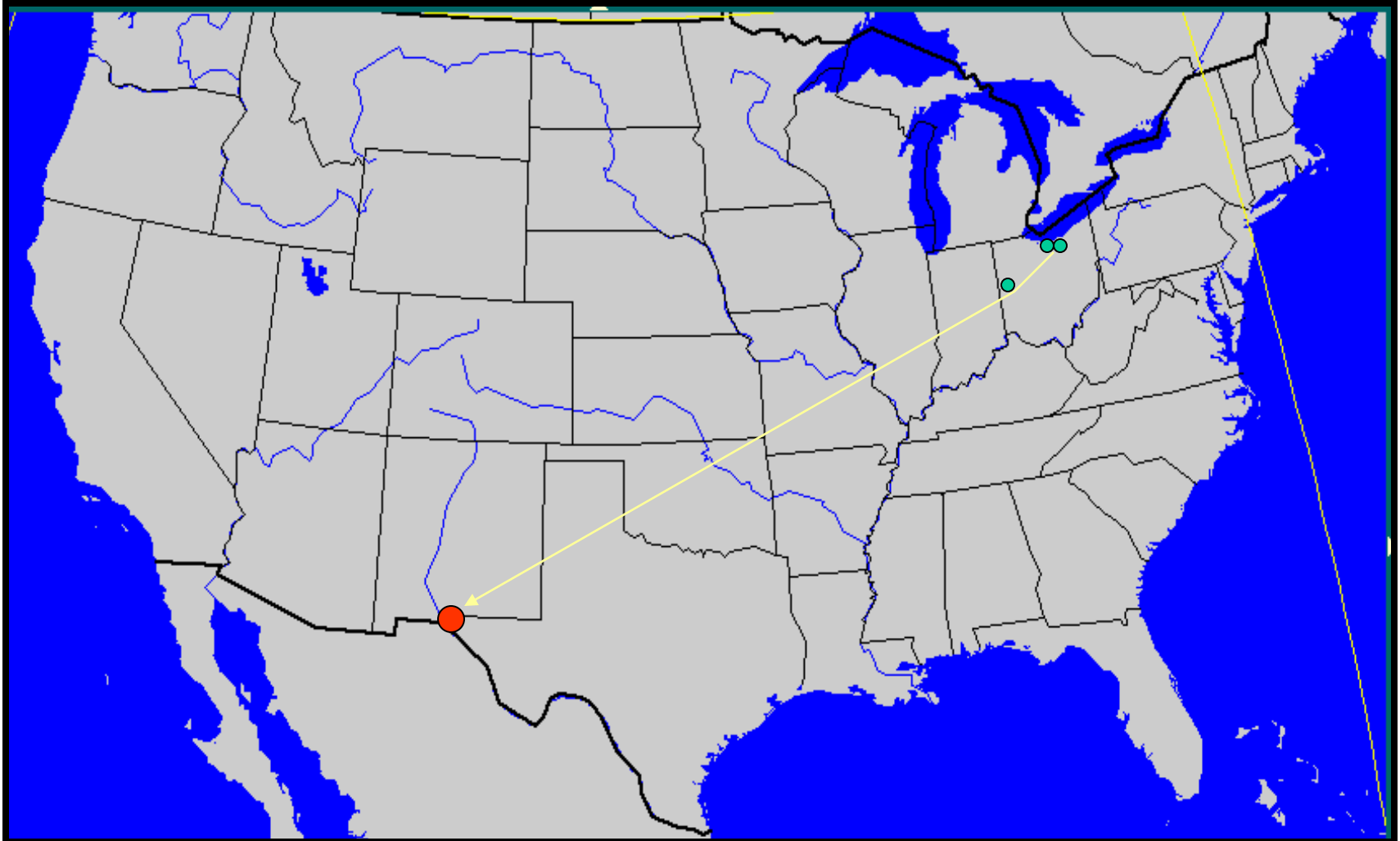
New Routes	Number of pallets	Cost per route **
1	36	\$412.00
2	12	\$655.82
3	19	\$524.83

Total pick up cost	\$1,592.65
Storage & handling	\$134.00
Cost for CIN-ELP	\$3,152.00
<b>Total Cost per week</b>	<b>\$4,878.65</b>

Savings =	<b>\$1,485.61</b>
% of savings =	<b>23.3%</b>

\*\* Keeping the original routes (Not Likely)

# Route: Cleveland-Brooklyn- Celina- El Paso



# Route: Blackstone-South Hill- El Paso



# Route: Grand Blanc-Archbold-Bowling Green





# Proposed: Consolidation of routes in Cincinnati



# Consolidation



# Coordination of inventory

- Currently the plant in Mexico and its counterpart in the US maintain independent inventories of the same product
- Sharing information to reduce inventory levels at both plants should be explored
- The coordination of inventory-transportation decisions between both plants should be explored
- The consolidation of both inventories should be explored
  - Vendor managed inventory
- Problem: How to set costs to be attractive to both Plants?

