

## **THE CADILLAC DFM SUCCESS STORY**

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This is the Design for Manufacture (DFM) story of Cadillac Motor Car Division of General Motors Corporation (GMC). A company with one of the longest and proudest histories in the automotive world. The only car company to win the Malcolm Baldrige Award. A company whose name itself is the benchmark for luxury and quality. Cadillac is a company, like most others in America, that is trying to shake off the old Harvard cost accounting paradigms and explore new lean-build techniques that will take them to even greater heights.

### **Exploration**

Cadillac's leadership made the decision, in order to put all of Dr. Deming's quality and elimination of waste teachings into effect, they needed to explore DFM.

Cadillac was named after a French explorer. A man who risked his life to lead the way. Exploration is dangerous and few want to get involved. After all, there are many risks and no road maps to tell you the right way, but without explorers leading the way there would be no progress. Cadillac felt that they were the explorers to lead General Motors to higher productivity and profit.

Like any explorer on a quest, Cadillac found there are many paths to pick from. All paths look inviting and the one you pick initially may not always be the right one. But as Cadillac found out, if you persevere and work hard, back track when you make a mistake and shrug off the comments of the doubting masses, you will be rewarded in the end.

Initially, DFM was brought into Cadillac by two sources prior to Munro & Associates. One internal and the other an outside consultant. These both proved to be false paths that actually did more harm than good. In many companies, these two tries would have been "good enough" to end all that DFM stuff: so they could get back to the old way of doing business.

## **Chevrolet and Munro & Associates**

"Good enough, isn't good enough" at Cadillac. They had heard of the DFM successes at Chevrolet. By using the Munro & Associates DFM approach, Chevrolet-Pontiac-Canada group (CPC) had saved the Camaro / Firebird (F Car) program from, what Lloyd Reuss had called, "dying a natural death". The F Car was over cost, weight, budget, and too labor intensive to build. The car had been all but canned by the executive staff. This would have been another tragic write-off for GM, but after three months of intensive effort the platform was pulled from death row. The three T's, Tools, Training, and Time worked so well that soon other CPC car platforms were experiencing similar dramatic results. Pulling hundreds of millions of dollars out of tooling and capital equipment costs.

### **The Process**

The process Munro & Associates used at CPC was a very structured workshop... Although the Munro & Associates system works best at the concept stage, it was evident to Cadillac that anytime is the right time to do what's right".

"The first day consisted of the Munro philosophy of "seeing what everyone else has seen, but thinking differently than everyone else has thought". Unlike other DFM consulting firms only one "canned" example was used for analysis. Every future "analysis was product specific. The products and subsystems to be analyzed in the workshop were characterized by high warranty, high cost and/or labor intensity.

This was what the Cadillac management team was looking for.

### **Deming, Simultaneous Engineering & DFM**

Bob Dom, chief engineer, and Gary Cowger manufacturing manager, had worked together to bring simultaneous engineering into Cadillac. Their teams of product design engineers, manufacturing engineers, hourly rated, purchasing, financial, and service were in place as a result of these efforts. The Deming philosophy was very strong, and Bob and Gary believed that quality and Cadillac had to be synonymous. Their unified commitment to Cadillac lead them to Munro &, Associates as their DFM consultants to review the newly restyled Eldorado and Seville.

Although the new Eldorado and Seville looked good, Bob and Gary wanted these cars to build easily with a quality level that can only be designed in. They had seen the Munro & Associates "Shadow Chart"

that states 5% of the product cost, influences 700A. Of the quality, manufacturability, serviceability and general acceptance in the market place. They felt that if they did a good job designing for DFM principles, the customers and profitability would come.

The one thing they were sure of was that the old paradigms were going to be the biggest road blocks to getting the job done right. To give this new paradigm a fair chance they would have to get involved personally and show they were committed and not just making a management contribution to the "program of the month".

## **Procedure**

### Step One: Profound Knowledge

Bob and Gary took the training from Munro & Associates themselves. Not a one hour Executive overview but two days of intensive training. They supplemented this by taking several benchmarking trips to successful DFM companies and finally making the pilgrimages to various DFM seminars.

They listened to "the wise"; those who had gone through the metamorphoses and received the information first hand as to what worked and to what did not. Then they formulated their vision. The manufacturing driven plan that lead to success.

### Step Two: Vision and Organization

Bob and Gary presented their subordinate managers with the vision to drive the process. As Deming says, "Everyone doing their best is not the answer; first it's necessary that people know what it is they are to do". The plan that Gary and Bob presented wasn't a "best guess", but a tried and true recipe that Munro & Associates had used with dozens of other clients. The process is a detailed strategy that empowers the multi-functional teams to think differently. It allows for a "take action" approach on the good DFM ideas. However, the leadership knew that with two false starts, DFM was going to be a tough sell. They needed a success story.

The leadership team decided to run a test case workshop of forty engineers who had taken training from the two prior sources. These were engineers who did not believe the process worked on cars and felt the two previous consultants were "smoke and mirrors" specialists. They supplemented the forty individuals with an additional ten people from areas such as purchasing, finance, and of course, the hourly rated. The participants were jammed into a conference room that was

too small, too cold and told to work on designs that everyone thought had been a "done deal".

To say the least, this was a tough crowd. The first two days of training were almost non-stop arguing and contradicting. The third day was disquieting apprehension. But in the last two days, the room was vibrating with an almost lost commodity, "American Ingenuity". Cadillac got their success stories and I got my converts. The participants were charged and ready to see if management\_would "walk like they talked".

### Step Three: Management Support

The worst thing that can happen to a company trying to implement DFM is to have upper management not show up at the report-outs on the last day. If management does not show it tells those who worked on the projects that it was just a "check-in-the-box". A fad to amuse the troops while they went on with "business as usual".

At Cadillac the leadership did show-up. They showed up at every workshop, in force. Not to just sit politely and listen, but to volunteer to take on the tough assignment of DFM management champions. Their task was to remove obstacles that got in the way of idea implementation. These jobs were, in many ways, tougher than the engineering work because it involved the shifting of both technical and financial paradigms. This was definitely not business as usual.

The results from subsequent Cadillac workshops (two weeks per month for three years) caught top management attention. J.T. Battenburg, vice president of Buick-Oldsmobile-Cadillac (BOC) was also the GM corporate DFM champion. He and Gary Cowger arranged to have a half day DFM awareness session for the top eighteen executives at GM. They were so impressed that they directed the top 200 executives to also attend.

### **The Wrap-up Format**

Every session facilitated by Munro & Associates ends the same way, with what we refer to as a report-out session. During the report-outs, the existing design, which has been benchmarked with an assembly diagram is reviewed with management\_so they know where the teams started. The teams then report final analysis results utilizing three levels of technology risk:

Low level risk: These ideas can be implemented almost immediately. The technology is not new to the product market and all team members feel comfortable that, with minimal testing and validation,

the ideas can be incorporated.

Medium risk: The medium risk idea takes some greater amount of research. It may be a technology utilized by another industry or a combination of materials and processes unfamiliar to the team. This level can sometimes produce patentable ideas and is the most likely level to be implemented.

Stretch: Ideas in this level require experimentation, research, testing and validation. They are ideas that are on the edge of a new paradigm and in some cases thrust their companies to the forefront of their businesses. Almost always patentable. These ideas are the ones which have the potential to leap frog past the competition.

Through the use of this idea migration, a Bob Dam sponsored BFM engineering fund, and the help of management to remove traditional American road blocks, a very high percentage of medium risk ideas were successfully implemented into the 1992 Eldorado and Seville. They turned out to be the right thing to do from both a DFM and business stand point.

## **Success Stories**

### Shifter Console Assembly

In the first Cadillac DFM session taught there were eleven very hard sells (fig. 1 team members). These people were members of the PDIT in charge of the 1992 EK (Seville Eldorado) mini and full console; they had bigger fish to fly than wasting their time at another DFM class. They had heard this song twice already and were convinced it was more "B.S.; I love you" from management.

