5-2 Metal Works

5-2-1 Organization and Personnel Assignment

1) Organization

The metal working for seat frames is performed by the Bus I Division. The painting process of frames is under the control of the Bus I Division. However, the painting equipment is located in the building of the Bus II Division across the street. Figure 5-2-1 shows the organization chart of the Bus I Division.

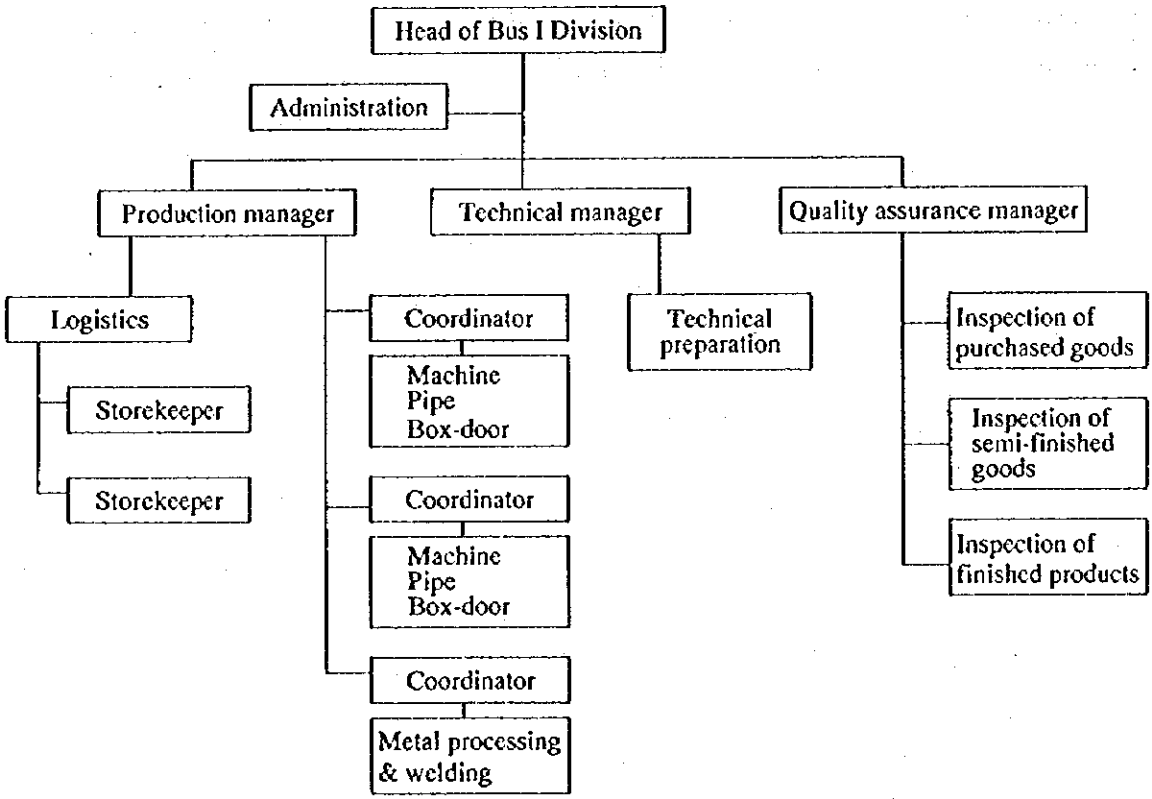


Figure 5-2-1 Organization Chart of the Bus I Division

The processing of frames is carried out by the following groups:

Cutting, press working, and pipe bending: Sheet metal working group
Welding of seat frames for buses and railway vehicles: Welding group
Welding of seat frames for passenger cars: Welding group

2) Personnel assignment

The personnel assignment of the Bus I Division is shown in Table 5-2-1. The Bus I Division

is composed of 4 managers, 3 coordinators, and 98 workers. With the present personnel, the division has the capacity to produce seats for 10 buses per day. Regarding the passenger car seats, it has the capacity to produce seats for 240 cars per day and is now running at its full capacity. The direct-to-indirect ratio of the personnel is surely 83:17

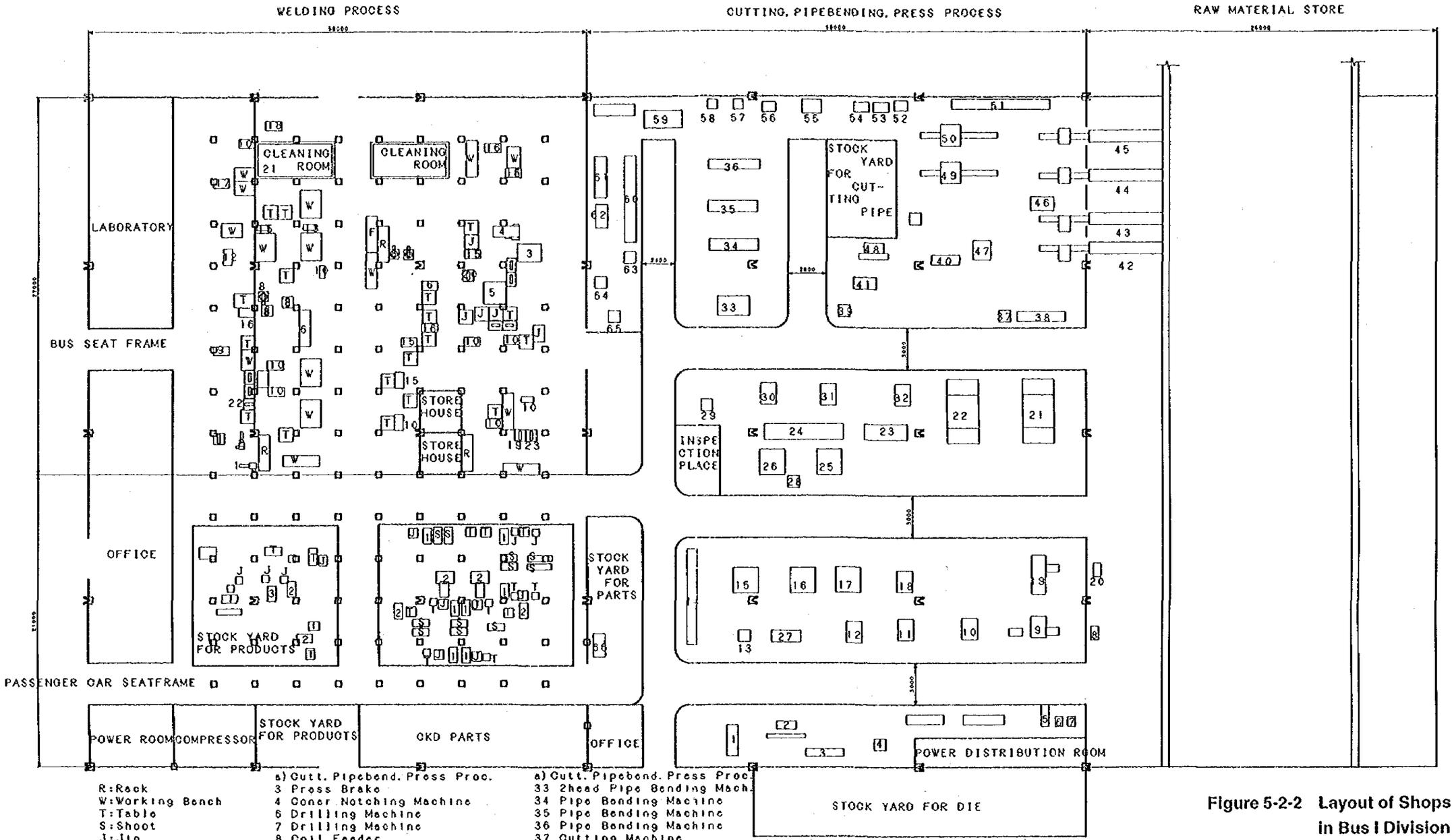
Table 5-2-1 Setup of Personnel in Bus I Division by Assignment

(Unit : persons)

Production line	Production capacity	Number of persons			Total
		Direct	Semidirect	Indirect	
Sheet metal working group 1	120 passenger cars, 5 buses	19	6	2	27
Sheet metal working group 2	120 passenger cars, 5 buses	22	4	2	28
Welding group 1	180 passenger cars, 7 buses	39	2	1	42
Welding group 2	50 passenger cars, bus parts	11	0	1	12
Painting group		7	1	1	9
Total		98	13	7	118

5-2-2 Layout of Shops

The layout of individual processes in the Bus I division is shown in Figure 5-2-2. The seat frames for buses and railway vehicles and the seat frames for passenger cars share the same production lines for sheet metal working (i.e., cutting and pipe processing) and press working. However, the two types of seat frames are processed on separate welding lines. This is because the seat frames for buses and passenger cars are produced in different production modes: the former are produced by multi-product small-lot production, making it necessary to replace jigs frequently during the process, while the latter are produced by mass-production of a small number of products.



R:Rack
W:Working Bench
T:Table
S:Shoot
J:Jig
F:Flat Plate

a) Cutt. Pipebend. Press Proc.
3 Press Brake
4 Coner Notching Machine
6 Drilling Machine
7 Drilling Machine
8 Coil Feeder
9 Mecha. Press (Pin Crutch)
10 Mecha. Press (Pin Crutch)
11 Mecha. Press (Pin Crutch)
12 Mecha. Press (Pin Crutch)
13 Rivetting Machine
15 Mecha. Press (Ain Crutch)
16 Mecha. Press (Pin Crutch)
17 Mecha. Press (Ain Crutch)
18 Mecha. Press (Pin Crutch)
19 Mecha. Press (Coil Feeder)
20 Coil Feeder
21 Plate Shearing Machine
22 Plate Shearing Machine
25 Mecha. Press (Ain Crutch)
26 Mecha. Press (Ain Crutch)
27 Oil Hydraurlc Press Brake
28 Butt Welder for Passa. Car
29 Handle Bending Machine
30 Oil Hydraurlc Press (Cusion)
31 Oil Hydraurlc Press (Cusion)
32 Oil Hydraurlc Press

a) Cutt. Pipebend. Press Proc.
33 2head Pipe Bending Mach.
34 Pipe Bending Machine
35 Pipe Bending Machine
36 Pipe Bending Machine
37 Cutting Machine
38 Pipe Feeder
39 Cutting Machine
41 Pipe Feeder
46 Pipe Cutting Machine
47 Mecha. Press
48 Pipe Bending Machine
49 Pipe Cutting Machine
50 Pipe Cutting Machine
53 Drilling Machine
54 Frame Bending Mach.
55 Frame Drilling Mach.
56 Frame Cutting Mach.
57 Drilling Machine
58 Drilling Machine
61 Frame Bending Mach.
62 Frame Bending Mach.
63 Drilling Machine
64 Air Hydr. Corking Mach.
65 Mecha. Press
67 Handle Polishing Mach.

b) Bus Seat Frame Proc.
1 Spot Welder
2 Spot Welder
3 Spot Welder
4 2head Pipe Bending Machine
5 4head drilling Machine
6 8head drilling Machine
7 Legframe Drilling Machine
8 Drilling Machine
9 CO2 Arc Welder
10 CO2 Arc Welder
11 CO2 Arc Welder
12 CO2 Arc Welder
13 CO2 Arc Welder
14 CO2 Arc Welder
15 CO2 Arc Welder
16 CO2 Arc Welder
17 CO2 Arc Welder
18 CO2 Arc Welder
19 Drilling Machine

b) Bus Seat Frame Proc.
20 Drilling Machine
21 Belt Polishing Mach.
22 Drilling Machine
23 Drilling Machine

c) Passe. Seat Frame Proc.
1 CO2 Arc Welder
2 Spot Welder
3 Portable Spot Welder

Figure 5-2-2 Layout of Shops in Bus I Division

5-2-3 Working system

A two shift system is employed. The working hours are 6:00-14:00 for shift A and 14:00-22:00 for shift B. Each shift lasts a total of 480 minutes including a total break time of 30 minutes. This means that the operating time is 450 minutes. There are 21 working days in a month, and 252 working days in a year. The timetable for the two-shift system is shown below.

Shift A		Shift B	
6:00-7:30	90 min. of operation	14:00-15:30	90 min. of operation
7:30-7:35	5 min. break	15:30-15:35	5 min. break
7:35-9:00	85 min. of operation	15:35-17:00	85 min. of operation
9:00-9:15	15 min. lunch break	17:00-17:05	5 min. break
9:15-10:30	75 min. of operation	17:05-18:00	55 min. of operation
10:30-10:35	5 min. break	18:00-18:15	15 min. lunch break
10:35-12:30	115 min. of operation	18:15-20:00	105 min. of operation
12:30-12:35	5 min. break	20:00-20:05	5 min. break
12:35-14:00	85 min. of operation	20:05-22:00	115 min. of operation

5-2-4 Quantity of Production by Component

The metal working for seat frames is performed in the Bus I Division. At present, the seat frames for 5 buses or railway vehicles and 240 passenger cars are produced each day. It is assumed that the number of seat frames produced has reached its limit.

The main components of the seat frames for buses and railway vehicles are the seat backs, seat cushions, and leg frames. The main components of the seat frames for passenger cars are the front seat backs, front seat cushions, rear seat backs, and rear seat cushions. The quantities produced per day by component are shown below.

For buses and railway vehicles

Seat backs	: 200
Seat cushions	: 200
Seat leg frames	: 100

For passenger cars

Seat frames	: 240
Front seat frames	: 480
Front seat cushions	: 480
Rear seat backs	: 480
Rear seat cushions	: 480

5-2-5 Bus Seat Division

1) Cutting, press working, and pipe bending processes (sheet metal working processes)

Both seat frames for buses and railway vehicles and seat frames for passenger cars are processed in the same cutting, press working, and pipe bending shops. As shown in Figure 5-2-3, the machines are laid out by machine type. Although the layout by type arrangement can easily respond to changes in the items to be processed, it has a low production efficiency and is not suited to mass production.

The sheet metal working group is composed of four indirect workers, ten semidirect workers, and 41 workers. Twenty workers work in each shift.