# Possible Implementation of Vendor Managed Inventory

- US Plant responsible of POC inventory under prearranged rules regarding minimum and maximum inventory and information sharing
- US Plant to manage inventory to seek the minimization of total costs of inventory, transportation as well as production leveling at their plant
- Implement an internal costing system that will encourage both parties to seek the overall optimization of the system

# VMI Formulas for Coordination

$$\min_{R_w, R_r, F} nC_w(R_w, R_r) + NF$$

$$s.t. C_r(R_w, R_r) - F \leq C_r^* - \frac{\gamma}{N} (N(C_r^* - C_r(R_w, R_r)) + C_w^* - C_w(R_w, R_r)),$$

$$C_w(R_w, R_r) + NF \leq C_w^*$$

- The optimal cost policy is dependant on the values of  $R_w$  and  $R_r$ .
- There is also a transfer between suppliers and customers of some of the benefits from the optimal policy, called: F
- As long as the firms are willing to share the benefits of VMI and they are willing to accept fixed transfer payments, all firms can be better off with VMI, and VMI coordinates the Supply Chain
- Cachon 2001

# Supply Chain Phases

<u>Day</u>	<u>Activities</u>
------------	-------------------

Monday	Receive firm releases from customers for next week shipments, together with an update of the forecast for the next 12 weeks.
Tuesday	Enter information from releases into Excel Worksheet that works as an MPS for the Plant.
Thursday	Planner gets a report on inventory of Finish goods on hand. Calculate the amount of production needed to accomplish customer requirements and also keep the safety stock at normal level. From the file “Management Inventory” Report the production program to the Production supervisors so they can schedule production for next week.
Friday	Upload the information from “Management Inventory” into the MRP system using it as the MPS.