The most vocal of the team was Karen Goff: manufacturing engineer and chairperson of the PDIT. She felt that since the product was classified as a "no-build" by the plant, the team would be better utilized working on a "clever process to get around" the design. "Let's get real here," she said "we aren't going to stop the program to redesign this thing, we're late already!" Her point of reference was the existing console on the newly introduced Oldsmobile Trofeo. This job was a nightmare for the floor personnel to build. It was so difficult that it stopped the line on a regular basis. Dealers who had orders for the car were hopping mad at how long it took to fill an order. Alan Papke hourly VOA (voice of assembler) ~hoed Karen's complaint.

"Nobody did anything about the Olds. It's always the same, they always blame the guys on the line. We're supposed to be the ones that are screwing up! Its BULL. I'd like to see some of those big shots try to do a better job".

These types of reactions are not unique to this group. This is typical of the frustration level encountered in any company, no matter if it's pharmaceutical, aerospace, appliance, machine tool or automotive. They are all bound by the mistaken belief that time charts should take the place of good engineering. This paradigm is one of the toughest to alter, but Gary Cowger and Bob Dam wanted the teams to know they did not want the Eldorado and Seville to suffer like the Olds. So ami4 all the "we can't do that", they did.

The initial design (shown in fig. 2 & 3) was and still is at OM and most everywhere typical of a full console build. The shifter was bolted to the tunnel, the console was bolted to the instrument panel and tunnel. Then the PRNDL cover was insta11~ and all the cables and wires were hooked lip. The PRNDI" was adjusted. The rear cover attached, trim pieces added. The parts were given a functional check and the final PRNDL adjust was made. Sounds easy, and it would have been, if they could have only found an operator with thin fingers three feet long.

Thankfully personnel didn't have to find that operator.

The new design (fig. 4) was the instrument of change. It changed the attitudes of the participants, made it easy for the plant to build a top Quality product, and it proved that up front teamwork can cut on floor de-bug time to zero. The features incorporated into the new design were:

- Shifter as part of the console assembly.
  - This idea improved build ability (IP to floor).
  - Locking tab locating shifter to console improved Quality off it (net build) and reduced parts and labor.
- End cap as Part of Console
  - Eliminated tough assembly build and improves appearance.
- PRNDL Plate to Shifter
  - Improved build ability with snap fit net build (no threaded fasteners no adjusting).
  - Better serviceability for bulb replacement.
- Console Attach to IP
  - Net locating pins built in.
  - Eliminated two difficult angled threaded fasteners.
  - Improved appearance and easier build.

- Stowage Bin
  - Improved part handling (eliminates damage)
  - Snap-in design also serves as a seal off for HVAC duct.
- Radio Trim Bezel and Seat / Lumbar Switches
  - Skin-lock snap in design improved looks and eliminated screws that could cause damage during run down.
- Shifter / Park Lock Cables
  - Connects to shifter already in console with snap-in features.
- HVAC Rear Duet System
  - Snaps in with 1/4 turn features

These ideas and many more allowed Cadillac to reduce the time by 400A., the number of parts by 33%, and the piece cost by 12%, but more importantly it changed eleven team member's way of doing future business and proved that management-was serious about DFM.

### **Cadillac Bumper System:**

Dave Adams, release engineer for the bumper systems, by his own admission is a loose cannon. When he embraced the DFM philosophy, it was whole hearted and with a passion that provided one of the two most exciting presentations for the top eighteen executives. His team had one extra important element of the company represented, styling. These folks are not usually consulted because, "they never listen anyway". Dave brought in styling and asked them to change the clays to facilitate DFM ideas. They "listened" to what he had to say, and then complied breaking yet another paradigm.

His team's ideas, (shown on fig. 5) dropped the time by 56%, the number of parts by 500A» and the piece cost by \$50.00. The use of net build techniques (NO SHIMS), a single bolt attachment to the EA shocks, and extensive use of snap fits made this the easiest bumper build in General Motors, perhaps in the industry. This system also has several pending patents.

### **1992 SLA Suspension:**

The new SLA suspension system design team for the Seville, Eldorado and Allante was headed up by Jim Casey. The team devised many new innovative DFA and DFM ideas as shown on figures 6 -12. These were the type of small successes we had come to expect out of the DFM sessions. These types of results added up to some very impressive numbers when totaled (shown on fig. 13). Two million dollars here, two million dollars there, and soon you've got some real money. However, in order to make money you have to invest in capital

equipment and this is where problems start to occur. Facilities and tooling funding was scarce, so Jim decided to DFM the machine tool to see if we could bring the cost down.

The facilities team included the same people as on the .SLA suspension team plus the machine tool vender and toolmakers from the plant. We started on a macro scale and immediately eliminated the float. I felt that the float gave no advantage to the assembly line. I was right and they chopped \$600,000 from the purchase price. The team then went on to analyze the pallets and all the work stations (fig. 14 & 15). The final results (fig. 16) reflect the new configuration; a savings of \$1.2 million in facilities.

Individually each of these achievements is a great success story, easily enough information for a technical paper. Collectively they are an outstanding successes that has turned the heads of the buying public around the world. Cadillac Seville is the Motor Trend "Car of the Year", Car & Driver voted it one of the "Top Ten", and Automobile magazine honored it with "Car of the Year". That's the auto industry triple crown and no car company has ever won all three before. From Germany to Japan the orders for this car make it a true American success. The biggest problem right now, they can't make enough.

Cadillac's pursuit of perfection is still going on. The Quality is reflected in the DFM changes they made on the 1992 Seville and Eldorado and the commitment to Deming's never ending cycle of improvement. Many subtle DFM changes have been made to the product after launch on subsystems that we had no time for during the design phase. There is a workforce committed to quality at the Detroit Hamtramck plant and the VOA (voice of the assembler) is clearly heard.

Gary Cowger and Bob Dam were right in 1988. They knew the car was a winner and DFM was one of the right tools to invest in. We at Munro & Associates are happy and proud to be associated with the Cadillac Eldorado and Seville success story.

**CAD. - 1992 EK FULL & MINI CONSOLES  
DFM/PDIT TEAM MEMBERS**

**KAREN GOFF - CHAIRPERSON / MFG. ENG.**

**BRIAN SCHLUETER - RELEASE ENGR.**

**KIM BRYCE - PURCHASING**

**ALAN PAPKE - DET/HAM VOA (VOICE OF ASSEMBLER)**

**CHET SIEMBOR - VALIDATION**

**GERRY HUBER - SALES ENGINEER/DAVIDSON**

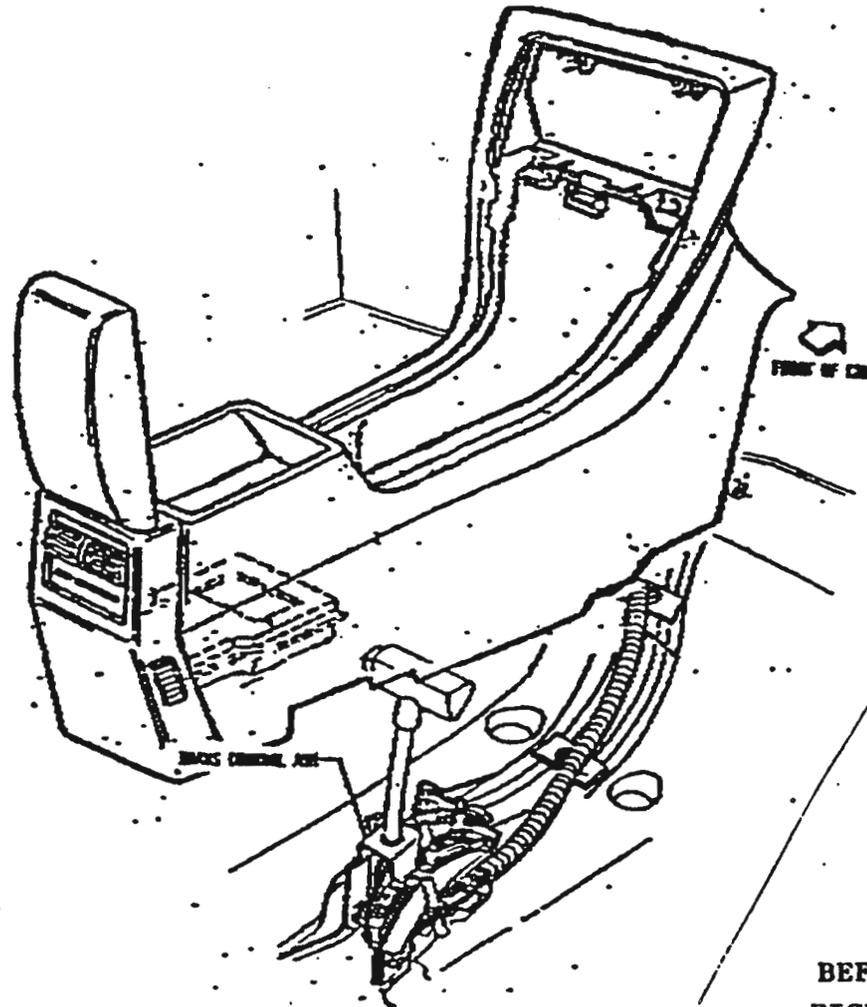
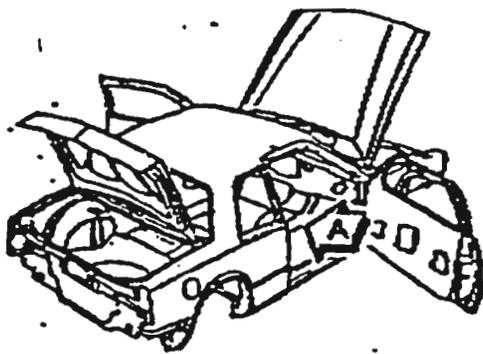
**CHUCK POE - EK CONSOLE ENGR/DAVIDSON**