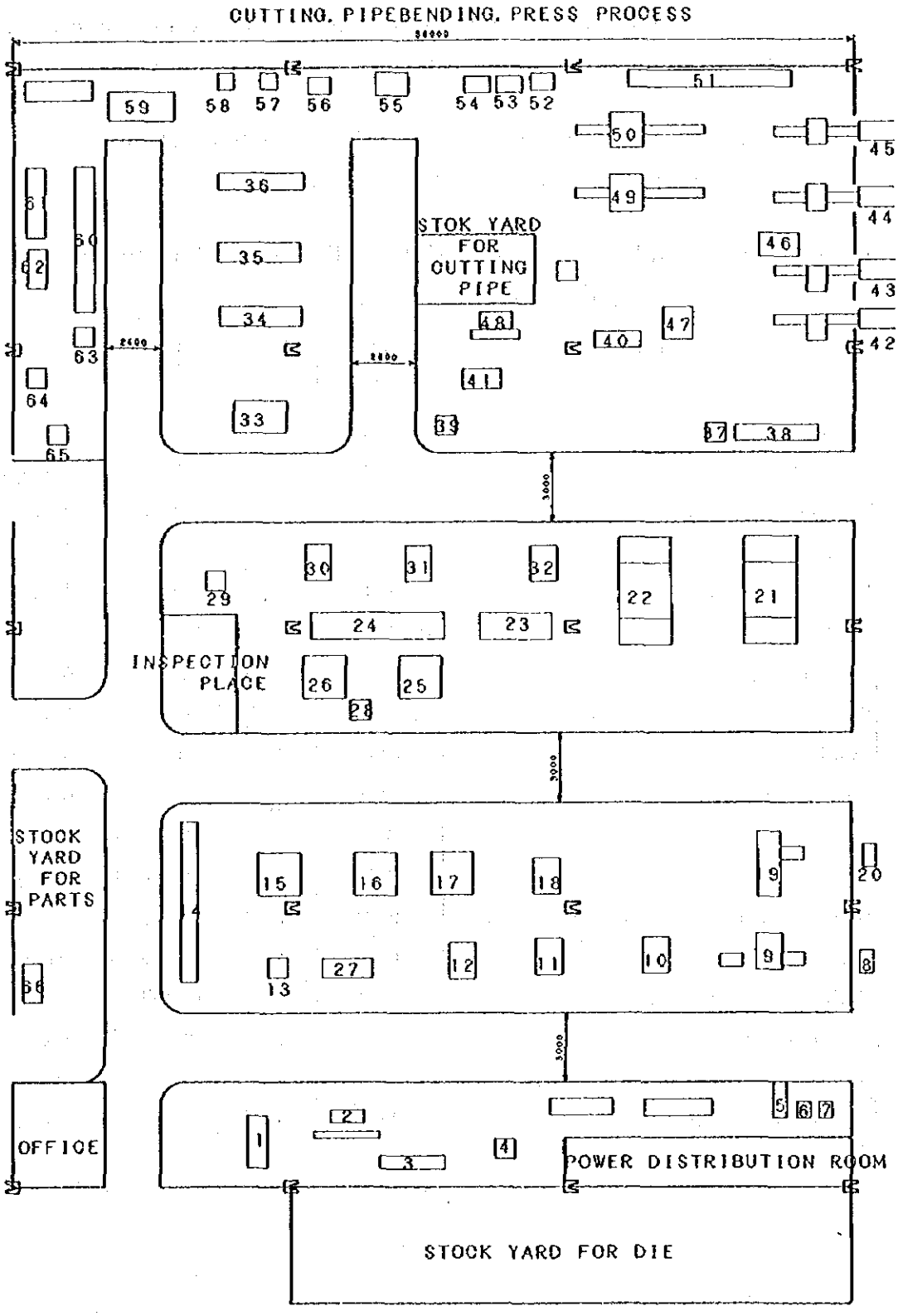


Figure 5-2-3 Equipment Layout of the Cutting, Press Working, and Pipe Bending Processes

Table 5-2-2 lists the main machines. Most of the machines used for cutting, press working, and pipe bending were bought about 20 years ago, and they are expensive to maintain and repair. The accuracy of products, depends on the workers' skill.

The workers take charge of their assigned machines, and the job allotment is fixed. The equipment is maintained periodically according to a check list.

Table 5-2-2 Main Machines in the Cutting, Press Working, and Pipe Bending Processes

Machine name	Year of purchase	Qty	Specification	Precision, degradation
Hydraulic press	1969 - 1974	3	250 ton	Average
Hydraulic press	1989	1	50 ton	Average
Hydraulic press bender	-	1	250 ton	Average
Mechanical press	1982	1	250 ton	Average
Mechanical press	1971, 1972	2	100 ton	Average
Mechanical press	1972 - 1985	6	63 ton	Average
Mechanical press	1971 -	4	40 ton	Average
Shearing machine (2,000 mm)	1968, 1972	2	3 ton, 5 ton	Average
Coil feeder	1983	2	ϕ 1,000	Average
Press brake	1978	1	ϕ 2,500	Average
PEYA pipe bender	1973, 1976	2	ϕ 10x2,000	Average
CNC pipe bender	1986	1	ϕ 30x2,000	Average
Butt welding machine for passenger car seat	1990	1	50 KVA	Good
Feeder for pipe cutting machine	1986	1	ϕ 25~ϕ 30	Good
KKS feeder for pipe cutting machine	1972	2	ϕ 200	Average
CNC pipe cutter	1972	1	ϕ 13	Average
Special-purpose bus seat processing machine	1981	4		Average
Bench drilling machine	Unknown	5		Average

2) Welding process

The welding process of the seats for buses and railway vehicles is done by the welding group composed of one manager, one submanager, and twenty workers for a total of 22 persons per shift. The welding process consists mainly of the following four product-specific lines. Figure 5-2-4 shows the layout drawing of the welding process.

General-purpose seat back line
High-quality cushion line
Leg frame line
Semi-finishing line

After welding, the workpieces undergo powder coating. After pretreatment by shot blasting, they are coated with black epoxy resin.

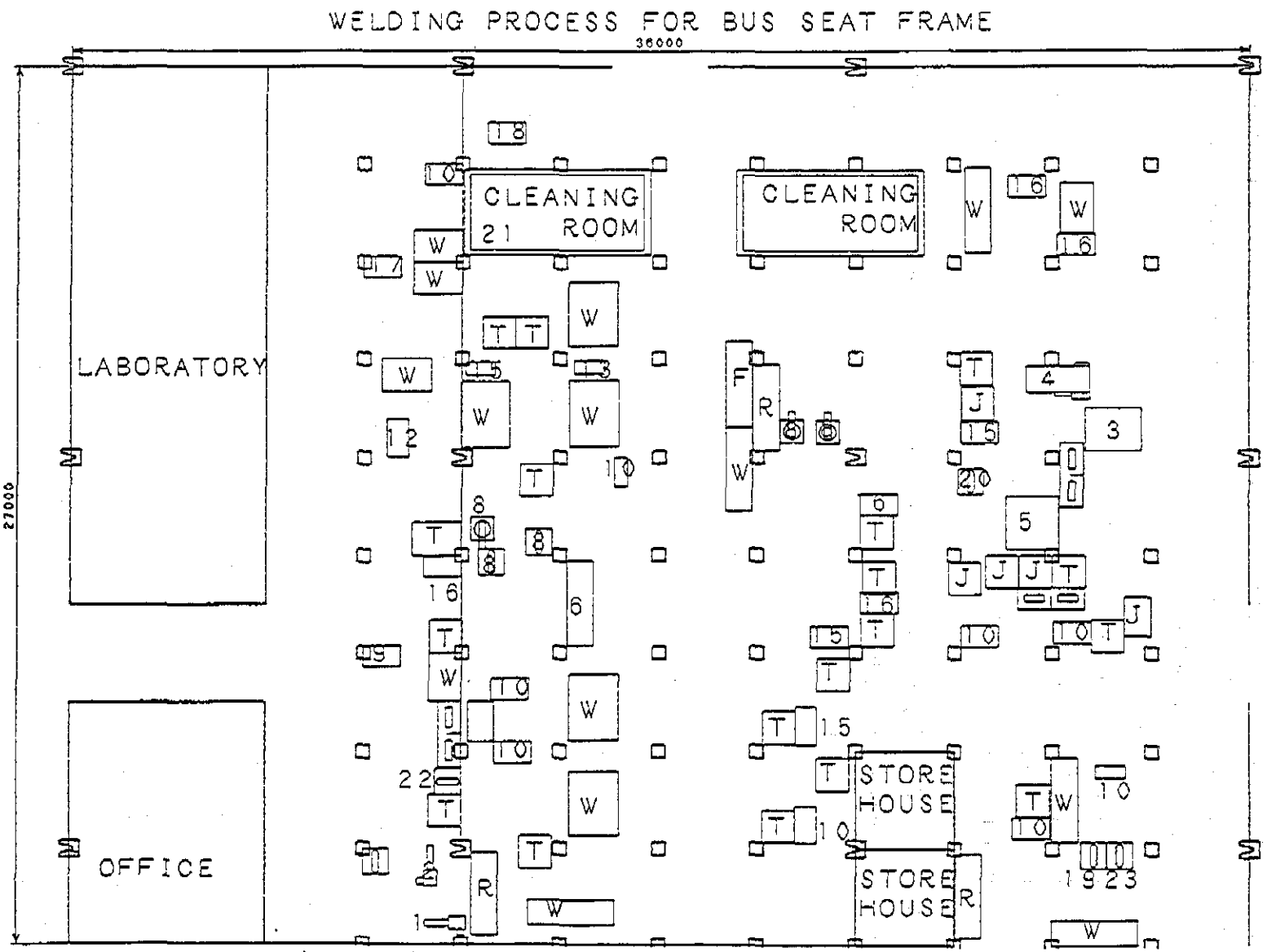


Figure 5-2-4 Layout Drawing of the Welding Process of Seat Frames for Buses and Railway Vehicles

Table 5-2-3 lists the main machines. All the machines used for the processing of the seat frames for buses and railway vehicles are of old types. The accuracy of products, depends on the workers' skill. Also, a lot of time is spent on correction after processing.
The workers take charge of their assigned machines, and the job allotment is fixed. The equipment is maintained periodically according to a check list. With reduced production, idle machines can often be seen.

Table 5-2-3 Main Machines in the Welding Process of Seat Frames for Buses and Railway Vehicles

Machine name	Year of purchase	Qty	Specification	Precision, degradation
Spot welding machine	1967-1974	3		Average
CO_2 arc welding machine	1987-1995	21	350A~400A	Average
Bench drilling machine	1972-1985	11	ϕ 13~ϕ 15	Average
Special-purpose drilling machine	1983	2	4-axis, 8-axis	Average
Special-purpose seat frame bending machine	1974	1		Average

5-2-6 Passenger Cars Seat Division

1) Welding process

The welding process for seat frames for passenger cars is run on dedicated lines by the welding group composed of one manager, one submanager, and nineteen workers.

The welding process is divided into four lines: the front seat back, front seat cushion, rear seat back, and semi-finishing lines. The rear seat cushion is of wire frame construction. Although the line of the rear seat cushion is located in the Bus II Division, it is managed by the Passenger Car Seat Division.

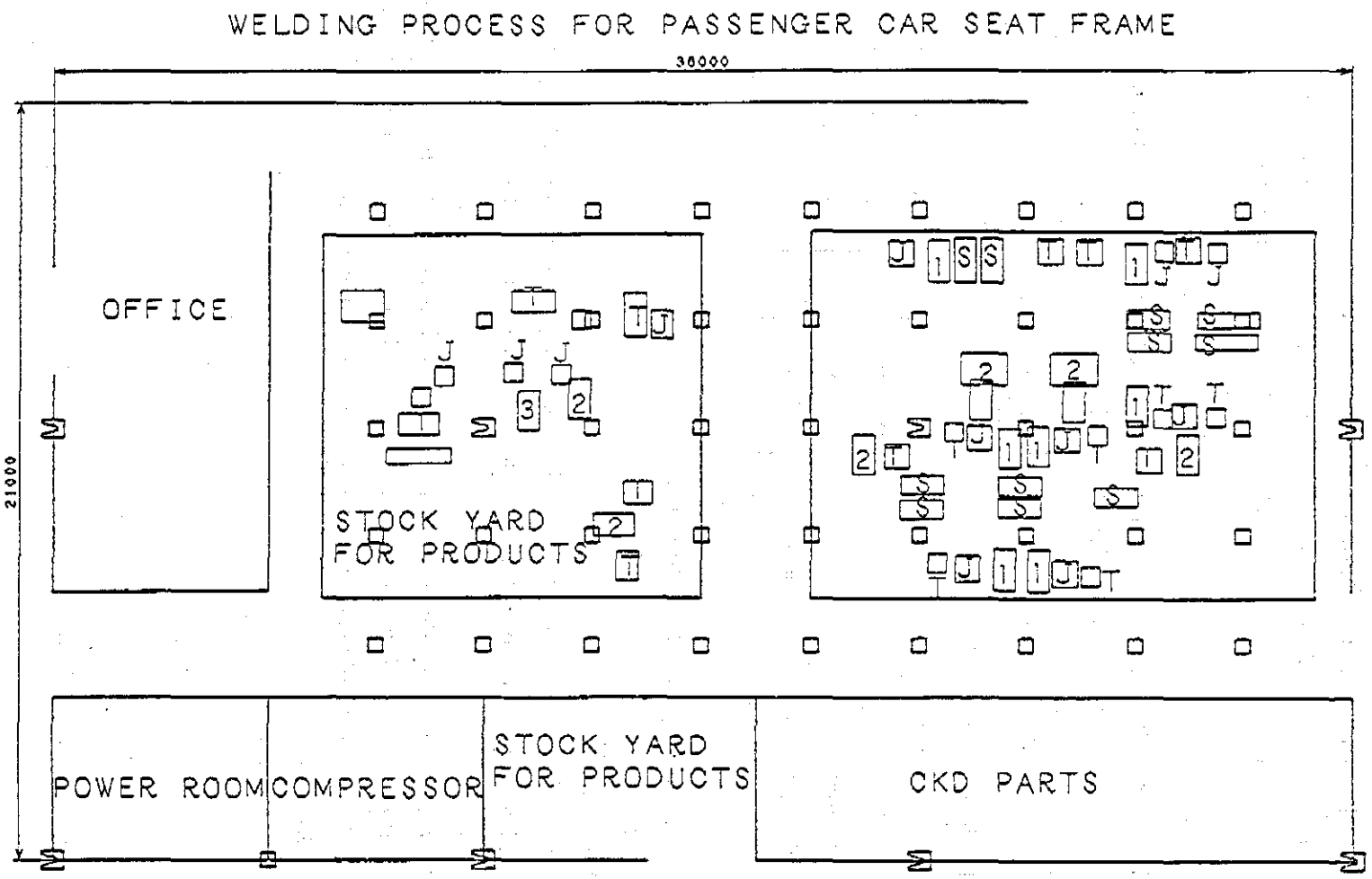


Figure 5-2-5 Layout Drawing of the Welding Process for Seat Frames for Passenger Cars

Table 5-2-4 lists the main machines. Although the machines used for the processing of the seat frames for passenger cars are of new types, the welding depends on the workers' skill. The workers take charge of their assigned machines, and jobs are fixed. The equipment is maintained periodically according to a check list and the tools are well maintained.

Table 5-2-4 Main Machines in the Welding Process for Seat Frames for Passenger Cars

Machine name	Year of purchase	Qty	Specification	Precision, degradation
Spot welding machine	1995	5		Good
Portable spot welding machine	1995	1	18KVA	Good
CO_2 arc welding machine	1995	8	400A	Good

2) Welding process for rear seat cushions

The rear seat cushions are of wire frame construction and are processed in the Passenger Car Seat Division. The processing consists of two processes: the sheet metal working process in which the work is cut and bent and the welding process in which the work is assembled by resistance welding. The sheet metal working process employs cutting and bending templates and produces tight tolerances. The welding process employs a technique called cross-wire welding in which approximately 60 spot welds are made with a portable spot welding machine to join the parts.

The welding is done by the wire frame group of the Passenger Car Seat Division. There are one manager, one indirect worker and nine workers per shift. Figure 5-2-6 shows the layout drawing of the welding process.