# Supply Chain Phases

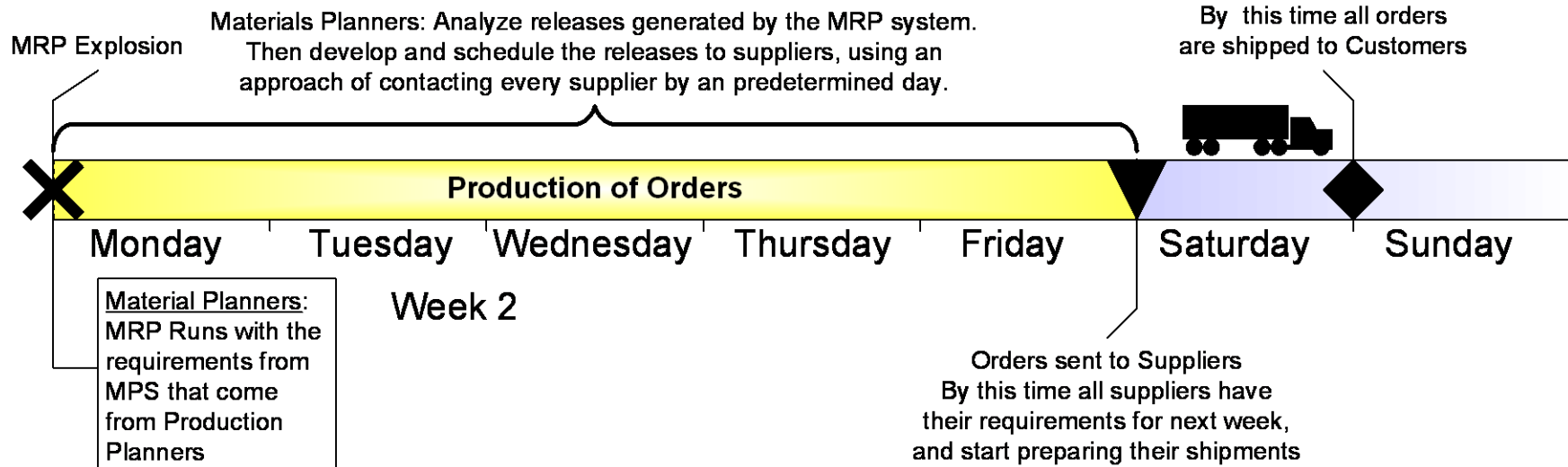
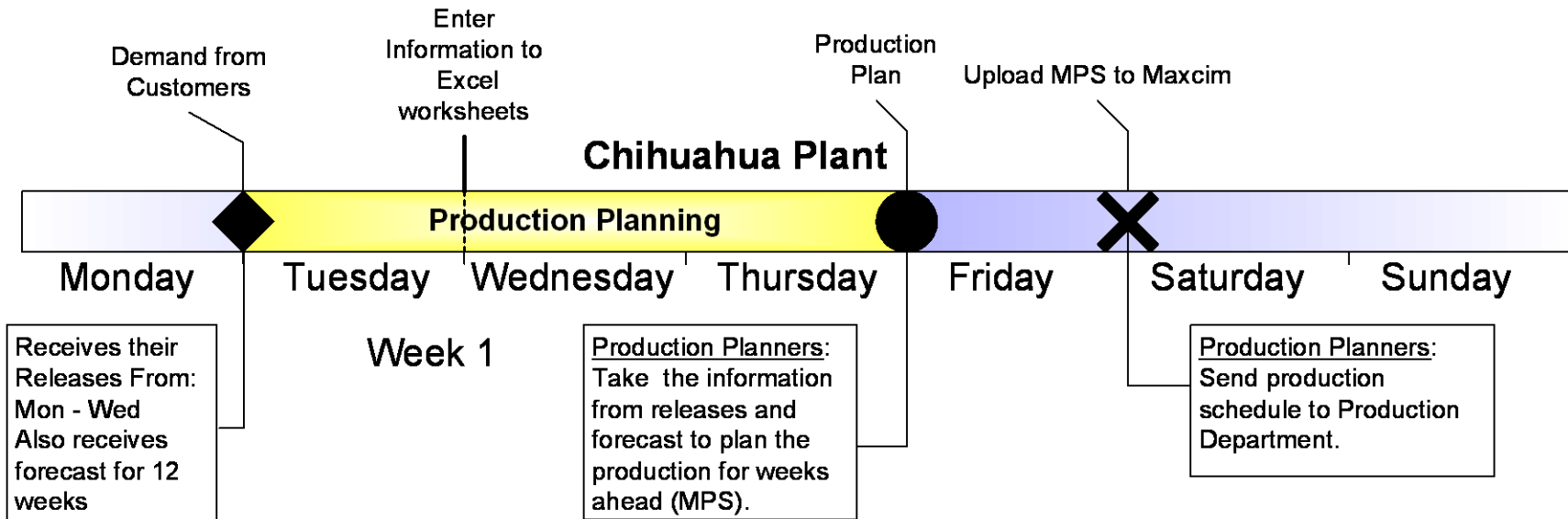
## Day      Activities

Monday      Run MRP system in the morning using the module BOM explosion for calculating the requirements, the information from order releases is the requirements from the week entered on Friday.

Along with the start of orders, the production of the customers requirements and shipment of these ones is also done during this week