**LARRY EDSON - VALIDATION TEST**

**RANDY ALLISON - CUSTOMER SATISFACTION**

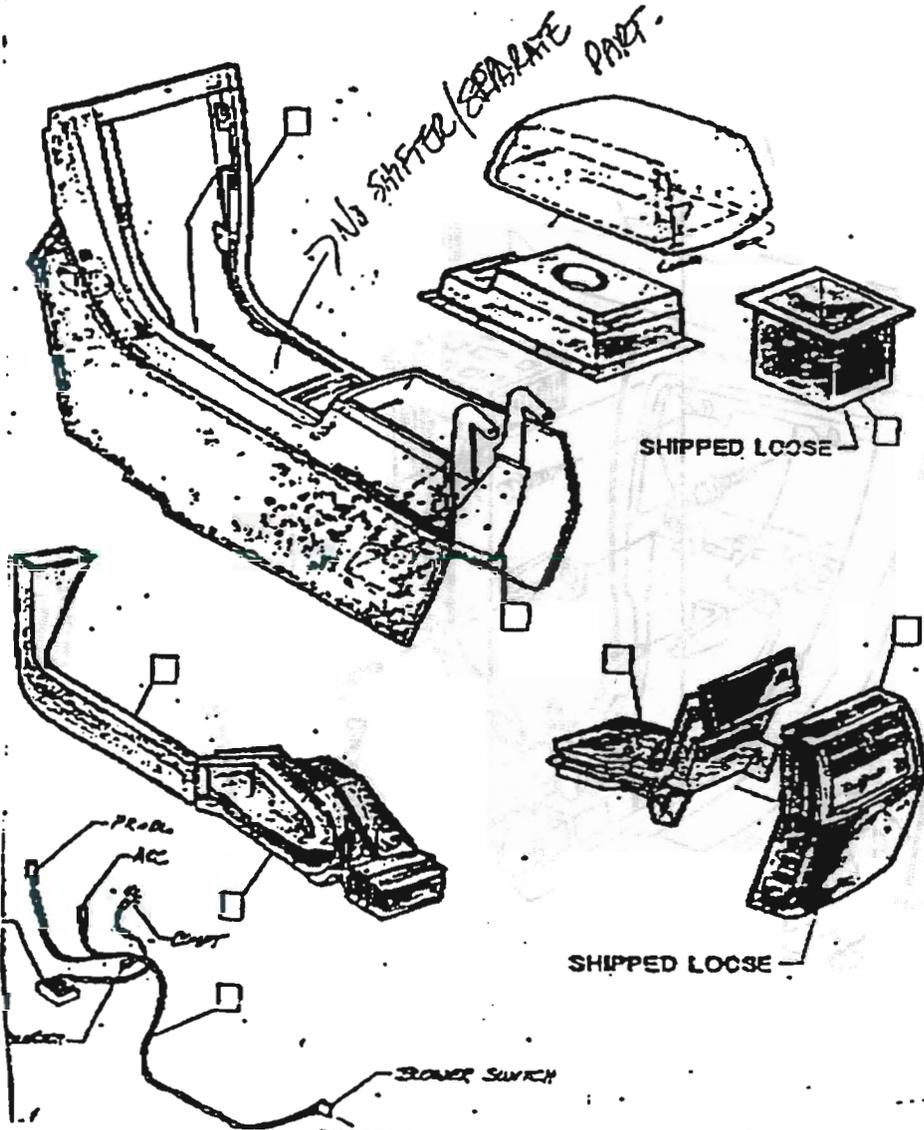
**JERRY SCHMIDT - DESIGNER - CADILLAC**

**JEANNE TAYLOR - FINANCIAL - CADILLAC**



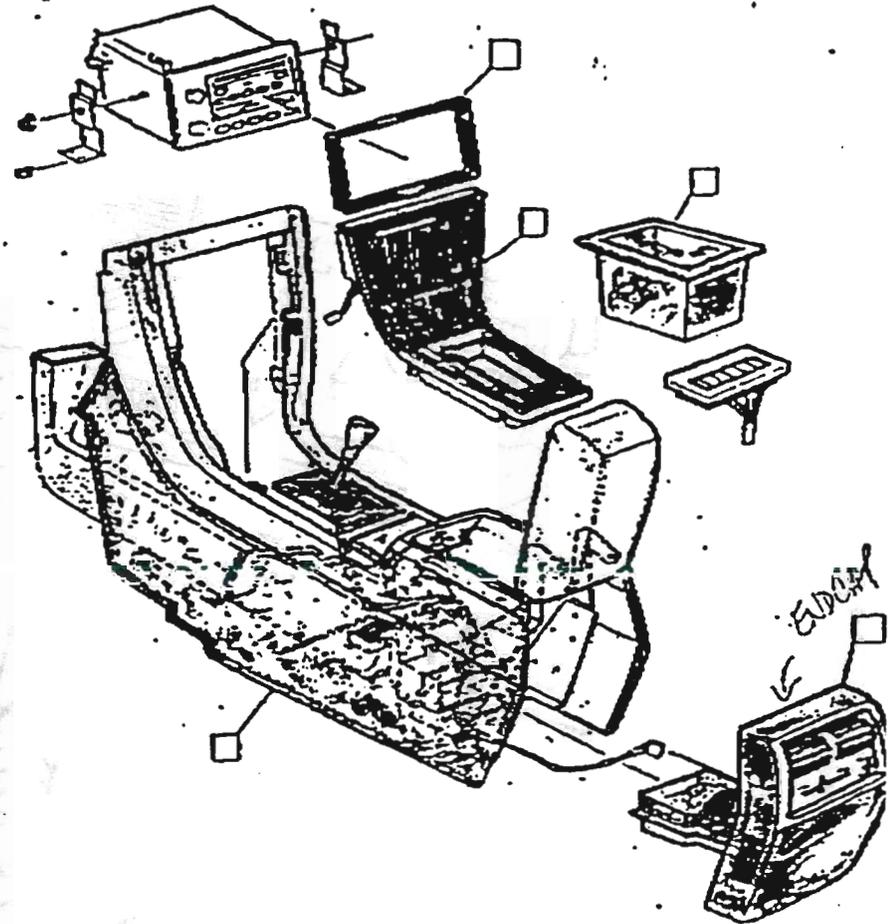
BEFORE  
FIGURE 2

**1992 CADILLAC E/K  
P.O.A. VENDOR ASM**



**"FULL CONSOLE"**

**FINAL CAR ASM**



**BEFORE  
FIGURE 3**

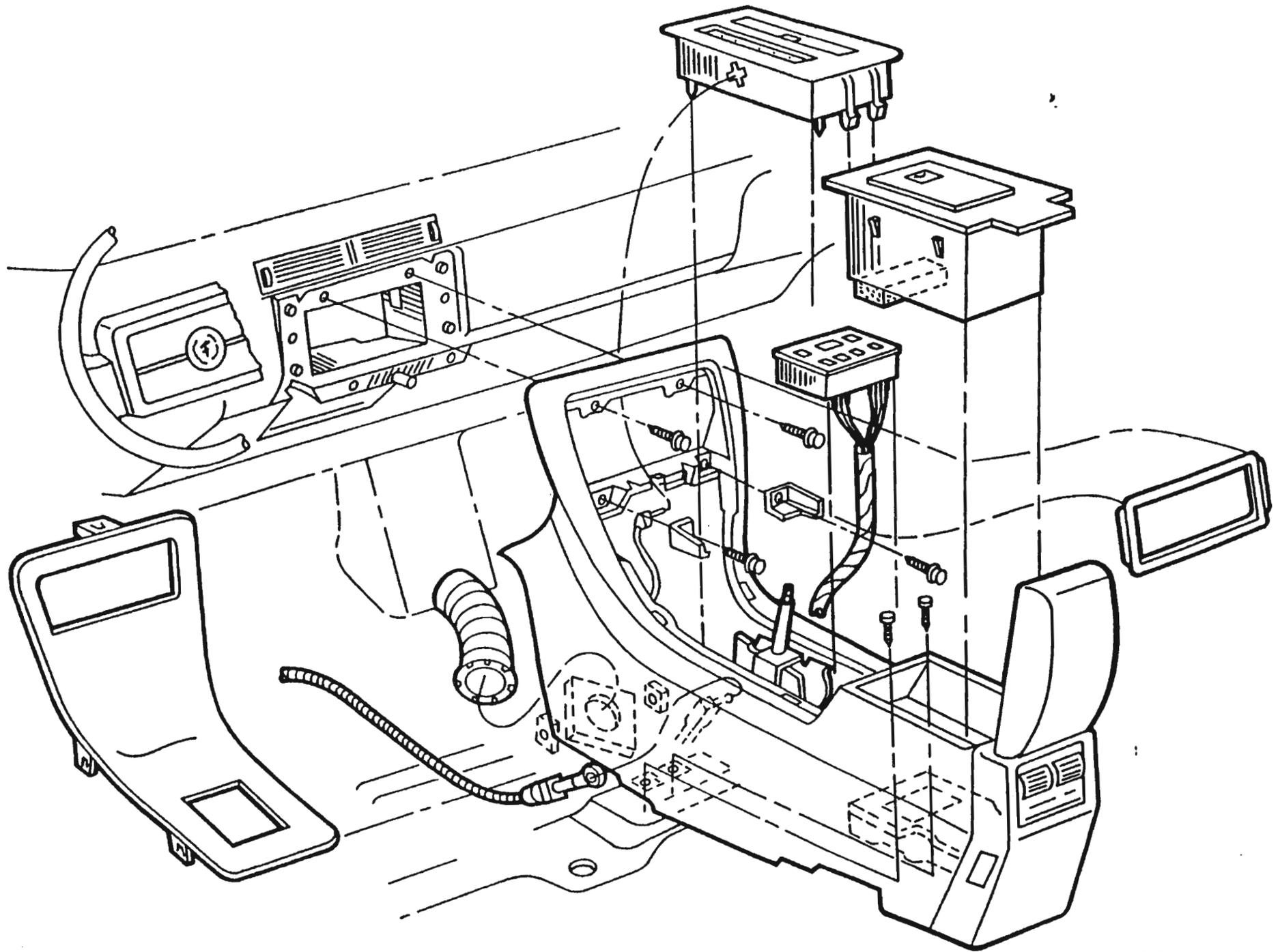
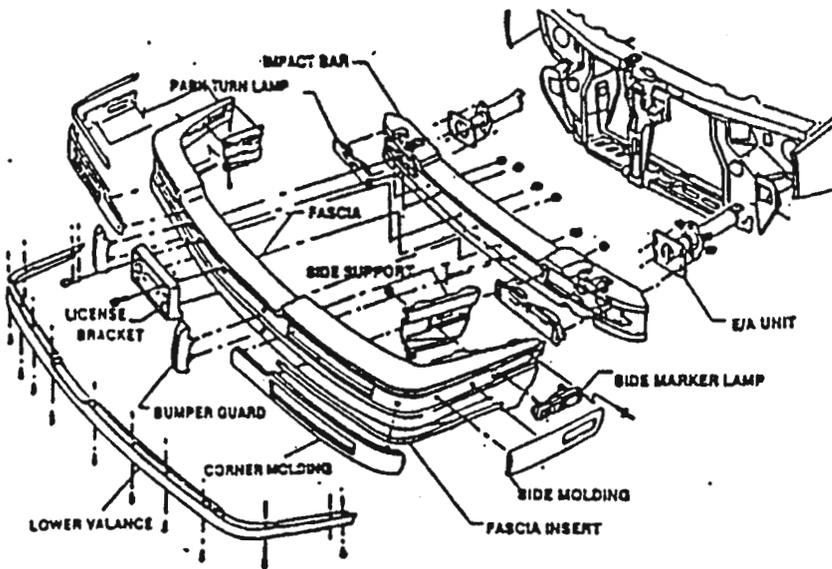


FIGURE 4

<b>CADILLAC FULL CONSOLE DFA</b>				