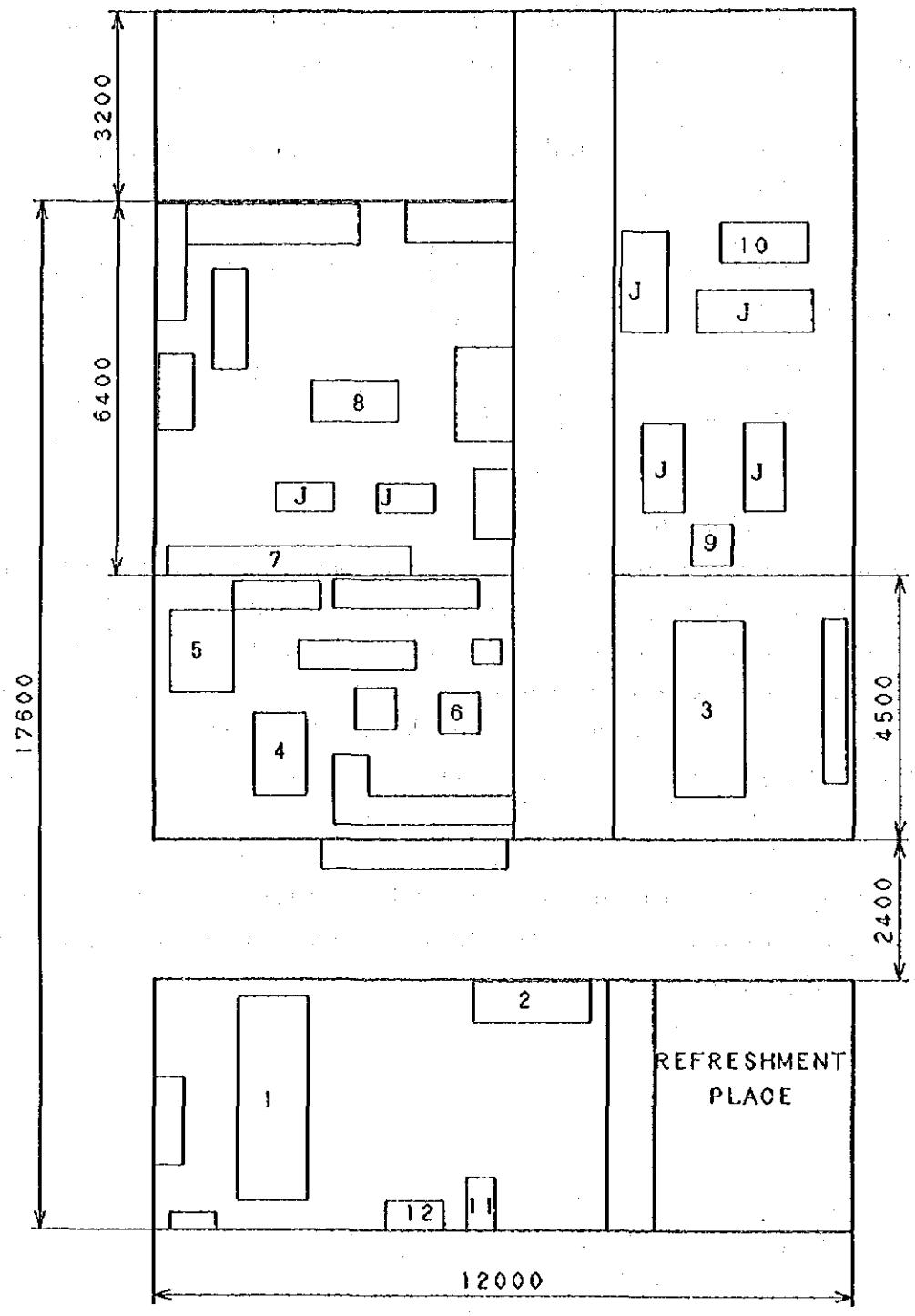


Figure 5-2-6 Layout Drawing of the Welding Process for Rear Seat Cushions for Passenger Cars

Table 5-2-5 lists the main machines. Machines of both new and old types are used for the processing of the rear seat cushions for passenger cars. In the operations that use old type machines, the accuracy of products depends on the workers skill. The workers take charge of their assigned machines, and the jobs are fixed. The equipment is maintained periodically according to a check list and the tools are well maintained.

Table 5-2-5 Main Machines in the Welding Process for Rear Seat Cushions for Passenger Cars

Machine name	Year of purchase	Qty	Specification	Precision, degradation
Hydraulic press brake	1995	1	3,000mm	Good
Hydraulic press brake	1978	1	2,500mm	Average
Hydraulic press	1989	1	50 t	Average
Mechanical press	1972,1978	2	15 t、63 t	Average
Special-purpose wire frame bending machine	1978	1		Average
Spot welding machine	1991,1994	2		Average
Portable spot welding machine	1993	1		Average

5-2-7 Present State of the Processes

1) Cutting process

The raw material is placed on a materials handling dolly, that also serve as a platform, by the crane installed in the materials warehouse, and is supplied to the cutting machine one package (approx. 240 pieces) at a time. The pipes are cut one by one with a metal saw. Although this method can cut materials of any cross-sectional shape, it tends to produce burrs. Thus, it is often necessary to deburr workpieces in the subsequent process. Because many circular pipes are used in the seat frames of passenger cars, and also because a mandrel is used in the pipe bending process following the cutting process, deburring is essential, requiring extra labor.

2) Pipe bending process

The seat backs for buses and railway vehicles are processed on an Italian-made pipe bender. It employs the compression bending method with the use of a mandrel. The seat frames for passenger cars are bent on a general-purpose pipe bender in eight bending operations. During compression bending using a mandrel, the work is clamped inadequately. This tends to cause slippage between the die and the work, lowering the accuracy of the product. The problem with this process is that in the eighth bending operation, the shape of the pipe is intentionally changed into a shape similar to a spring washer to avoid interference with the die. Although this makes it

easier to remove the work from the die, a great deal of time and labor is required in the subsequent process in order to correct the shape of the work.

3) Butt welding process

The study team inspected the condition of welds on several occasions and found out that 30% of the welds were poor. However, in our final inspection, the condition of the welds was acceptable. It seems that the poor welds were caused by fluctuations due to drops or variations in the voltage of the power supply in the shop. The electrical capability of the butt welding machine turned out to be sufficient. During the maintenance of welding electrodes, emphasis should be placed on securing a good contact between the work and electrodes to prevent poor welds due to shunt currents. IMAG uses sandpaper wound around a pipe to clean the electrode surfaces. However, this method cannot produce a good contact. Although poor welds can be corrected by CO_2 welding in the subsequent process, efforts should be made to reduce the number of poor welds to zero.

4) Press working process

IMAG contracts out the dies to domestic companies. Our investigation found that the accuracy of the dies was high. It was noted that some joints had to be welded again in the subsequent CO_2 arc welding process. This is because the press-worked parts do not fit up to each other properly, leaving big clearances. The press working process should be improved to provide the proper clearance for welding.

Many fastening devices are used for mounting dies on the pressing machines, causing setups to be time-consuming. Because of the difficulty in securing a budget for repair of the presses, the machines have not been repaired adequately and are in great need of maintenance.

5) Welding process for seat frames for buses and railway vehicles

This process is run by highly skilled workers, the technical level is higher than in Japan. However, the floor space per process is 9 square meters, which means that the floor space of the production line is excessive. As a result, the workers have to walk a long distance to transfer workpieces, which makes production less efficient.

The gaps between joined parts are improper, making it sometimes necessary to weld the same places more than once. Some basic improvements are required, such as rechecking the lash between jigs and parts or modifying the dies for processing the parts. It is also necessary to review the standards to clarify the methods used to carry out and manage the work in the shop.

6) Welding process for seat frames for passenger cars

This process is done by highly skilled workers. The working positions of the welding fixtures are suited to the workers' physique. The clamps and other fastening devices provided with the fixtures are well adjusted. The floor space per process is 9 square meters, which means that the floor space of the production line is excessive. As a result, the workers have to walk a long distance to transfer workpieces, which makes production less off efficient.

The gaps between joined parts are improper, making it sometimes necessary to weld the same places more than once. Some basic improvements are required, such as rechecking the lash between jigs and parts or modifying the dies for processing the parts. Work is carried out in accordance with the standards and the standards are posted on the wall in the work area and are posted in the work area.

7) Welding process for rear seat cushions

The sheet metal working process produces 120 pieces per lot. Some goods in stock are gathering rust. In the welding process using a portable spot welding machine, there are so many spot welds to make that workers sometimes forget to make some welds because they are over looked. The weld strength of completed parts is expressed in strict numerical terms, and a record is kept.

5-2-8 Problems with Processing of Frames

The processing of frames described above has the following problems:

1) Cutting process

A deburring process is necessary after cutting.

2) Pipe bending process

(a) The shape of the bends has been changed to avoid interference with the dies.
(b) The use of a mandrel makes the processing time longer.
(c) The use of compressive bending makes dimensions unstable.

3) Butt welding process

(a) The voltage may drop during operation at full capacity. A voltage drop can be fatal to good resistance welding.
(b) The shape of the electrode used for butt welding does not match the shape of the pipe.
(c) Slippage between the electrodes and pipe prevents the application of pressure.
(d) Variations in product shapes make it impossible to use fixed welding conditions.

4) Press working process

(a) The parts to be joined do not fit each other properly.
(b) It takes considerable time to mount the dies.
(c) The maintenance of the machines is inadequate.

5) Welding process for seat frames for buses and railway vehicles

(a) The parts to be joined do not fit up to each other properly.
(b) It takes a lot of time to handle parts and products.
(c) The floor space of the line is too large.
(d) The standards and the like do not suit the actual conditions in the shop.

6) Welding process for seat frames for passenger cars

(a) The parts to be joined do not fit up to each other properly.
(b) It takes a lot of time to handle parts and products.
(c) The floor space of the line is too large.

7) Problems with welding process for rear seat cushions for passenger cars

(a) Workers sometimes forget to make some welds because of an oversight.
(b) Some parts are gathering rust.

5-2-9 Processing of Panels

At present, IMAG only uses panels for its passenger car seats. Processing of panels requires a large press with a capacity of 300 to 500 tons. Therefore, seat panels are not produced internally, but are purchased from Magyar Suzuki.

The main components of the seat panels include the front seat cushion main, front seat cushion sub, and rear seat back panels, which are produced by Prestechnica KFT in Budapest. In Japan, panels are not produced in-house on a large press in many cases, either. This is because of the high capital cost and low operating rates of large presses. The requirements for the above mentioned items per press line is 1,440 pieces, which is only about 50% of the average output per shift of 2,800 in Japan, and considering that IMAG uses a two-shift system, the operating rate of the equipment would be only 25%. Considering this figure and the current state of affairs at IMAG, it is advisable to stick to the practice of purchasing the panels.

5-3 Cutting and Sewing Processes

5-3-1 Organization and Personnel Assignment

1) Seats for buses

The cutting and sewing processes for bus seats are managed by the Bus II Division, as shown in Figure 5-3-1. Two coordinators are assigned to the production manager and they are in charge of the cutting and sewing lines, and cable harnesses. A staff for logistics is also assigned for inventory control. Under the control of these coordinators, production is organized and carried out in two processes, cutting and sewing.

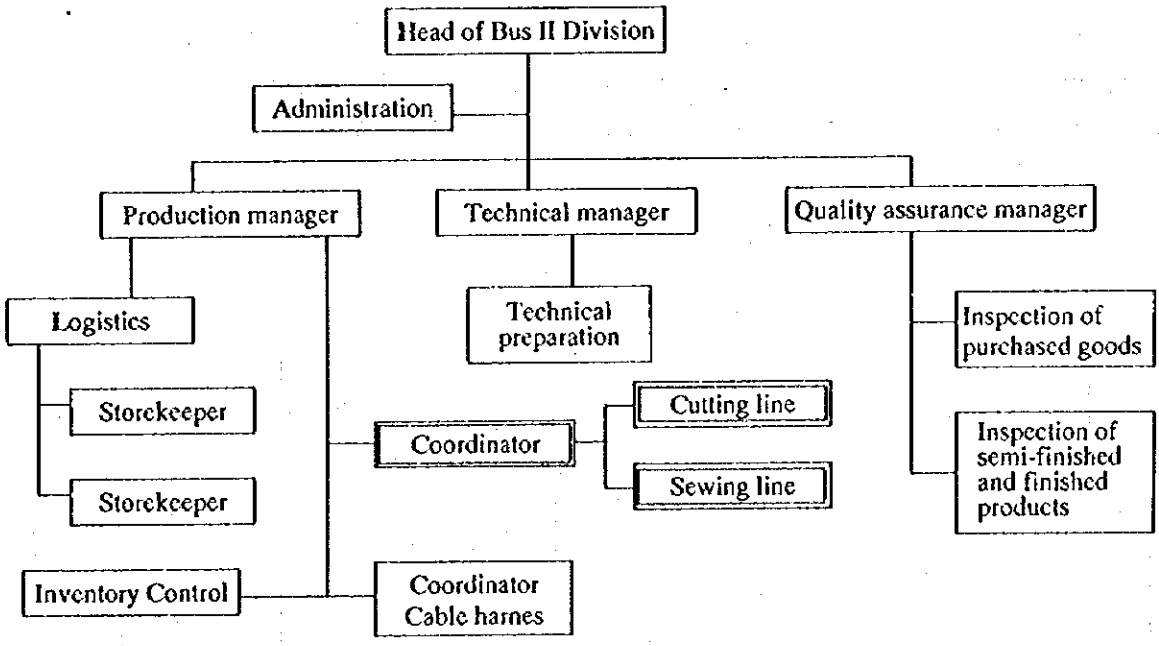


Figure 5-3-1 Organization Chart of the Cutting and Sewing Processes

A total of 21 workers, including nineteen workers directly employed in production, one worker employed in inspection, and one worker supporting production, are assigned to the cutting and sewing processes. The cutting process uses two cutting presses. Punching is used to cut PVC material including materials for passenger car seats. Cutting tools are also used for the manual cutting required for the production of bus seats. As regards sewing, five workers (nine workers have been employed, but five of them are always out helping other departments) produce the required quantity in a corner of the large workshop in which there are about 50 sewing machines just as there were when buses were mass-produced.

Table 5-3-1 Personnel Assignment of the Cutting and Sewing Processes of Bus Seats

Production Line	Production Capacity	Personnel (Persons)			Total (Persons)
		D.W.	S.D.W.	I.W.	
Cutting Line		10	1		11
Sewing Line		9		1	10
Total		19	1	1	21

2) Seats for passenger cars

The sewing process for passenger car seats is managed by the coordinator in charge of cutting and sewing, seat assembly, rear-seat wire frame assembly, door trim assembly, and roof trim assembly under the control of the production manager of the Passenger Car Seat Division.