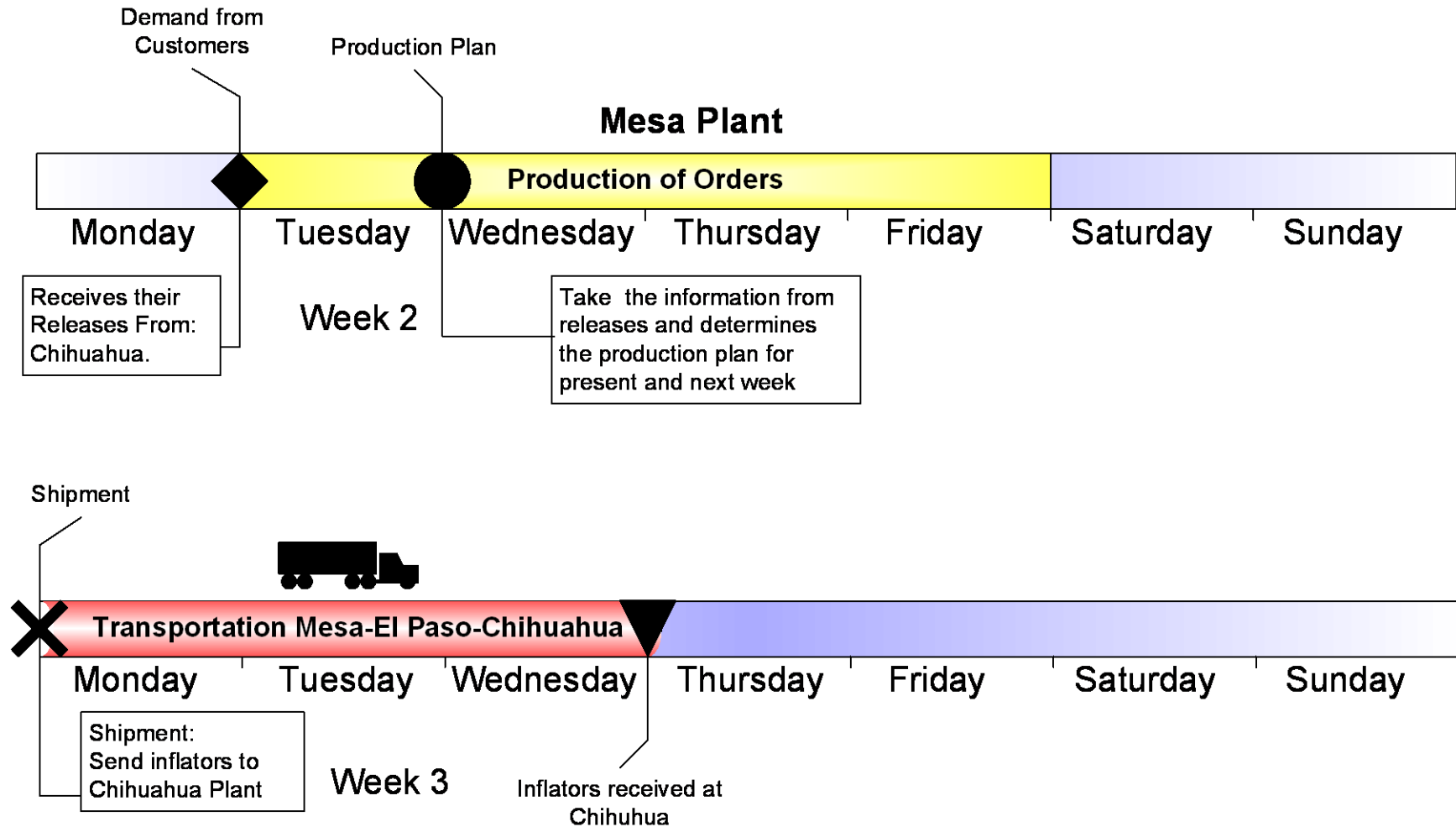
Tuesday-      After the planners get the information of the requirements from MRP, then they  
Friday      determine how much to order and when to schedule the shipment from suppliers.  
The suppliers are managed by different planners and they schedule the orders to each one of them on fixed days.