<b>ORIGINAL DESIGN</b>	<b>DFA DESIGN</b>	<b>△ TIME</b>	<b>% IMPROVED</b>	<b>PART REDUCTION</b>
<b>3590 SEC</b>	<b>2300 SEC</b>	<b>1290 SEC</b>	<b>40 %</b>	<b>33 %</b>

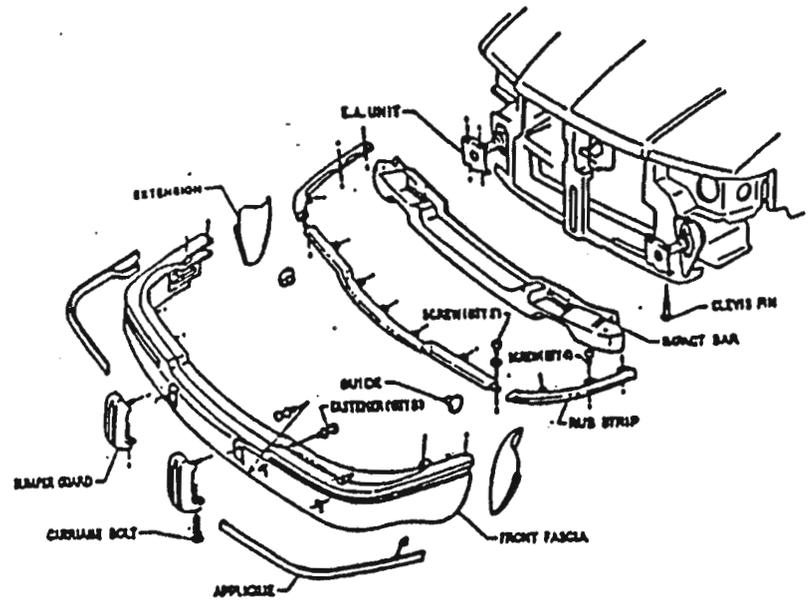
**FIGURE 5**

# DESIGN FOR MANUFACTURABILITY SEVILLE FRONT BUMPER SYSTEM



## CURRENT

- NUMBER OF PARTS = 124
- ASSEMBLY TIME = 15.31 MINUTES



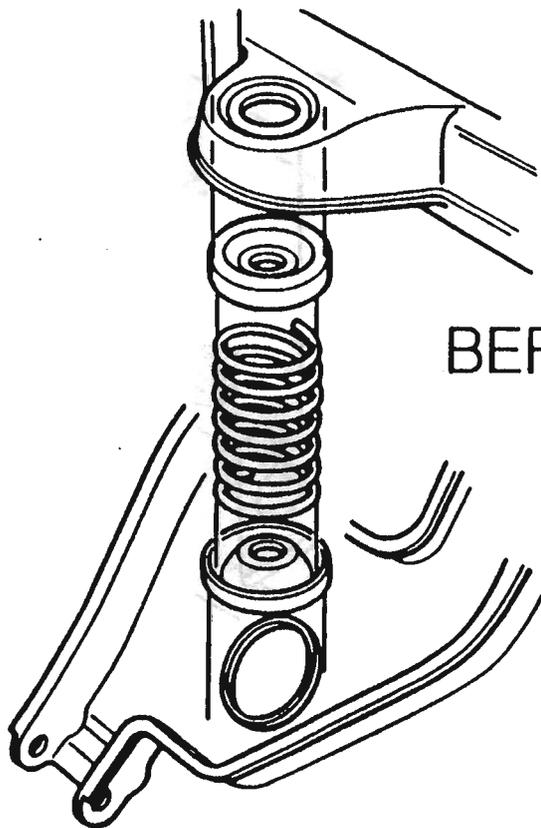
## 1992

- NUMBER OF PARTS = 63
- ASSEMBLY TIME = .68 MINUTES (56% REDUCTION)
- EST. ANNUAL LABOR SAVINGS = \$417,000 (ELDORADO AND SEVILLE)