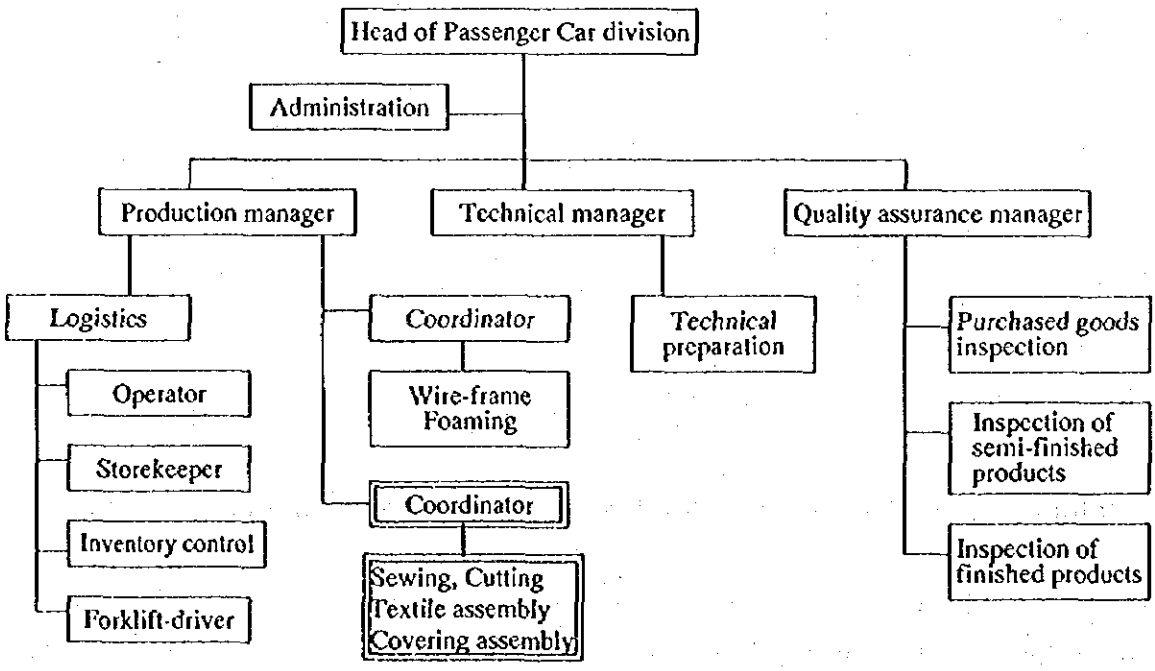


Figure 5-3-2 Organization Chart of the Cutting and Sewing Processes of Passenger Car Seats

In the cutting process, the cutting is performed manually with cutting tool. The PVC leather is cut by punching in the Bus II Division. The sewing process consists of three lines: a 9-person line, a 5-person line, and a 7-person line. 28 persons are assigned to this process including those assigned to the mini-quilting and finishing operations. The cutting and sewing processes operate in two shifts.

Table 5-3-2 Personnel Assignment for the Cutting and Sewing Processes of Passenger Car Seats

Production Line	Production Capacity	Personnel (Persons)			Total (Persons)
		D.W.	S.D.W.	I.W.	
Cutting line	250 units	13	*0.5	0	13.5
Sewing Line	220 units	56	0	0	56
Total		69	0.5	0	69.5

The Semidirect Workers Hold an Additional Post.

5-3-2 Main Equipment and Layout

1) Seats for buses

(1) Cutting process

The main equipment used for cutting is as follows:

Cutting presses	2 (160t, 100t)
Cutting tools	2 (hand-operated jig-saw type)
Spreading tables	4

The equipment in the cutting process consists of two lines as shown in Figure 5-3-3. However, two lines are excessive for the present production volume.

(2) Sewing process

There are 50 industrial sewing machines, but only five of them are in actual use. There are also automatic conveying systems such as belt conveyors that were used for mass production in the COMECON days. For the present production, they are not used at all, and remain idle. The way of treating such excess capacity is an important problem for the future.

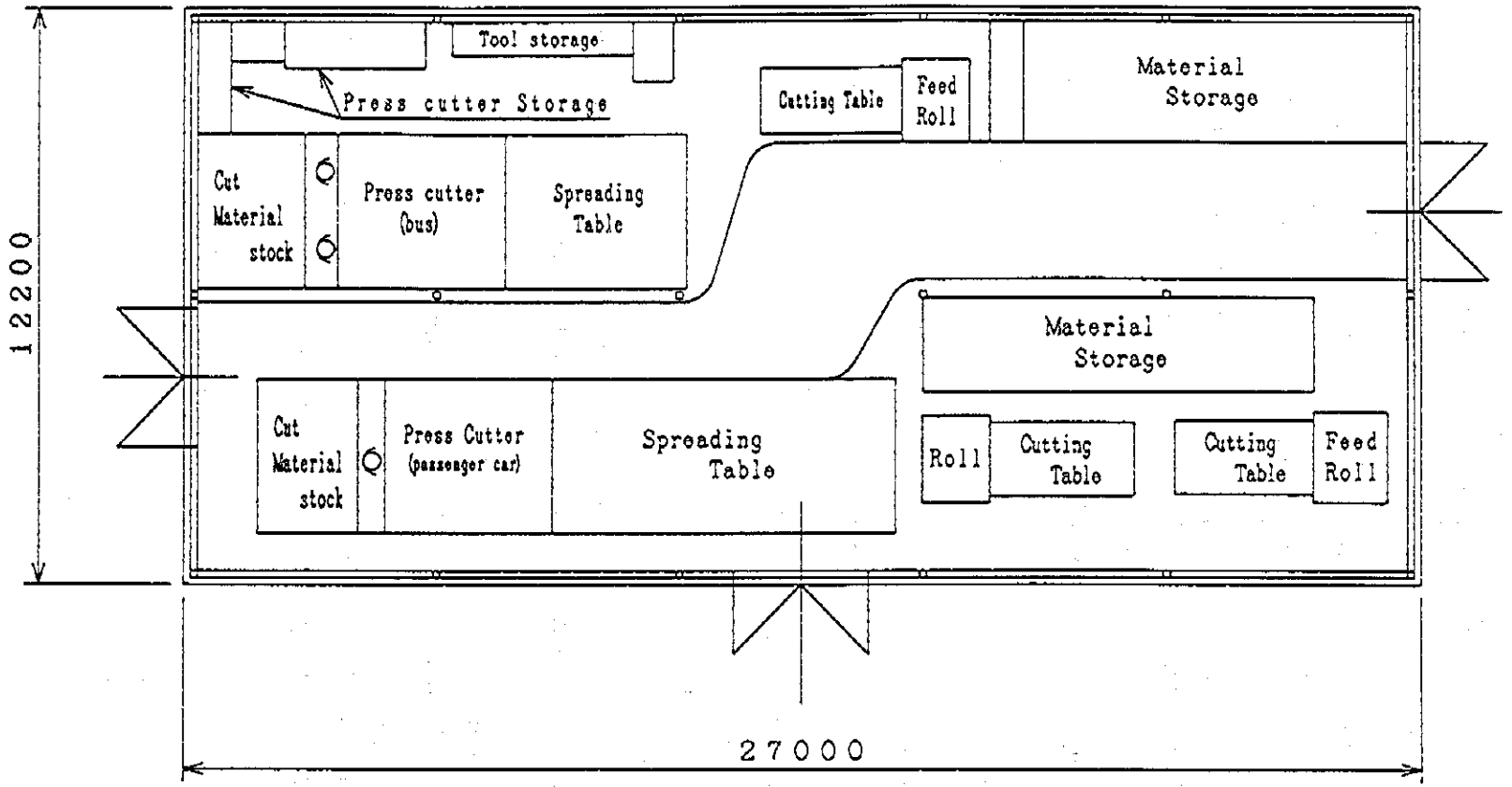


Figure 5-3-3 Equipment Layout of the Cutting Process

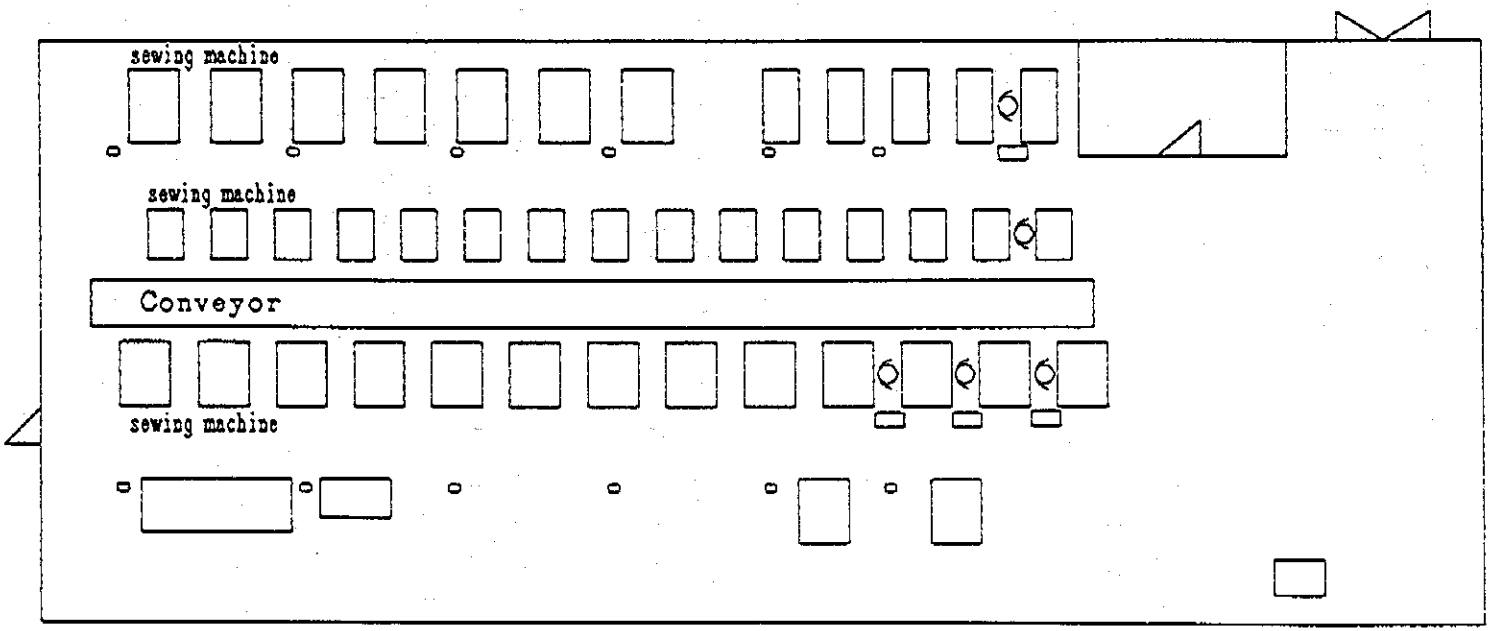


Figure 5-3-4 Equipment Layout of the Sewing Process (for bus seats)

2) Seats for passenger cars

(1) Cutting process

As shown in Figure 5-3-5, operations from spreading to cutting of rolled sheets are carried out efficiently on a single work bench. The PVC leather, which must be cut into complex shapes, is cut in the Bus II Division. The Passenger Car Division handles mainly cloth, which is cut into simple shapes, and no machinery is used except for three hand-operated cutting machine.

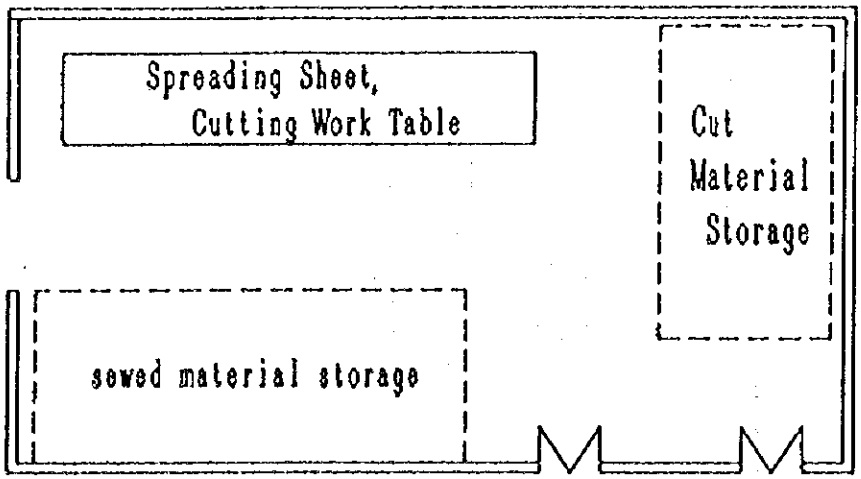


Figure 5-3-5 Equipment Layout of the Cutting Process (for passenger car seats)

(2) Sewing process

As shown in Figure 5-3-6, the sewing process has 22 industrial sewing machines and one mini-quilting machine. The layout is orderly with the sewing machines arranged in three straight lines and the mini-quilting machine located in the center. However, since products with more than twenty specifications are produced each day, the layout of machines grouped by product should be considered, instead of the present well-ordered mechanical arrangement. Also, because the production line is running at full capacity now, it is planned to enlarge the line to suit the increased production of passenger cars.

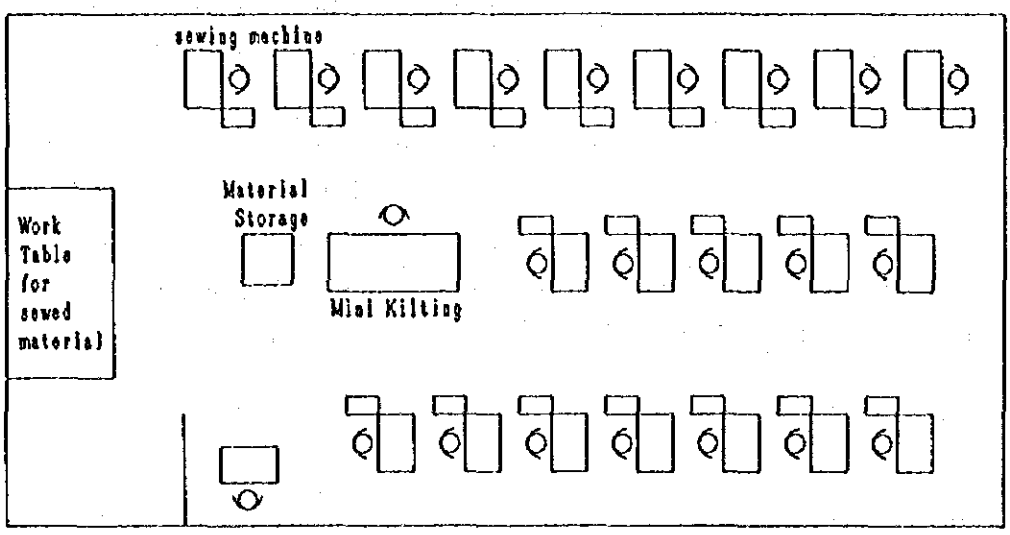


Figure 5-3-6 Equipment Layout of the Sewing Process (for passenger car seats)

5-3-3 Present State of Cutting and Sewing Processes

1) Seats for buses

(1) Cutting process

The seat surface materials consist mainly of cloth and PVC leather. In the cutting process, surface materials, supplied as rolls, are first spread on the spreading table, and the required number of sheets are piled on top of each other. Then they are cut according to the shape of the seat. All the PVC leather is cut by dies using a press, and the cloth is cut manually by a cutter, using paper patterns.

Regarding the cutting of PVC leather by dies, 10 rolled sheets (40 m/roll) are set on the roller stand and punched together on a press. The productivity is high and the dimensional accuracy is good. On the other hand, the yield is poor because of the large margin for cutting.

The cloth is cut to a certain length, cutting gauges (paper patterns) are placed on the top sheet of the pile, the top sheet is marked with a ballpoint pen, and the pile is cut along the marked line with a cutting tool. Cloth that requires pattern matching is cut sheet by sheet with scissors (see attached picture).

(2) Sewing process

Five workers are engaged in sewing in a corner of a large workshop in which about 50

sewing machines, that were used in the times when buses were mass-produced, are arranged orderly in three rows. About 40 sewing machines are left idle.

Each worker operates one sewing machine in a sitting position and takes care of the entire process of one item. One day's requirements of the assembly process are produced in batches two days in advance. Since the surfaces of bus seats are thick, the sewing operation requires skill. However, the workers sew without difficulty, they are highly skilled, and there are no quality problems (see attached pictures).

2) Seats for passenger cars

(1) Cutting process

Cloth other than PVC leather is cut in the Passenger Car Division: all the PVC leather is cut by the presses in the Bus Seat Division.

The rolled sheet is cut into sheets of a given length (3-8 m), which are piled on top of each other on the spreading table. A pile of 10 to 40 sheets is processed per lot. In the spreading operation, scissors are used for cutting, which makes the cut ends of the sheets irregular. Improvements are necessary to increase the yield and productivity.