# Supply Chain Phases

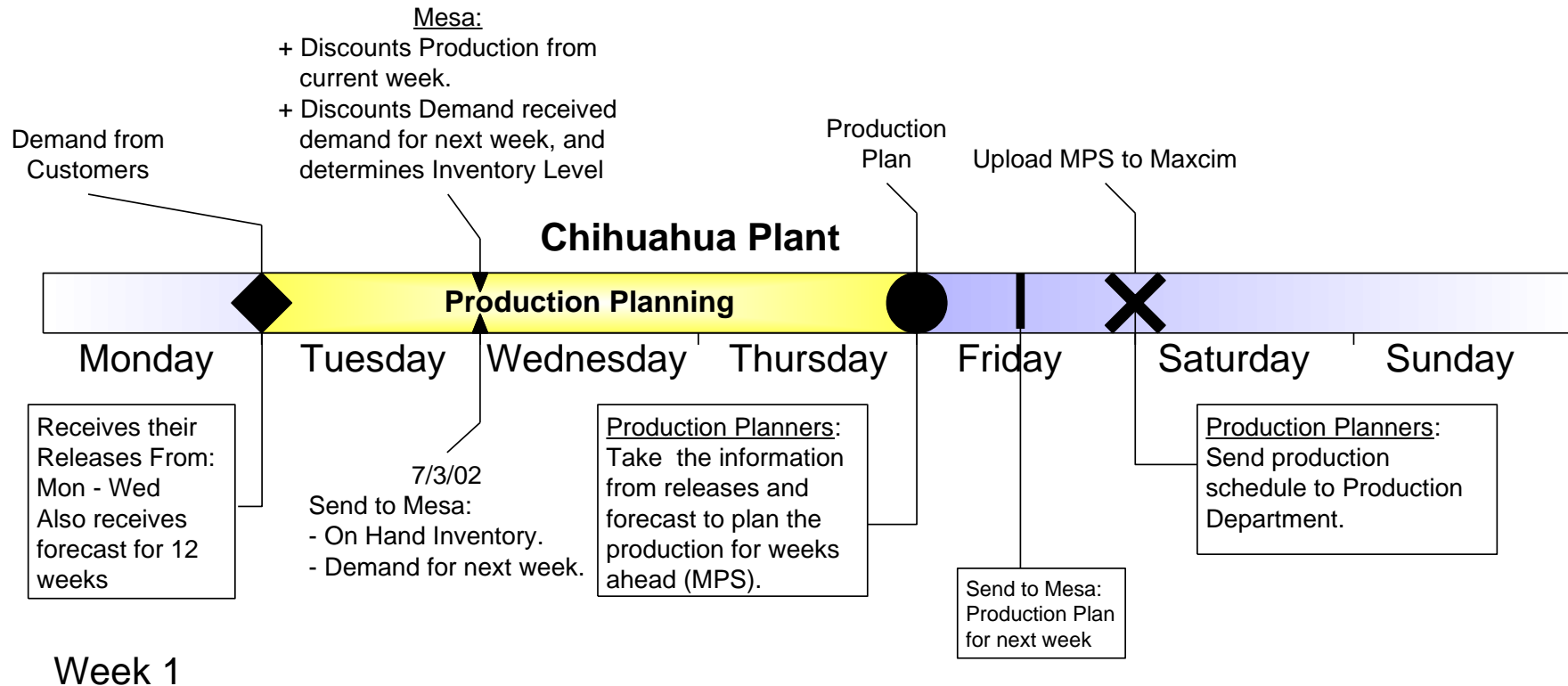




# Supply Chain Phases



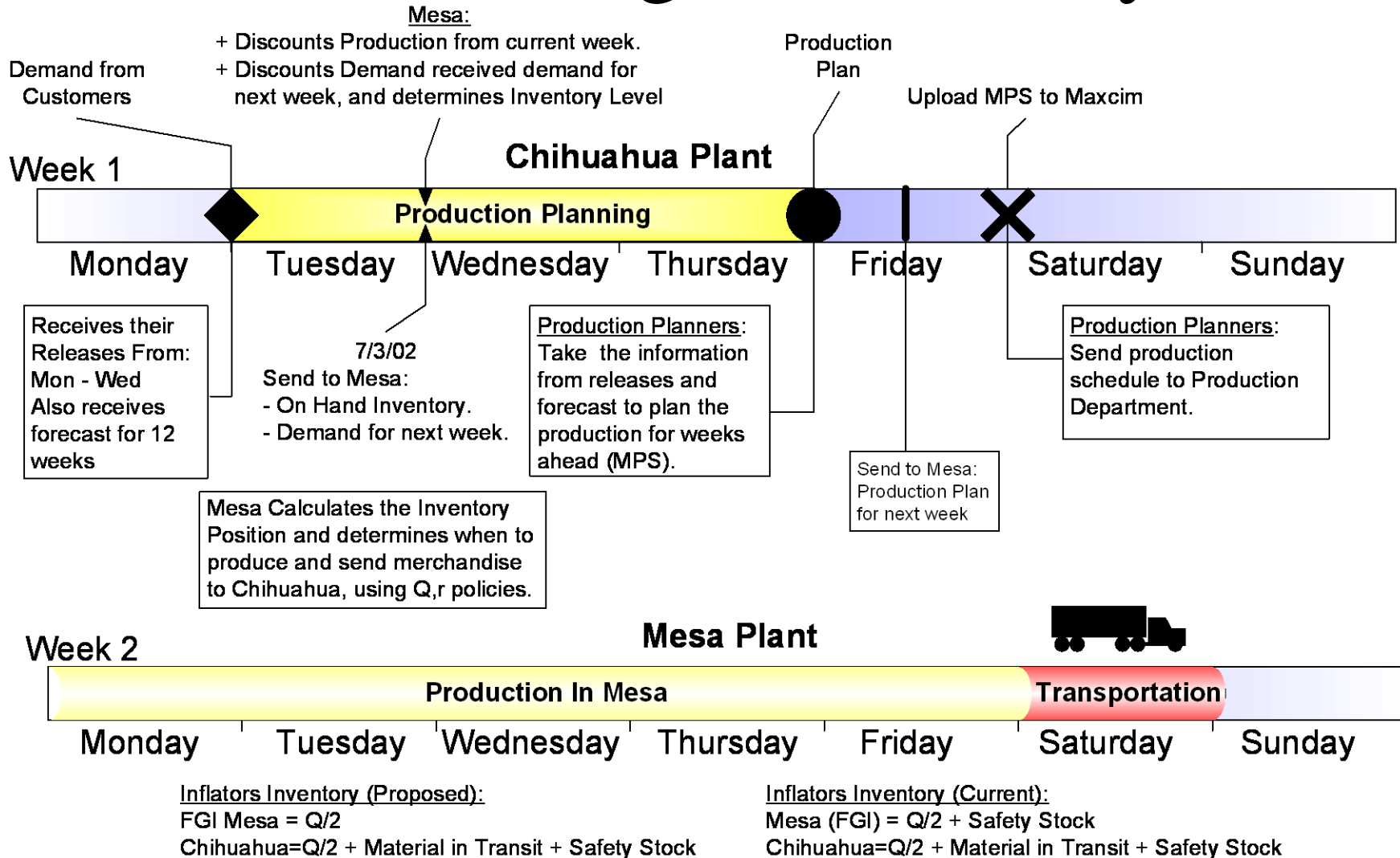
# Supply Chain Phases with Information Sharing