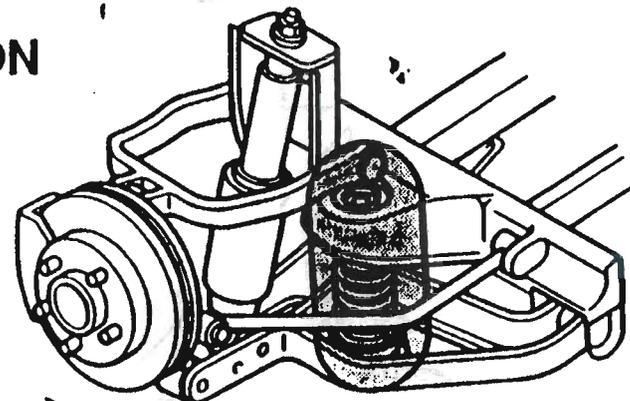
FIGURE 6

# 1992 1/2 SLA DFM ENHANCEMENTS

## SPRING INSTALLATION



BEFORE



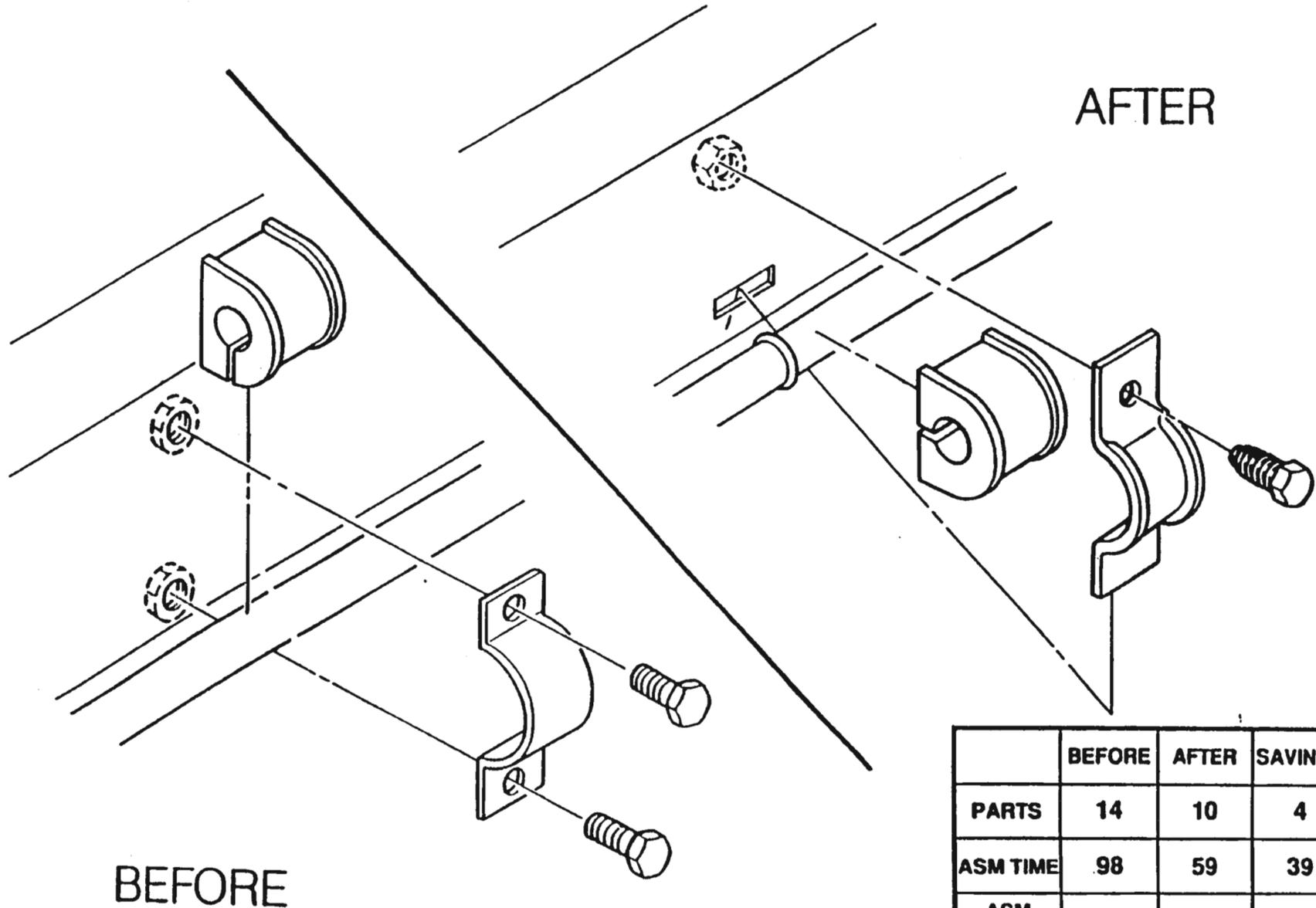
AFTER

	BEFORE	AFTER	SAVINGS
PARTS	6	6	0
ASM TIME	52	32	20
ASM COST	.60	.36	.24

FIGURE 7

# 1992 1/2 SLA DFM ENHANCEMENTS

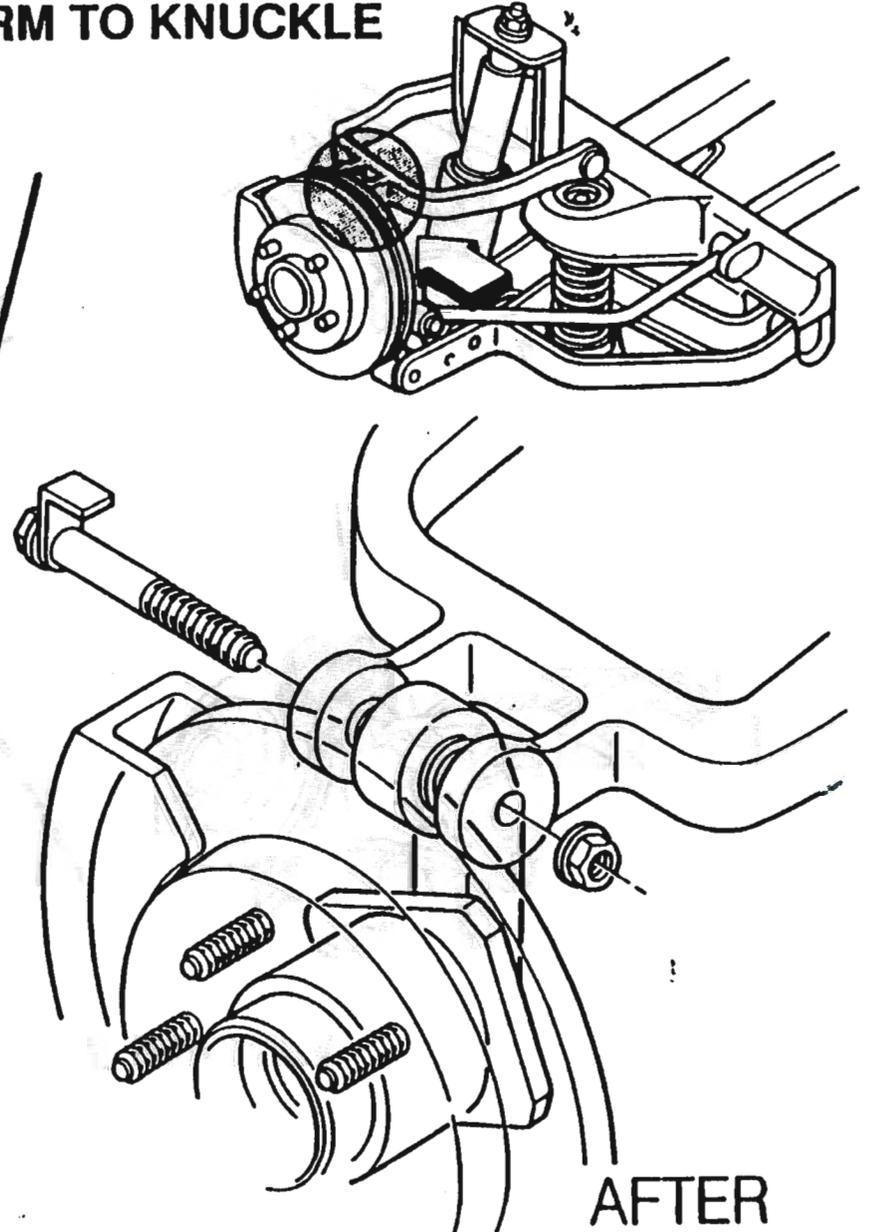
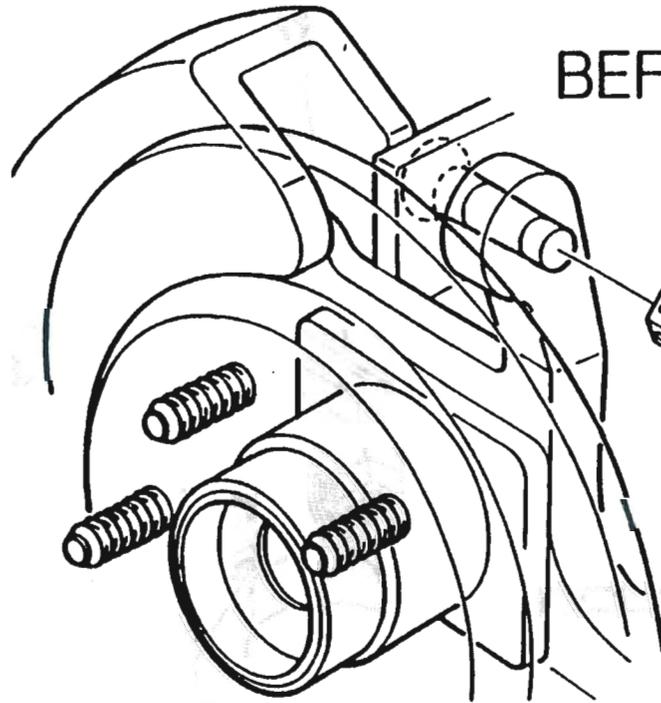
## STABILIZER BAR TO SUPPORT ATTACHMENT