The cutting method is as follows: cutting gauges are placed on the top sheet of the pile according to operating standards, the top sheet is marked, and the pile is cut along the marked lines with a cutting tool. Spreading, piling, and cutting are all performed manually. Since the rolled sheet is heavy and the quantity handled in a day is large, there is a possibility that the efficiency will be reduced due to fatigue.

The important operations in the cutting process, "pattern layout" and "cutting," are carried out properly according to the operating standards, and there are no quality problems (see attached picture).

(2) Sewing process

There are two working methods: in one of them the entire process is carried out by individual workers using a sewing machine in a sitting position, in the other method the process is split up among several workers. Since production is done in job-lots in which parts for 24 cars are produced in a batch, instead of flow production in which the entire process is divided among workers, the material being processed for 24 cars piles up between the workers, and the sequence of work and the flow of products are not clear.

A lot of German-made sewing machines provided with automatic thread cutters and many other function have been installed. The workers, all of whom are female, are highly skilled. So there are no speed or quality problems.

On the whole, the workshop is lively and neat with the walls hung with operating standards, checkpoints, and samples (see attached picture).

5-3-4 Problems with the Cutting and Sewing Processes

1) Cutting process

(a) Punching gives high productivity and good dimensional accuracy, but poor yields because of the large margin for cutting.

(b) In the spreading operation prior to punching, a sheet is folded in two for punching, which causes larger losses at both ends than if it had been punched without folding the sheet.

(c) In the spreading operation for passenger car seats, scissors are used for cutting the ends of the sheets, which makes the cut ends of the sheets irregular (zigzag) and causes loss of material.

(d) Since the marking for pattern layout is performed manually, both operating performance and yield are variable.

(e) The bus seats and passenger car seats are processed in two separate shops. This results in wasted effort due to additional management.

(f) In the spreading operation, the spreading table is too high, which makes the work tiring.

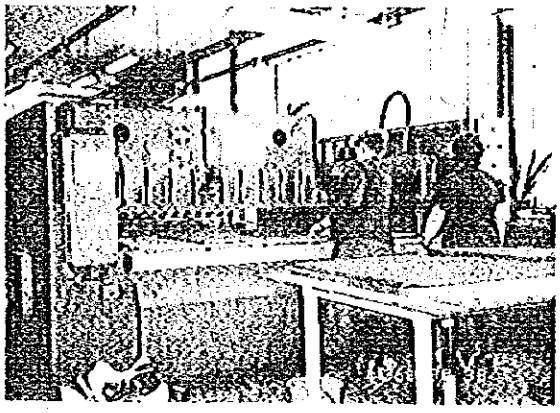
2) Sewing process

(a) Although the sewers work at a fast pace, there is no reference for determining the work tempo. As a result, the performance is uneven and the production efficiency varies.

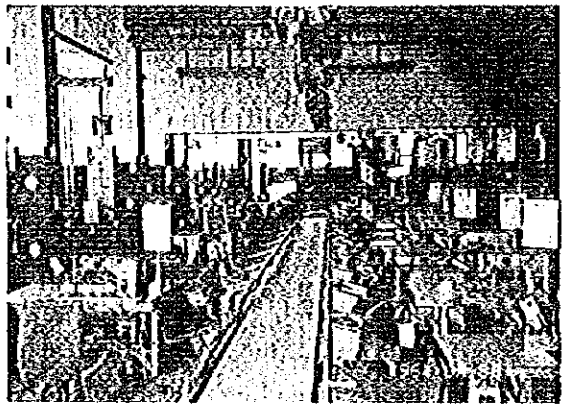
(b) Since the method employed is not flow production in which processes are divided among workers, in-process stocks pile up between processes (workers), making it difficult to detect problems.

(c) The build-up of in-process stocks results in extra labour being needed for its movement and storage.

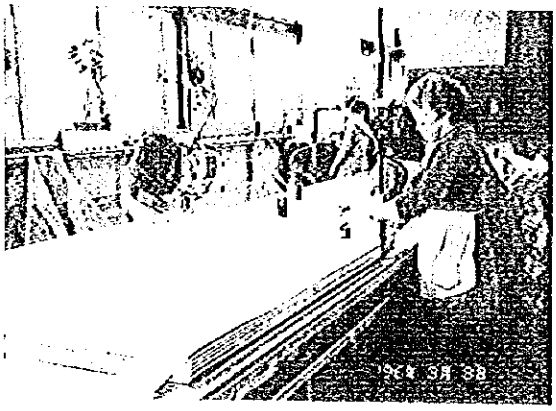
(d) Since the workers themselves must leave their seats to pick up materials as well as to tidy up and transfer the semi-finished products, their work is interrupted frequently.



Cutting Process
(Seats for Buses)



Sewing Process
(Seats for Buses)



Cutting Process
(Seats for Passenger Cars)

Sewing Process
(Seats for Passenger Cars)

5-4 Cushion Process (Polyurethane Foaming Process)

5-4-1 Organization and Personnel Assignment

The entire cushion process (polyurethane foaming process) is managed by the Bus II Division. As shown in Figure 5-4-1, three coordinators are assigned reporting to the production manager and they are in charge of the cushion foaming, bus seat assembly, and injection processes, respectively. Fifty workers are employed in the cushion foaming process, four workers in the injection process, and eighteen workers in the bus seat assembly process.

The cushion process is handled by a total of 55 workers including the fifty production workers and five additional workers in charge of raw materials and machinery. The equipment for foaming urethane is a comprehensive system that contains everything from the blending machine for the raw materials to the molds for the foaming machines. Since a large sum has been invested in the equipment, two-shift working is employed with emphasis on the production rate.

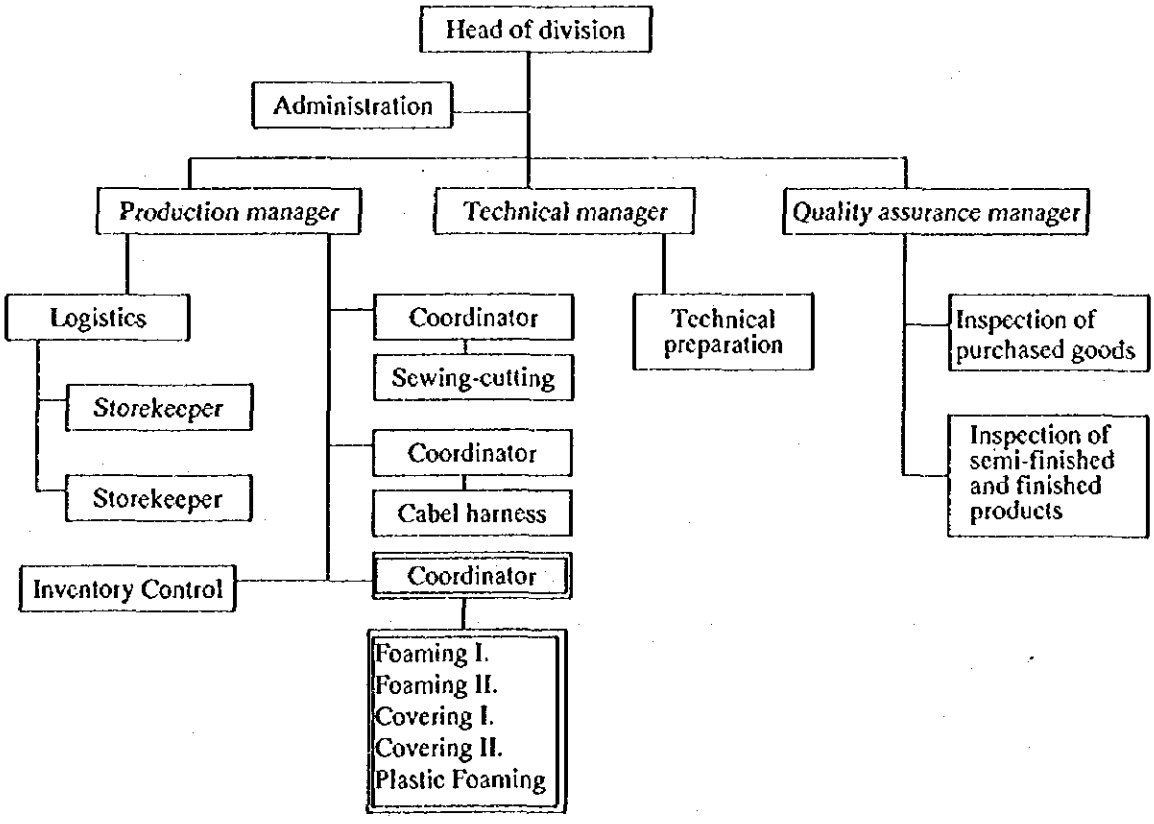


Figure 5-4-1 Organization Chart of the Bus II Division (cushion process)

5-4-2 Main Equipment and Layout

The equipment for the production of cushions is a state-of-the-art system that incorporates high-pressure foaming machines and direct-heating mold transfer systems. The equipment consists of two systems of stationary mold lines (4 lines consisting of 8 zones in all). The main items of the equipment other than the foaming machines are manufactured by IMAG itself. The equipment is laid out as follows: one foaming machine is placed on a frame, under which two lines of molds are placed; each line is divided equally into two zones and each zone is provided with an injector. Two such systems are installed in parallel.

5-4-3 Present State of Cushion Process

The cushion process uses a production system based on IMAG's own technical expertise. It employs raw materials of the nontoxic diphenylmethane diisocyanate single type in consideration of the working environment. Although the productivity is low, the product has many variants, and the integrally molded seats are evaluated for highly their quality appearance and processing technique. The mass-produced cushions are of high and uniform quality, free of burrs and blow holes. The process employed for the production of cushions (polyurethane foam) is the cold curing process, and the raw materials employed are of the diphenylmethane diisocyanate single type procured as two components (A and B).

The cushion specifications vary widely from surface material integrated foaming to skinless foaming. For efficient production, products with similar specifications are produced separately in eight zones. The operations are performed by two or three workers per zone. The cushion process consists of the following operations:

(Cushions for front seats of passenger cars)

(a) Application of mold releasing agent to the molds.
(b) Mounting of inserts (frames, plywood, and wires).
(c) Drying of mold surfaces with an air gun.
(d) Mounting of inserts (light materials such as felt).
(e) Injection of raw materials (including injector head movement).
(f) Mold clamping
(g) Cleaning of injector heads
(h) Cleaning of gas holes in upper cover
(i) Application of mold releasing agent to gas holes in upper cover
(j) Mold opening
(k) Pattern with drawing (removal of products from molds)
(l) Cleaning of molds
(m) Deburring of products

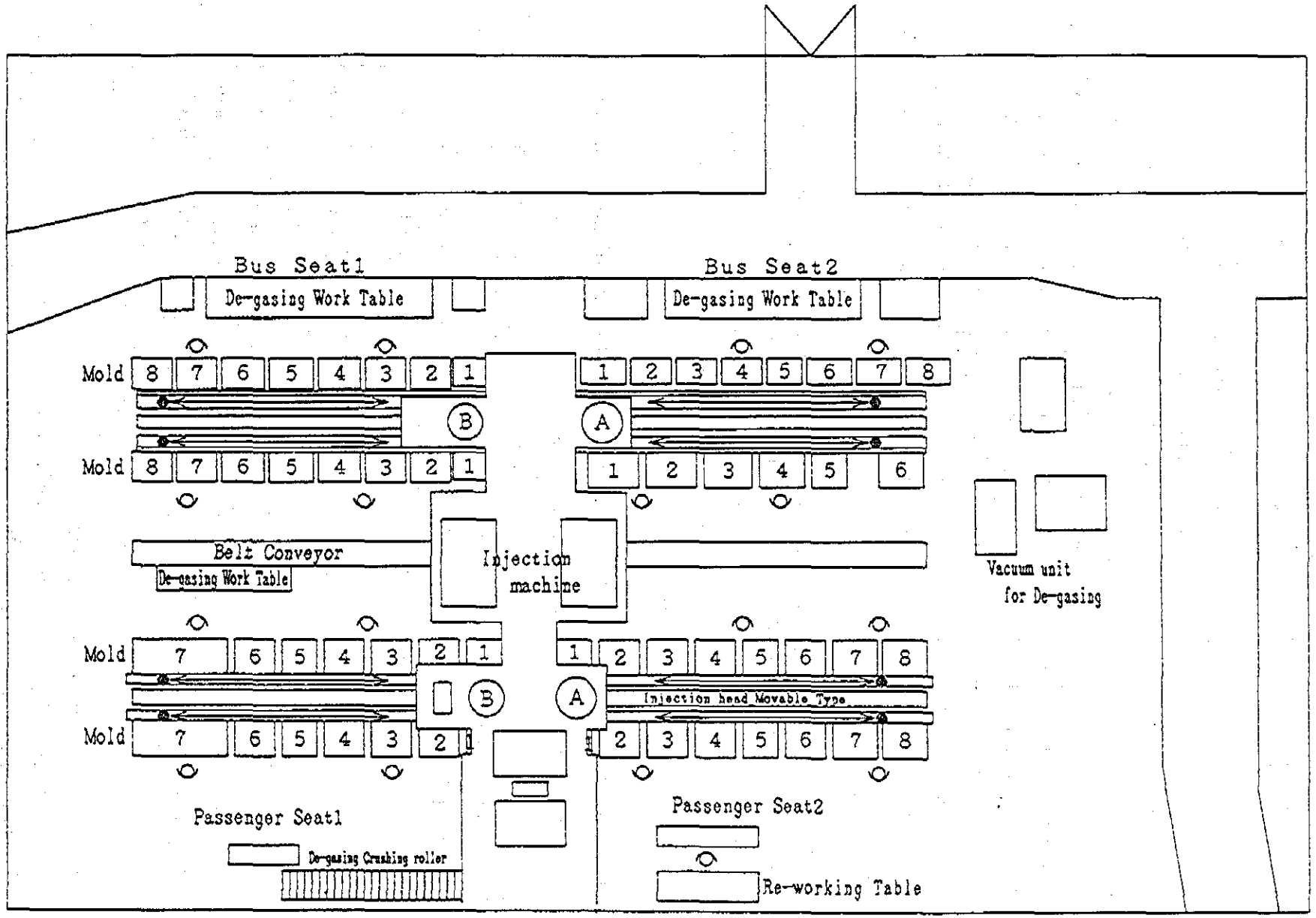


Figure 5-4-2 Equipment Layout of the Cushion Process

(n) Transfer to inspection and degassing processes

There are five to eight stationary molds in one zone. The twelve operations are divided among two or three workers who repeat their assigned operations walking around each of the eight molds in the zone. The raw materials are computer controlled: automatically mixed, measured, and fed under pressure to the injector heads according to the mold numbers. Then the raw materials are injected into the molds manually. Since the ready-mixed raw materials start to react and begin to foam as soon as they are injected, the injection operation must be carried out swiftly. They must be distributed uniformly over the entire inner surfaces of the molds. Also, some deep or sloping molds require infection to be done in a sequence in which the raw materials are injected from the higher portions and flow downward to the lower portions. The injection operations that require such skills are assigned to the same workers to stabilize the product quality.

Table 5-4-1 shows the production capacity and actual production of the cushion process. Since stationary mold lines are used, some of the workers' time is wasted in moving around and waiting, which results in a low output per worker. Generally, when a turn table or circular line is used, the output is approximately 3,000 units per month per worker. The very low productivity is reflected in operating rate as low as 43%.