Week 1

Benefits: Mesa will have 2 weeks in advance the demand for shipments, also an expected reduction in variability, tending to reduce safety stock in both plants.

# Supply Chain Phases with Vendor Managed Inventory



# Areas of Opportunity

- Improvement of systems
- Integrated logistics decisions
- Coordination of inventories
- Improvement of transportation strategies
- Production scheduling decisions based on “historical” and experience with production. Can we take a look at how materials and production are influencing each other? What is their combined performance? Can it be improved?
- Both inventory and transportation costs seem to be a small portion of the total “added cost”. Setting metrics, efficiency goals and continuous benchmarking and improvement programs on the “labor burden” component of cost is recommended to strive for “overall” improvement of the supply chain

# Some Recommendations for improvement

- Increase truck utilization by:
  - modifying the current milk run routes
  - Modifying the frequency of ordering raw materials according to minimize total costs (or at least making the buyers aware of the cost implications of their ordering policies)
  - Consolidating orders from different buyers/companies
  - More collaboration/communication across Materials Departments from the plants
- Decrease total inventory by:
  - Revise current ordering policies to minimize the variability observed by Mesa
  - Reduce the information lag between plants
  - Sharing information between plants
  - Move to Vendor Managed Inventory

# Some problems common to Maquiladora Industry

- Bottlenecks caused by international crossing points
- Under performing transportation system
- Increased use of third party logistic companies
- Effective management of inventory
- Use of paradigms that might not apply to reality of maquiladoras
- Over reliance on low cost labor
- Lack of effective measures of performance

# Some Points

- The Mexican content of supplies is still very low (below 4%)
- The overwhelmingly majority of supplies for the maquiladoras still come from the USA and other countries → the maquiladoras usually keep their original supplier base when they move to Mexico
- As the maquiladora industry matures more plants have migrated to the interior of Mexico making the procurement and transportation of supplies both more complex and more important
- Very often the inbound supply chains for maquiladoras lack the sophistication to face the challenges of moving to border/interior of Mexico

# Conclusions

- When a plant (maquiladora or otherwise) is relocated to Mexico a careful look at the preexisting inbound (and outbound) supply chain practices should be taken
- The solutions that might have worked well for the original plant may not work well for the new plant, particularly if the new plant is located in the interior of Mexico
- Opportunities for improvement include better transportation practices, integrated inventory/transportation decisions, judicious use of third party companies, relocation and/or identification of new suppliers, better coordination throughout the supply chain