	BEFORE	AFTER	SAVINGS
<b>PARTS</b>	14	10	4
<b>ASM TIME</b>	98	59	39
<b>ASM COST</b>	1.14	.69	.45

# 1992 1/2 SLA DFM ENHANCEMENTS

## UPPER CONTROL ARM TO KNUCKLE

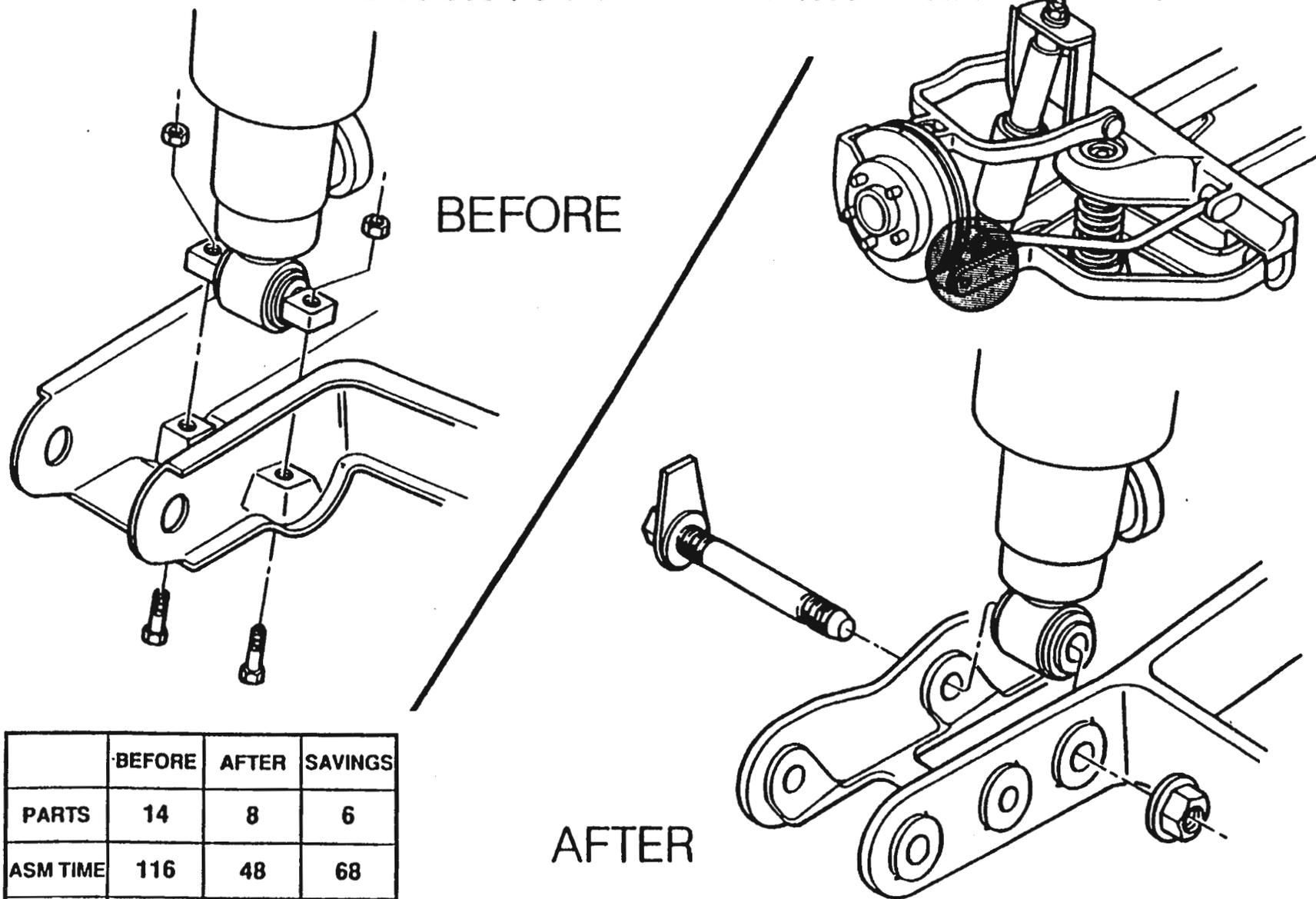


	BEFORE	AFTER	SAVINGS
PARTS	8	8	0
ASM TIME	164	42	122
ASM COST	1.90	.50	1.40

FIGURE 9

# 1992 1/2 SLA DFM ENHANCEMENTS

## SHOCK TO LOWER CONTROL ARM

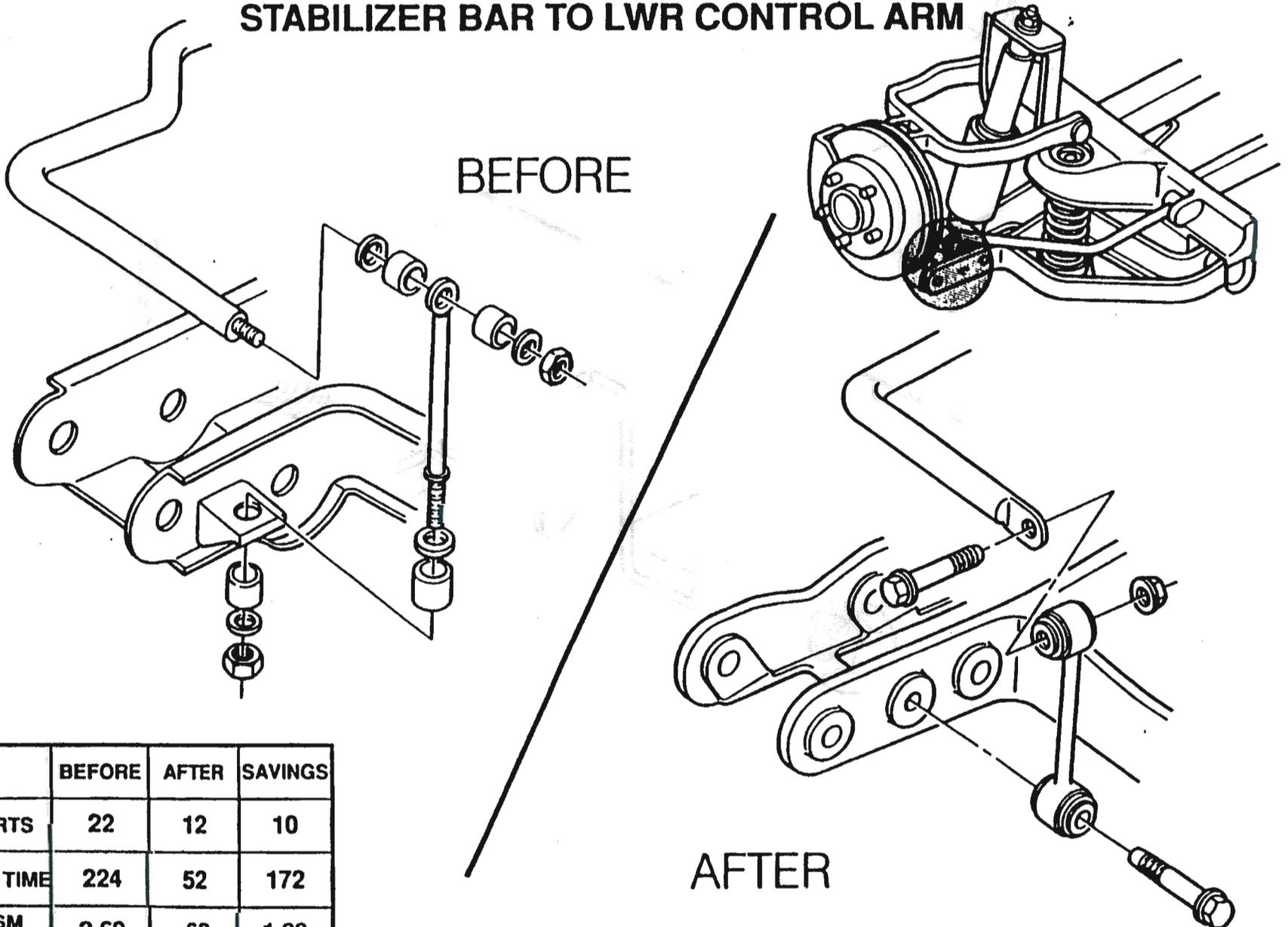


	BEFORE	AFTER	SAVINGS
PARTS	14	8	6
ASM TIME	116	48	68
ASM COST	1.34	.56	.78

FIGURE 10

# 1992 1/2 SLA DFM ENHANCEMENTS

## STABILIZER BAR TO LWR CONTROL ARM



	BEFORE	AFTER	SAVINGS
PARTS	22	12	10