Table 5-4-1 Production Capacity and Actual Production of Cushion Process

Zone	Model Name	Output(Per Month) as of Jan. '96	Number of Workers (Persons)	Production Capacity (units/month)	Remarks
A	Long distance bus model 8	1,210	3	8,320	
B	Municipal bus model 6	1,960	2	6,720	
C	Ope-piece foamed sheet model 8	2,271	3	6,720	
D	SWIFT model 8	6,911	8	16,640	2 shifts
E	SWIFT model 6	9,243	7	12,080	2 shifts
F	SEDAN model 6	4,576	7	11,680	2 shifts
G	GL 3DOOR model 5	2,068	7	7,520	2 shifts
H	SWIFT 5DOOR model 6	7,230	8	11,680	2 shifts
Total		35,469	45	81,360	

The above can be summed up as follows:

Output per worker = 788 units/month

Operating rate of equipment = 43%

The equipment is maintained by two persons according to inspection standards. Since there are many items of equipment that have been manufactured by the company itself and the foaming equipment is sophisticated, maintenance is carried out effectively with attention focused on important parts. The mold carrying systems attached to the devices for opening and closing the molds are manufactured by the company itself. The molds are also well maintained: and there are no problems with respect to their mechanism and accuracy.

100% of the products are visually inspected; for quality and a stamp of acceptance is affixed to identify the responsible inspector. Physical testing is carried out by the Quality Assurance Section by taking samples three times a shift. The results are analyzed and controlled statistically by computer.

5-4-4 Problems with the Cushion Process

(1) Since the work procedures are not standardized and are left to the workers, the performance is uneven and a lot of labor is wasted.

(2) The traveling speed of the injector (the speed at which the injector travels to the next mold after injection) is slow, resulting in the workers loosing time in waiting (injection is carried out manually, but the injector travels automatically).

(3) Injection takes a considerable time: after positioning the injector and starting injection, the workers must wait and time is lost.

(4) The stationary lines require the workers to walk long distances.

(5) The products are heavy and expensive.

The reasons include:

(a) The cold curing process is employed (hot curing equipment is preferable).
(b) The raw materials are of the diphenylmethane diisocyanate single type (nontoxic type).
(c) A technique to reduce the weight of raw materials remains to be developed.

(6) The crushing (degassing) process is inefficient.
The following four techniques are employed, which should be integrated to improve efficiency.

(a) Crushing roller technique: Work is degassed by being fed between two rollers.
(b) Vacuum technique: Work is degassed under vacuum (this technique is used when there are inserts).
(c) Air hose technique: Work is degassed by partial application of pressure using an airjet.
(d) Batting technique: Work is degassed by being beaten with a bat.

(7) 5S in shop are poor.
The entire cushion shop is dirty, although the molds and injectors that directly influence the product quality are well maintained.

(8) Productivity is low.

5-5 Assembly Process

5-5-1 Organization and Personnel Assignment

1) Seats for buses

The assembly process for bus seats is run by the Bus II Division, as shown in Figure 5-5-1. Under the production manager, one coordinator takes charge of the cushion, assembly, and injection processes. The assembly process is divided into three lines: the municipal bus line, long-distance bus line, and assembly line.

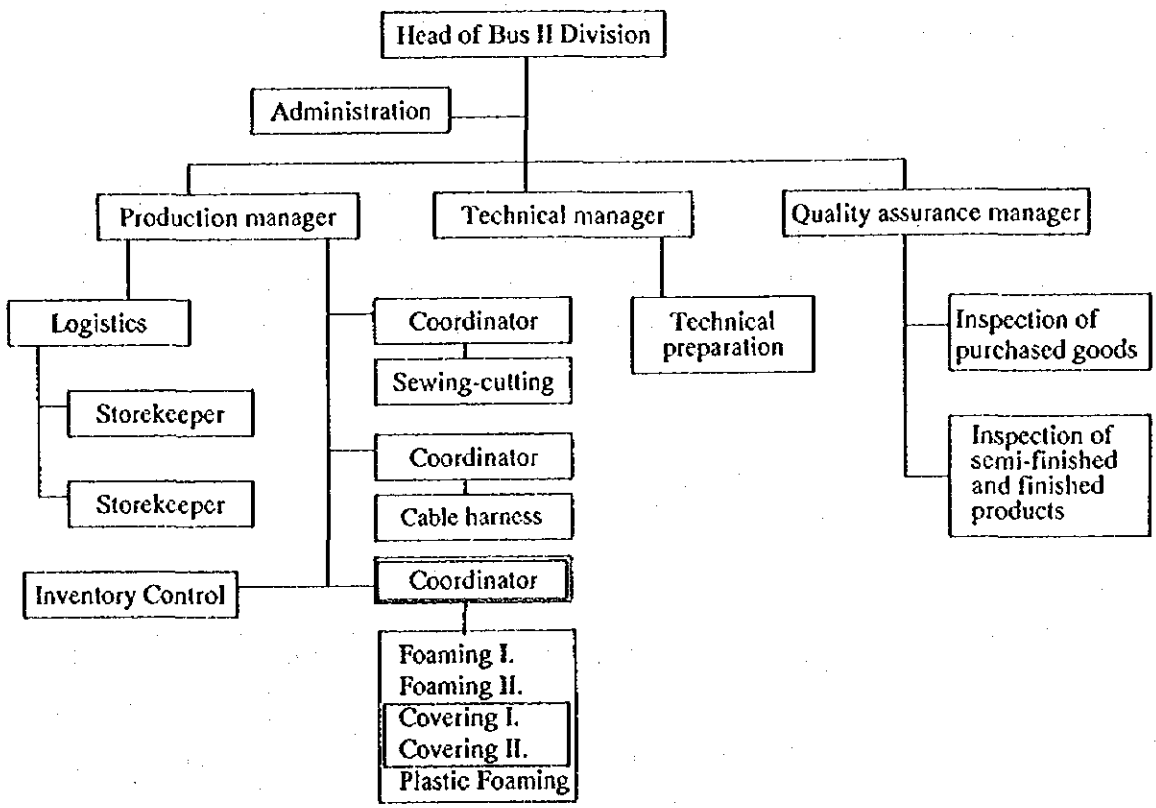


Figure 5-5-1 Organization Chart of Assembly Process (Bus II Division)

A total of eighteen workers are assigned to the assembly process including fifteen direct workers, one semidirect worker, and two indirect workers. As for production capacity, 240 seats (i.e., seats for six buses) are produced in a day. Since order production is employed, the quantities and models to be produced vary greatly. To deal with this situation, the processes in the Bus II Division help one another by transferring workers. Table 5-5-1 shows the personnel assignment in the assembly process of bus seats.

Table 5-5-1 Personnel Assignment in Assembly Process of Bus Seats

Production Line	Production Capacity	Personnel (Persons)			Total (Persons)
		D.W.	S.E.W.	I.W.	
Municipal Bus Line	*For 5 Buses	3			3
Long Distance Bus Line	57 Seats	7	1	2	10
Assembly Line	57 Seats	5			5
Total		15	1	2	18

*One bus has 40 seats on average.

2) Seats for passenger cars

As shown in Figure 5-5-2, the assembly process for passenger car seats is part of the Passenger Car Seat Division. It is managed by the coordinator in charge of cutting and sewing, seat assembly, door trim assembly, and roof trim assembly under the production manager. Under the control of this coordinator, production is divided into three lines: the front seat line, rear seat line, and head rest line.

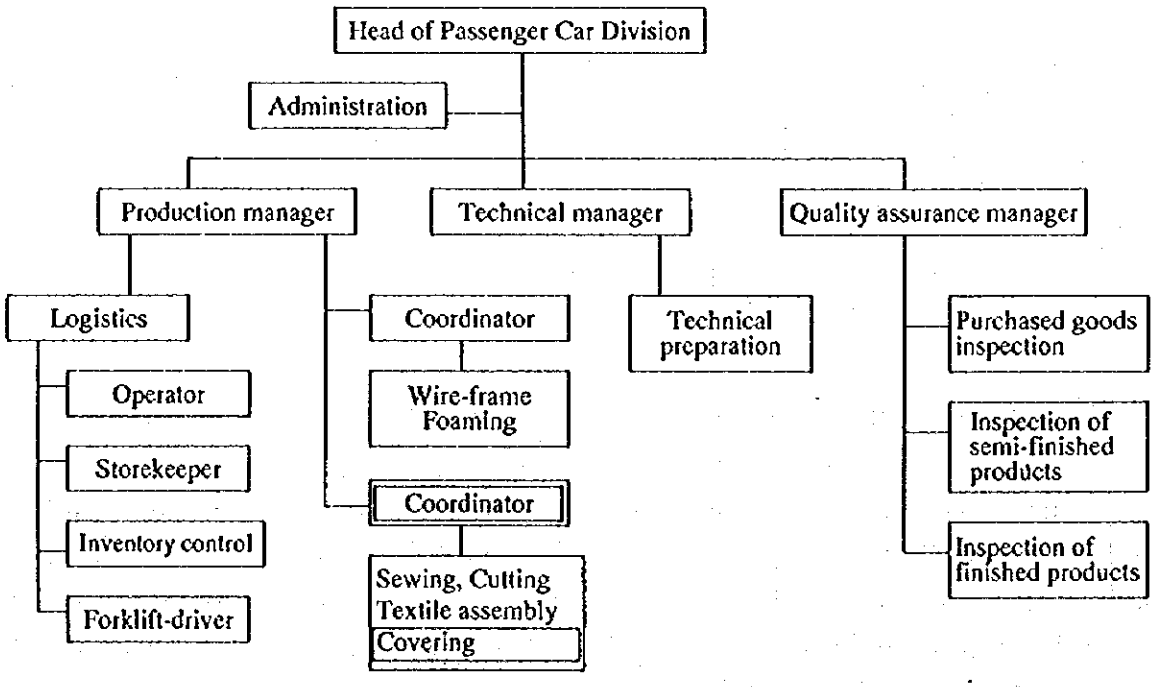


Figure 5-5-2 Organization Chart of Assembly Process (Passenger Car Division)

A total of 58 workers including 42 direct workers, 13 semidirect workers, and 3 indirect workers are assigned to the assembly process and engaged in production on two shifts. Seats for three models of hatchbacks and four models of sedans are produced with a total daily output for 240 cars. Production is planned as follows: lots are organized by model, and seats for 24 cars, as a rule, are produced per lot according to the sequence specified by daily delivery orders.

Table 5-5-2 Personnel Assignment in the Assembly Process for *Passenger Car Seats*

Production Line	Production Capacity	Personnel (Persons)			Total (Persons)
		D.W.	S.D.W.	I.W.	
Front Cushion Line	240	20			
Rear Sheet Line	240	18	13	3	42+16
Head Rest Line		4			
Total		42	13	3	58

Since the assembly process is the final process in the production of seats, it is greatly influenced by events in the preceding processes, such as lack of materials. Also, it is closely related to the production plan because the final adjustment of the shipment is made in this process.

Information about orders that serves as the basis for production planning is faxed by Magyar Suzuki once a month. This information includes preliminary figures for the next four months and the confirmed order quantities for the next month. Also, the confirmed quantities for the next month, are broken drown into weekly production plans (planned quantities of delivery). IMAG enters this information in its computer. It orders the cloth and CKD parts that require long delivery times using the preliminary figures given four months in advance, and orders the other materials using the confirmed quantities. For internal production planning, production orders are issued to all the processes according to the delivery plan for Magyar Suzuki. The paces of the individual processes are set according to the company standards as shown below.

Process:	Cutting Process →	Sewing process →	Assembly process →	Shipment
Pace:	2 days before next process;	1.5 days before next process;	0.5 day before next process	

In 1995, the production of passenger cars was increased, and the preliminary figures for the next four months changed every month. The company's ordering system for raw materials could not respond to this change adequately, resulting in a shortage of raw materials. In particular, cloth makers were unable to support the increased production, leading to delays in the delivery of seats. As a result, confidence in IMAG's deliveries was impaired. IMAG still suffers the consequences of this confusion in the company's material control, which needs immediate improvement.

5-5-2 Main Equipment and Layout

1) Seats for buses

All the assembly of seats is performed manually and does not require machinery. The shop is equipped with conveyors for supplying materials and with assembly jigs that also serve as inspection tools for facilitating tasks:

Hanger chain conveyor	2
Heating box for sewn parts	1
Assembly jig (seat frame + plywood)	1
Assembly jig (seat cushion + back)	2

The equipment layout of the assembly process is shown in Figure 5-4-3. There are two simple-seat assembly lines: the assembly line for municipal buses and assembly line for long-distance buses. Assembly tables are arranged in two rows on both sides of the hanger chain conveyors which supply materials.

The separately assembled seats are combined into finished products on the seat cushion & back assembly line and carried out to the shipping area. Or, simple seats covered with cushion surfaces (sewn parts) are combined with simple back rests to form finished products on the assembly line and are then carried out to the shipping area.

2) Seats for passenger cars

The main equipment items of the assembly process for passenger car seats are as follows:

Fixture for front back line recliners (with fool-proof device)	1
Assembly jig for front seats & backs (with fool-proof device)	1
Assembly jig for front seat belt buckles (with fool-proof device)	1
Assembly jig for front seat slide rails (with fool-proof device)	1

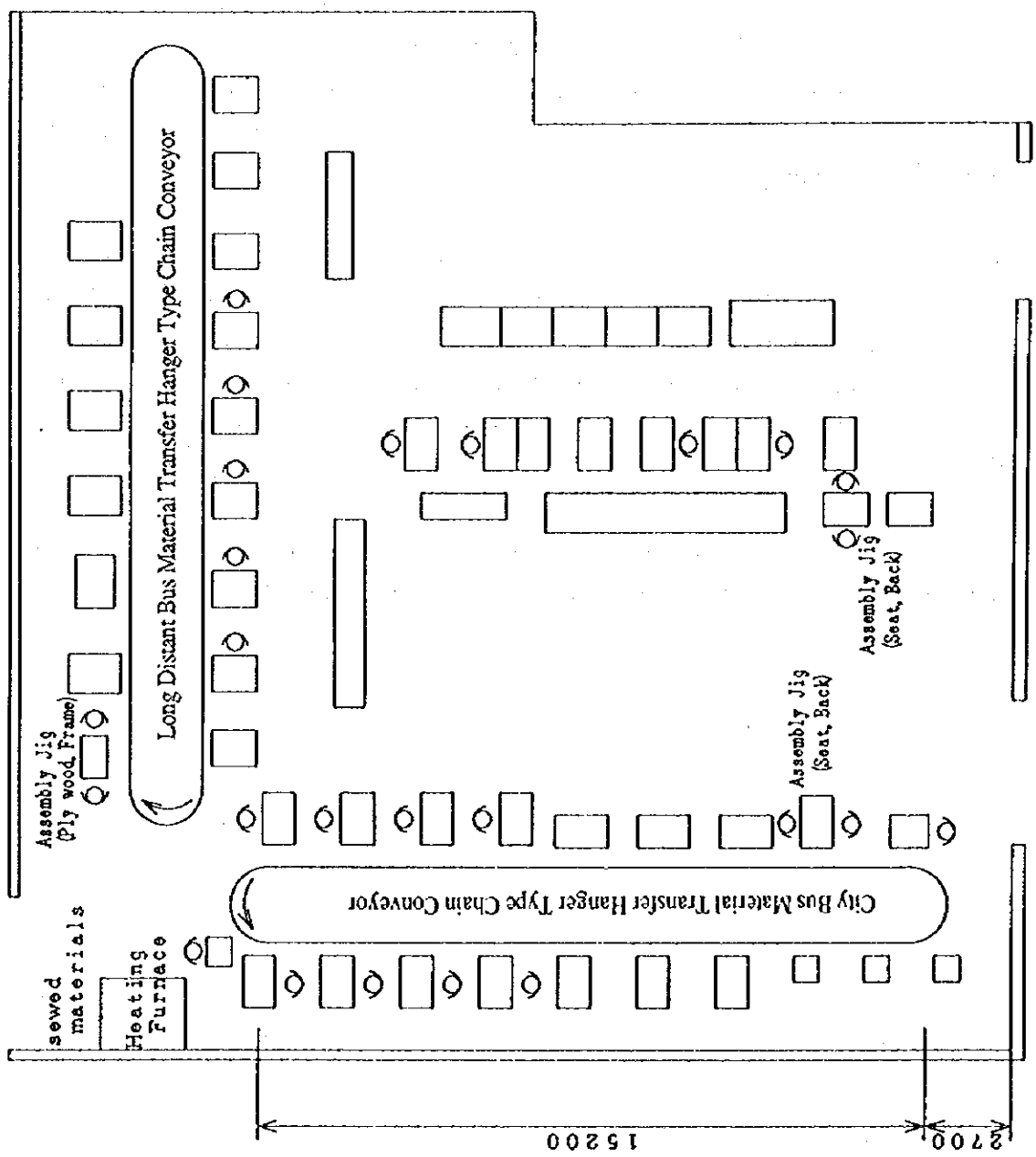


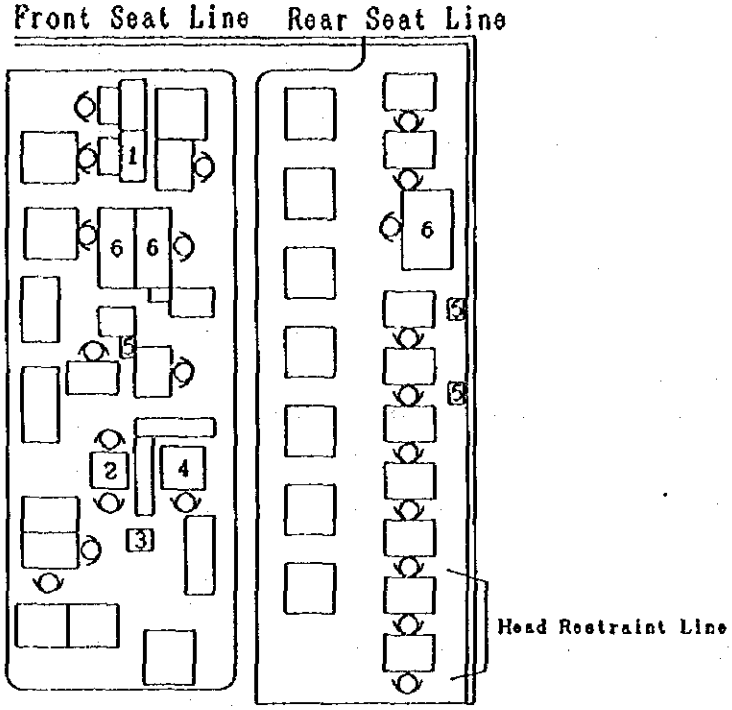
Figure 5-5-3 Equipment Layout of Assembly Process (Bus Seat Division)

Small steam generator	3
Bonding table (with ventilation duct)	3

As shown in Figure 5-5-4, the assembly process consists of three lines: the front seat line, rear seat line, and head rest line. In the front seat line, the seat cushion assembly line and seat back assembly line are laid out in parallel; they eventually converge where the seat cushions and seat backs are assembled into finished products. After 100% inspection, the products are loaded two each on a special-purpose delivery dolly, which is moved into the finished-product warehouse by a finished-product storekeeper and shipped out a half a day later.

The rear seat line has work benches arranged linearly at regular intervals, where the seat cushions and backs are assembled independently. The entire process of rear seat assembly is handled by one worker and the finished products are loaded on a dolly. The process of rear back assembly is divided between two workers. Since they work independently of each other, work-in-process is piled up in the workshop. This means that there is inadequate allocation of duties in the process.

The head rest line is located behind the rear seat line. The assembled products are carried to the end of the front seat line, where they are mounted on the front seats.



1 Front Back Line Reclining Fitting Jig. (with Fool-Proof Device) 1set
2 Front Seat Back Assembly Jig. (with Fool-Proof Device) 1set
3 Front Seat Belt Buckle Assembly Jig. (with Fool-Proof Device) 1set
4 Front Seat Slide Rail Assembly Jig. (with Fool-Proof Device) 1set
5 Small Steam Generator 3sets
6 Binding Work Table. (with Exhaust Duct) 3sets

Figure 5-5-4 Equipment Layout of Assembly Process (Passenger Car Seat Division)

5-5-3 Present State of Assembly Process

1) Seats for buses

The assembly process is the final stage in which the plywood, urethane, metal frames, plastic moldings, and sewn parts produced in the preceding processes are assembled one after another into finished seats.

In the assembly line for the seats of long-distance buses, where the seats for one bus (approximately 40 seats) are produced per lot, seat cushions and seat backs are assembled independently. Large materials such as plywood, urethane, and sewn parts are carried from the individual material yards to the entrance of the assembly shop, then transferred to the hanger chain conveyor, and supplied to the assembly live. The assembly workers pick up materials form the chain conveyor running continuously, and return assembled parts to empty hangers on

the chain conveyor. When one lot is completed, the simple seats are combined with plastic moldings and metal frames to form finished seats on the assembly line using special-purpose assembly jigs designed separately for each seat specification. The finished seats are stored in the finished-product yard until sufficient products for one bus have been completed, and are then shipped out in a container.

There are two types of surface material for municipal buses: cloth and PVC leather. The PVC leather surface is heated in the oven and made soft and readily workable before being put over the cushions. The next assembly worker completes simple seat cushions and seat back cushions using a tacker. The seats for municipal buses are stored as simple items in the finished-product yard, and then delivered in a container. The seat frames are delivered in a container directly from the painting shop.

The assembly work is done manually with pneumatic tools such as pneumatic tackers and screwdrivers. Although the installation of sewn parts requires physical strength and skill, it is carried out without trouble mainly by women. There is no relationship between the pace of the assembly workers and the rotational speed of the chain conveyors. Each worker processes the material she has picked up until a simple seat is completed: the flow production method in which the processes are divided among workers is not employed.

Since the assembly and finishing operations of the long-distance bus seats are not synchronized, the stock of simple seats accumulates: they are piled up directly on the floor, reducing the floor space in the workshop. There is no particular quality problem: the articles are free of wrinkles and contamination.

2) Seats for passenger cars

The assembly process of the front seat line is the final stage in which the metal frames, cushions, sewn parts, plastic moldings, recliners, and slide rails produced in the preceding processes are assembled one after another into finished seats. The flow of the assembly process is shown in Figure 5-5-5.

On the front seat cushion line, the front seat frames are fitted with cushions and covered with the sewn parts, then the seat belt buckles and slide rails, that are important functional parts, are mounted on them. On the front seat back line, the front back frames are fitted with the S-shaped springs which support the passengers' backs, the recliners that are important functional parts, and are the cushions, and are then covered with the sewn parts. In the final operation, the front seat cushions and front seat backs are assembled, on an assembly jig, into finished products. After 100% inspection, four products are loaded on a special-purpose pallet. They are stored

temporarily in the finished-product warehouse and shipped out a half a day later.

Although the production method employed is flow production where processes are divided among workers, there is plenty of work-in-process at each stage. Important processes are provided with fool-proof devices to prevent defective parts from leaving any of the processes. Operations are performed according to the work procedures and the production lines are managed with consideration given to quality.

On the rear seat line, the rear cushions and rear backs for the back seats of passenger cars are assembled. The processes which come after the bonding process (operation (2) or later operations in Figure 5-5-5) are not divided among workers, and each worker carries out all the operations until the product is completed.

The rear seat cushions are completed by putting the sewn parts over the cushions which were foam-molded integrally with frame wires in the previous process. The finished products are loaded on the delivery dolly, stored in the finished-product warehouse for a certain time, and then shipped. Although the shape of the products varies with the models, the processes employed are identical.

The rear seat back is assembled as follows: the rear back panel which was assembled in the metal working process, is fitted with a lock assembly that locks and unlocks the reclining rear seat back, the cushion is glued to the panel, and the panel is covered with the sewn part. In the final process, a luggage mat is attached to the back of the panel, and the panel is complete after inspection. As is the case with the rear seat cushions, the rear seat backs are shipped after being stored for a certain time.

The head rest is completed as follows: two workers put the sewn part manually over the cushion that has been insert-foam-molded with a head rest stay. The finished products are assembled on the front seats in the final process of the front seat line.

In the Passenger Car Seat Division, written standards such as work standards and specifications are in place and posted. The assembly processes of important safety parts are provided with fool-proof devices that are in good working order. All of the finished products are inspected visually. They are free of wrinkles and contamination, the product quality is stable.

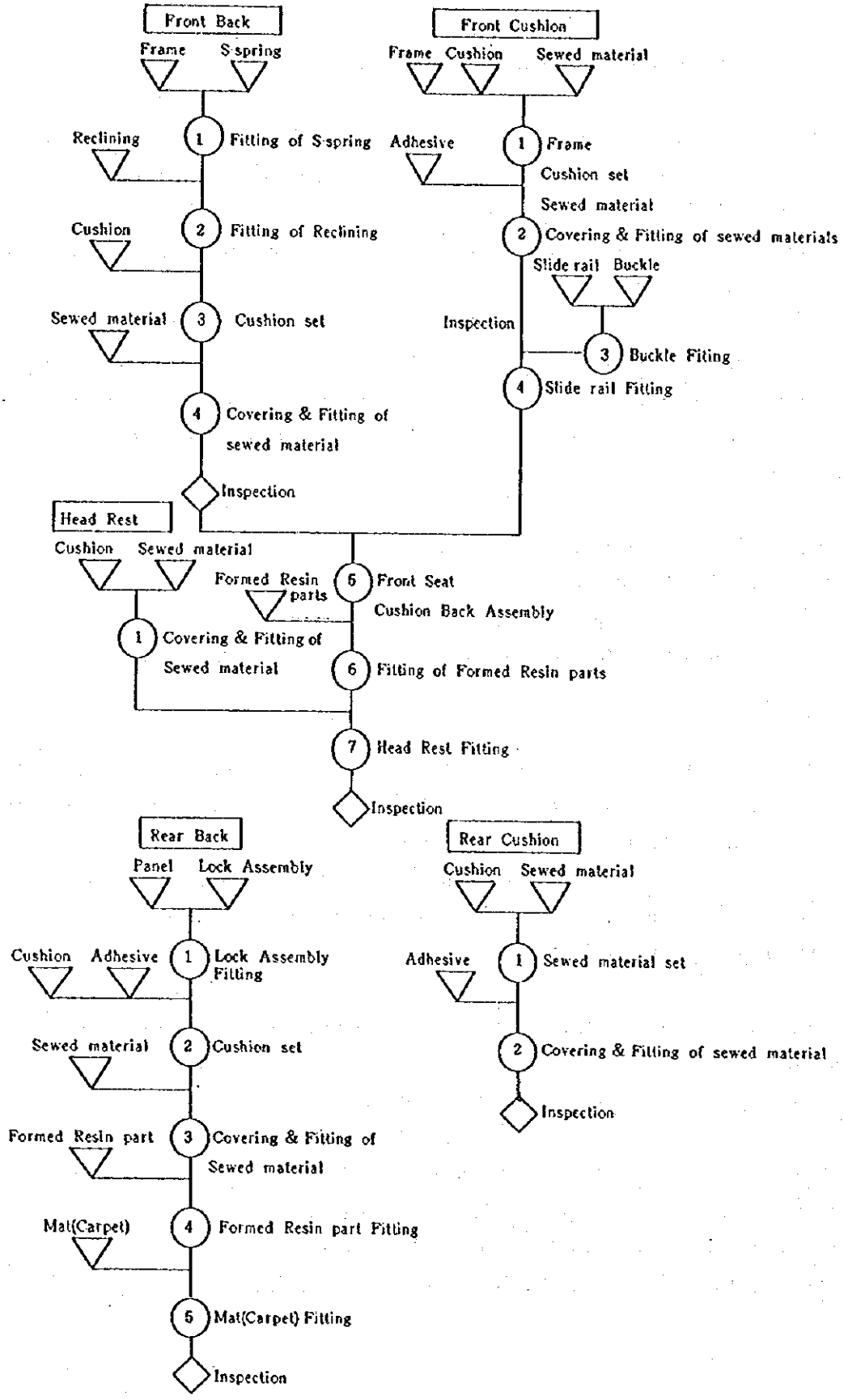


Figure 5-5-5 Flow Chart of Assembly Process for Passenger Car Seats

5-5-4 Problems with Assembly Process

1) Seats for buses

The assembly process for bus seats has the following problems:

(1) Criteria for issuing of materials

(a) The criteria for issuing materials to the assembly lines are unclear. This sometimes leads to stoppage of the lines and a waste of workers' time while waiting, because of material shortage.

(b) Since the pallets for receiving materials do not have wheels, a forklift is required to move them. This causes delays in issuing goods.

(c) Assembly workers have to go out of the assembly shop to fetch small parts with a hand truck, and the operation stops during this time thus, causing a drop in productivity.

(d) Since the materials yard in the assembly shop is located at some distance from the assembly tables, workers have to walk some distance to fetch a few pieces of material at a time. This is a waste of time and labor.

(2) Production lines

In the assembly process of the seat backs for long-distance buses, after the plywood is screwed to the metal frames, the parts are transferred to another building where urethane is glued to them, and then the parts are transferred back to the chain conveyor of the assembly line. This additional transfer is wasteful.

(3) Storage of finished products

Finished products are often placed or piled up directly on the floor. This results in a waste of time and labor spent on looking for necessary items to be shipped, extra handling, storage, and reinspection because the seats may become wrinkled or deformed as a result of piling up.

(4) In-process inventories

Since the assembly line of simple seats and the assembly line of seat cushions and backs are not coordinated, work-in-process piles up, resulting in unnecessary stocks and handling.

(5) Chain conveyors

The workers pick up materials from the hanger chain conveyors and return assembled parts to them. However, since the conveyors rotate continuously at a fixed speed, empty hangers and loaded hangers are not always available when needed. This results in workers' time being wasted while waiting.

(6) Pace of work

Since there are no rules concerning the pace of work, the workers leave their seats as they wish and the pace of work is uneven.

(7) Thread fastening

Before screwing parts to the plywood of seat backs, the tapped holes are opened up by drilling again. Since minus-head screws are driven with a pneumatic screw driver, the tip of the driver bit tends to slip off the slot in the screw heads when torque is applied. As a result, performance is poor and the process itself is rather wasteful. Also, there are some safety problems: workers might damage the tips of their fingers while holding the parts.

2) Seats for passenger cars

The seat back assembly process in the front seat line has the following problems:

(a) There is a large in-process stock of frames on the work bench between the first and second process. This is meaningless overproduction.
(b) Many recliners assembled in the second process are orderly arranged on the racks in front of the work bench. It is wasteful to arrange them on the racks and store them.
(c) Dollies dedicated to work-in-process front backs are provided between the second and fifth processes. Workers in each process have to walk to the dollies to fetch and return parts. This is a waste of labor.