ASM TIME	224	52	172
ASM COST	2.60	.62	1.98

FIGURE 11

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## 1992 1/2 SLA DFM ENHANCEMENTS

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### ANTI-ROTATION TAB

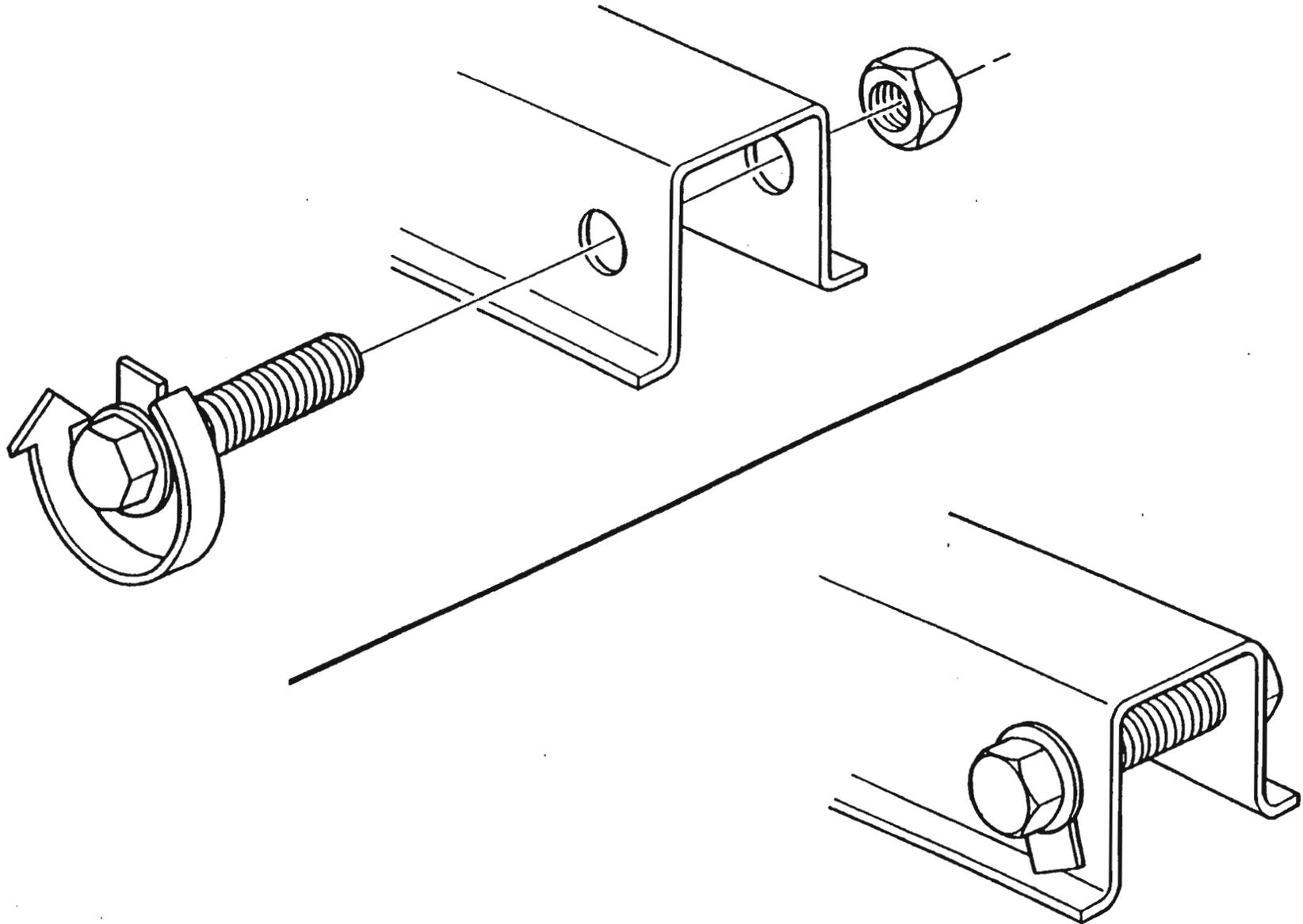


FIGURE 12

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## 1992 1/2 SLA DFM ENHANCEMENTS

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### SUMMARY

	BEFORE	AFTER	SAVINGS
PARTS	110	60	50
ASM TIME	1122	324	798
ASM COST	13.08	3.79	9.29

$$\text{YEARLY SAVINGS} = \$9.29/\text{UNIT} \times 225,000 \frac{\text{UNITS}}{\text{YR}} = \$2,090,250.$$

# SLA MACHINE DFM: MACRO

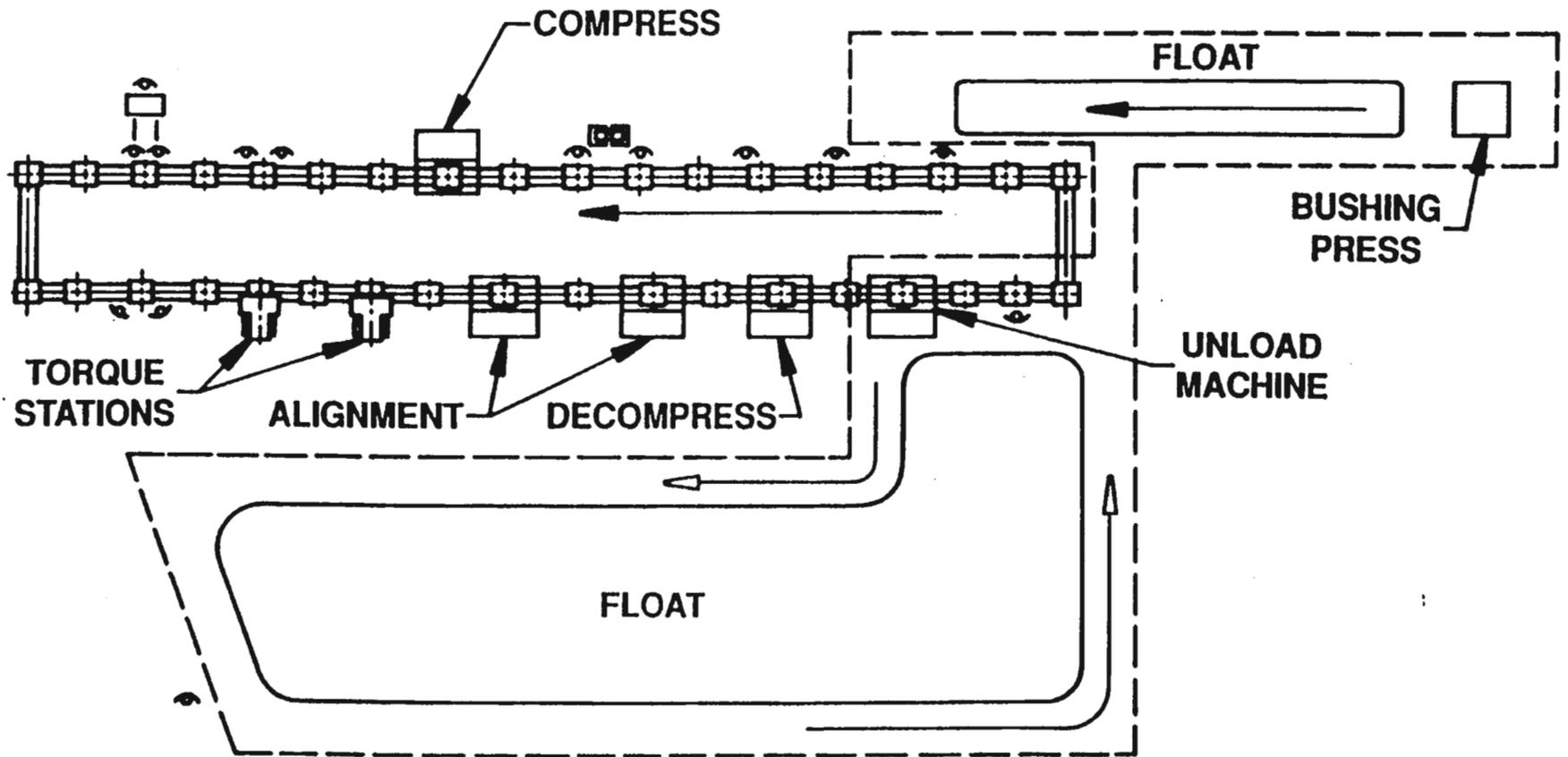


FIGURE 14

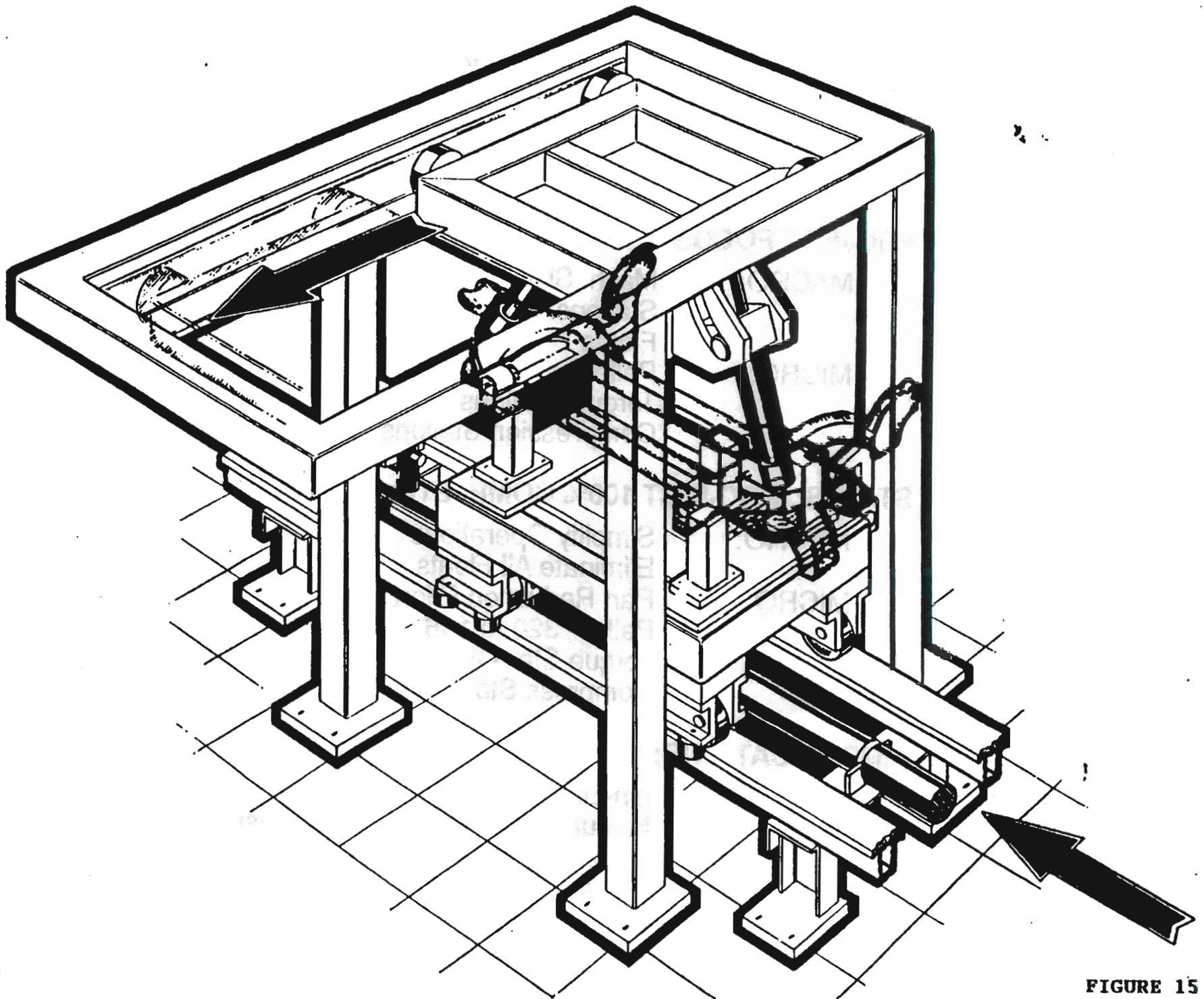


FIGURE 15

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# 1992 1/2 SLA DFM ENHANCEMENTS

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## SLA MACHINE DFM PROJECT

### PROJECT FOCUS:

MACRO: Mach. Size  
Stations  
Floats  
MICRO: Pallets  
Torque Stations  
Compression Stations

### STATUS: PROJECT 100% COMPLETE:

MACRO: Simplify Operations  
Eliminate All Floats  
MICRO: Part Reduction Effort  
Pallet - 320 to 146  
Torque Sta. - 260 to 220  
Compress Sta. - 415 to 300

### SIMPLIFICATIONS:

On-Line Hand Held Bushing Press Tool  
Manual Unload of Complete Suspension  
Wobble Spindles on Nutrunners  
Quick Change Nutrunners