The seat cushion assembly process in the front seat line has the following problems:

(a) The work bench (for mounting sewn parts) in the first process and the work bench (for bonding and covering with sewn parts) in the second process are some distance from each other. It is a waste of labor for the workers to walk between the work benches.
(b) In the third process in which the slide rail is fitted with a buckle, work-in-process is heaped up on the racks. This is meaningless overproduction. Also, the racks for the guide rails are so large that carrying parts to and from the racks is a waste of labor.
(c) Too many slide rails are issued to the side of the assembly line: they occupy a large space, resulting in meaningless stock. (36 cases each containing 24 slide rails are held in stock)
(d) The processes are not properly allocated, work-in-process piles up, and the lines are poorly balanced.

The assembly process in the rear seat line has the following problems:

(a) In the assembly process for rear seats, a number of dollies for storing work-in-process are arranged alongside the assembly line, as is the case with the rear back assembly line. After producing each unit, workers have to walk to a dolly to carry parts. This is a waste of labor.

(b) With the present layout of the assembly line including the work benches and dollies for storing work-in-process, it is difficult to reduce if this means walking them. The production flow should be reviewed and the layout should be changed.

(c) In the second process of the rear cushion assembly in which sewn parts are installed and fixed, the holes for passing seat belt buckles are cut in the sewn parts with a knife. The use of knives in the final stage of the assembly process may result in accidentally leaving a knife in the product.

(d) In the process of fitting the sewn part over the rear back, one worker repeats the same preliminary setup operation for each lot (24 units), during which time other operations are interrupted, resulting in a loss of production time.

Regarding the entire assembly process, since there are no rules to control the pace of work on the assembly lines, workers interrupt their work or make a lot of unnecessary motions during operations. As a result, the productivity is lower than the measured pace. However, the abundance of in-process stock in each process makes it difficult to notice the loss of production time resulting from interrupted work.

Cardboard boxes of CKD parts are left directly on the floor alongside the assembly lines, or used cardboard boxes are left folded on the materials racks, occupying extra space. Some improvements should be made in the packing styles and storage areas of the materials to be issued to production.

5-6 Inspection Process

5-6-1 Organization and Duties

Under the Quality Assurance Department that controls the product quality in the entire factory, the Bus I, Bus II, and Passenger Car Seat Divisions have their own quality assurance sections. Under the quality assurance manager of each division, the persons in charge of the inspection of purchased goods, inspection of semi-finished products, and inspection of finished products control the individual inspection processes in close contact with the production processes. Figure 5-6-1 shows the organization chart of the inspection process. Inspections in the Quality Assurance Department will be described in Section 6-4 of the report.

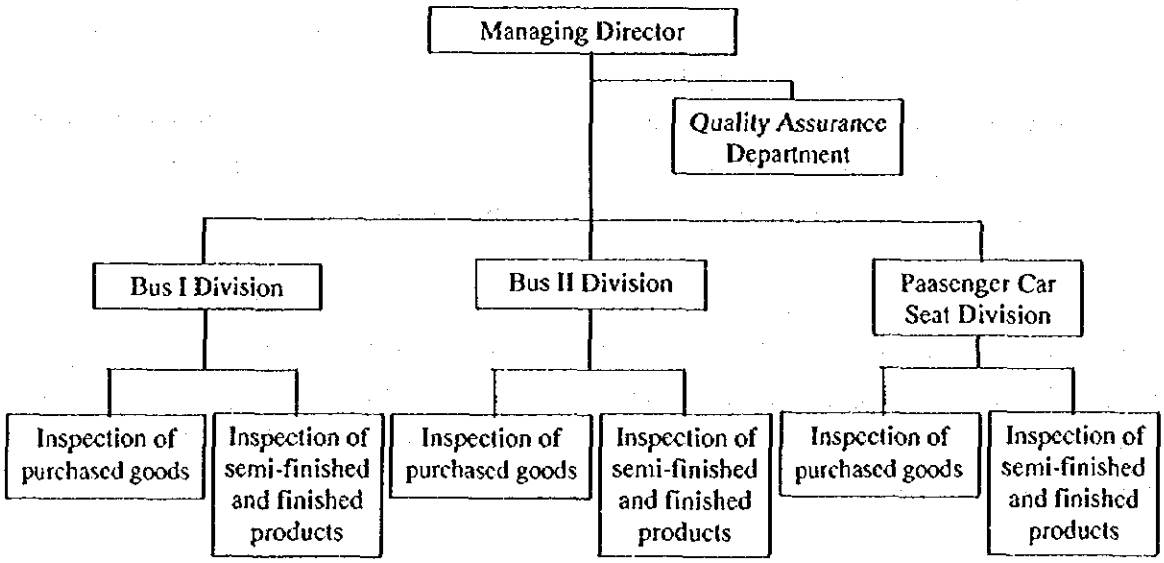


Figure 5-6-1 Organization Chart of the Inspection Process

In the metal working process for the seat frames for buses and passenger cars, the inspection processes are controlled by the persons in charge of the individual inspection processes under the direction of the quality assurance manager of the Bus I Division. In the cutting and sewing processes, cushion process, and seat assembly process of bus seats, the inspection processes are controlled under the quality assurance manager of the Bus II Division.

In the cutting process of the PVC surfaces of passenger car seats, inspections are carried out by the Bus II Division, while the inspections of textile seat surfaces are controlled by the Passenger Car Seat Division.

The wire-frame welding process for the rear seat cushions for passenger cars and the cushion process for the passenger cars are carried out in the shops of the Bus II Division. However,

their inspections are performed by the personnel in charge of inspection processes under the direction of the quality assurance manager of the Passenger Car Seat Division. Table 5-6-1 shows inspector assignments in each division.

Table 5-6-1 Personnel Assignments in the Inspection Processes

	Personnel (Persons)			Total
	Inspection of Purchased Goods	Inspection of Semi-Finished Products	Inspection of Finished Products	
Bus I Division	1.5	2.5	1.0	5.0
Bus II Division	1.0	3.0		4.0
Passenger Car Seat Division	1.5	0.5	5.0	7.0

5-6-2 Main Equipment and Layout

In the assembly lines for bus seats and passenger car seats, sampling inspection is carried out periodically by workers with a torque wrench. In the assembly lines of the Passenger Car Seat Division, the assembly processes of parts important for safety are provided with fool-proof devices that checks for missing parts and ensures that the specified torque is used for tightening. The testing and laboratory equipment necessary for the functional checks of seats is managed by the Quality Assurance Department, which runs tests or experiments on seats at the request of Divisions. Table 5-6-2 lists the main testing and laboratory equipment installed in the Quality Assurance Department.

Table 5-6-2 List of Quality Inspection Equipment

Equipment Name	Frequency of Inspection	Inspection Record
Merton's Foam Elasticity Tester	Every 2 Years	Retained
Resin Strength Meter	Every 2 Years	Retained
Three-Dinention Measuring Machine	Every 2 Years	Retained
Hardness Testers of Various Types	Every Year	Retained
Weather Resistance Test Chamber	Every Year	Retained
Thermostatic Chamber	Every Year	Retained
Micrometer Calipers	Every Year	Retained

According to the rules, the instruments and main inspection machines installed in the field undergo the checks listed in Table 5-6-3 once a year.

Table 5-6-3 Checklist for Measurement Devices

BUSZ II. Divízió MINŐSÉGBIZTOSÍTÁS	Mérőeszközök nyilvántartása M2ZA 0004	1 / 1. oldal 1995.06.30.

	Név	Mérőeszköz megnevezése	Mérőeszköz nyilvántartási száma	Kalibrálás dátuma	Érvényes 1.	Érvényes 2.	Érvényes 3.	Érvényes 4.
1	Sury Gyula	tolómérő 150	ZR 3091	1995.06.30	1996.06.			
2	Zsöllei László	tolómérő 150	ZR 3094	1995.06.30.	1996.06			
3	Czetli Imre	tolómérő 150	ZR 3093	1995.06.30.	1996.06			
4	Németh Miklós	tolómérő 150	L 729	1995.03.03.	1996.03.			
5	Sury Gyula	tolómérő 150	B 240	1995.03.03.	1996.03.			
6	Sury Gyula	szögmérő	A 977	1995.03.03	1996.03			
7	Antal József	derékszög 250	ZR 3104	1995.03.03.	1996.03.			
8	Kálhok Ferenc	tolómérő 150	ZR 3011	1995.03.03.	1996.03.			
9	Takács László	tolómérő 150	ZR 3124	1995.03.03	1996.03			
10	Finta Bálint	tolómérő 150	ZR 3092	1995.06.30.	1996.06.			
11	Sury Gyula	tolómérő 150	ZR 3090	1995.06.30.	1996.06.			
12	Nagy László	tolómérő 150	ZA 3001	1995.06.30.	1996.06.			
13	Sury Gyula	tolómérő 150	06117381	1995.06.30.	1996.06.			
14	Sury Gyula	nyomatékkulcs	BDAU-07-B	1995.06.30.	1996.06.			
15	Kábel műhely	erőmérő (kábelsaruhoz)	K 001	1995.06.29.	1996.09			
16								
17								
18								
19								
20								

Listát ellenőrizte: Sury Gyula 1996.02.22.

5-6-3 Present State of Inspections

1) In-process inspection

(1) Seats for buses

Regarding the inspection of purchased goods, a check sheet is created for each part, and sampling inspection is carried out. As for inspection of semi-finished products, 100% of the products are inspected when drawn from the molds in the cushion process, and their quality is fairly good. However, dirtiness conditions may results in defective foaming. Workers are sometimes seen correcting such defects during assembly line operations.

Although the assembly jigs for seats are positioned according to the assembly work specifications, they are not provided with fool-proof devices for verifying tightening torque and dimensions. Work-in-process is often piled up on work benches or placed directly on the floor, resulting in lowered working efficiency and quality. All of the finished products are inspected in the final process of the seat cushion and back assembly line.

(2) Seats for passenger cars

Regarding the inspection of purchased goods, a check sheet is created for each part, dimensions are checked and strength is tested for every lot according to the list of characteristics to be inspected, and a record is kept. The results of sampling inspections are entered in the record without fail according to the list of characteristics to be inspected. Also, chemical analysis of urethane materials is conducted for every lot received. The voucher of IMAG is shown in Table 5-6-4.

For the inspection of semi-finished products in the production processes, sampling inspections are conducted regularly every day, and efforts are made to prevent defective parts by posting work standards and specifications in each process. In the sewing process, the person in charge who does the final sewing makes final checks after completion and signs to confirm she has done so. This clearly defines who is responsible for quality verification.

For the assembly of parts important for safety in the seat assembly process, the assembly jigs have built-in fool-proof devices that check, within the process, for missing parts such as bolts and checks whether the tightening torque is within specification. This prevents defective parts from being passed on to the next process. The workers operate according to the procedures specified by the work standards and the fool-proof devices function normally.

The quality of the passenger car seats is stable: a system has been established in which the quality is assured by conformance to the work standards and by quality checks.

Table 5-6-4 Material Receiving Card

MBEU5 2. sz. melléklet

IMAG

Idegenáru átvételi napló

IMAG Kft

Divizió: BUSZ II. Sorszám: 358/1
Beszállító: Graboplast Kold. Dátum: 96.01.18.
Szállítólevélszám: 62 16515 Mennyiség: 226 szt
Szállítás, csomagolás, tárolás: Kötegelve, védőfóliás
Laborvizsgálati igény száma: MK 0150/96 Laborvizsgálati eredménye: M.
Minősítés: M Zárolás (címke szám): Engedménnyel felhasználható:
Megjegyzés:
NIPPON 04
D.Sp. 102.1126 1782-R-107-00

műszaki ellenőr: Fabó

Felülvizsgálati intézkedés:

Minőségbiztosítás vezető:

Divizió: BUSZ II. Sorszám: 358/2
Beszállító: Graboplast Kold. Dátum: 11.15.
Szállítólevélszám: 62 46608 Mennyiség: 7 166.40 fm
Szállítás, csomagolás, tárolás: kötegelve, védőfóliás
Laborvizsgálati igény száma: Laborvizsgálati eredménye:
Minősítés: M Zárolás (címke szám): Engedménnyel felhasználható:

Megjegyzés:
NIPPON 04
1782-R-107-00

műszaki ellenőr: Fabó

Felülvizsgálati intézkedés:

Minőségbiztosítás vezető:

Divizió: Sorszám:
Beszállító: Dátum:
Szállítólevélszám: Mennyiség:
Szállítás, csomagolás, tárolás:
Laborvizsgálati igény száma: Laborvizsgálati eredménye:
Minősítés: Zárolás (címke szám): Engedménnyel felhasználható:

Megjegyzés:

műszaki ellenőr:

Felülvizsgálati intézkedés:

Minőségbiztosítás vezető:

Divizió: Sorszám:
Beszállító: Dátum:
Szállítólevélszám: Mennyiség:
Szállítás, csomagolás, tárolás:
Laborvizsgálati igény száma: Laborvizsgálati eredménye:
Minősítés: Zárolás (címke szám): Engedménnyel felhasználható:

Megjegyzés:

műszaki ellenőr:

Felülvizsgálati intézkedés:

Minőségbiztosítás vezető:

2) Inspection of finished products

The inspection of finished products is carried out in the final process of the production lines by workers of the Production Department during the final finishing operation. The front seat line of the seat assembly process handles many parts important for safety, 100% of which are inspected by inspectors in the final process of the line. The other products processed on the line also undergo sampling inspection as finished products. As an overall quality control technique, the amount of losses incurred from defective parts are totaled, and the cost of correcting defective parts and the loss incurred by discarding defective parts are reported separately every month.

Although measures against quality failures are taken, it still remains to establish other aspects of quality control ranging from factorial experiments to discussion of methods, under the leadership of the Quality Assurance Department by using such quality control techniques as a cause and effect diagram, and the format of the report on quality measures.

3) Dealing with defective products

If a product (or semi-finished product) produced in one department is found to be defective in a subsequent process in another department, the Quality Assurance Section of the department that found the defect sends a report on the discovery to the Quality Assurance Section of the department that produced the defective product. In response, the Quality Assurance Section of the department that produced the defective product prepares and submits a report on measures to prevent such defects. For important quality problems, a system has been established in which the Quality Assurance Department that controls the product quality in the entire factory gives instructions and concerted action is taken across the company.

5-6-4 Problems with Inspection Processes

1) Seats for buses

As a whole, the inspection on the production lines is conducted without fail according to the rules. However, it is necessary to improve the facilities and review the parts and working methods in order to stabilize the quality as described below.

(a) It is necessary to standardize the sequence of operations and the setting of the time interval between injection and mold removal in order to prevent defective foaming in the cushion process.

(b) Although the cushion process is provided with crushing rollers and a vacuum degassing apparatus, they are used only for part of the products and the remaining products are degassed and inspected manually. To stabilize the quality, mechanization of the

degassing operation should be considered.

(c) It is necessary to look into the problem areas of the assembly process on the bus seat assembly lines and put planned measures into practice. (Sections in charge: Quality Assurance Section, Production Section)

(d) To ensure that inspection is carried out in the important seat assembly process, it is necessary to install a fool-proof device that checks for missing parts in important processes and checks tightening torque.

(e) It has become a common practice to stack up products or place products directly on the floor, resulting in lowered quality and the necessity to check the finished products again before shipment. Measures should be considered to avoid this practice.

2) Seats for passenger cars

The passenger Car Seat Division has the following problems:

(a) Regarding the inspection of semi-finished products, although checks are made in each process of the production lines, the formats of the check sheets for in-process defects are not standardized.

(b) Although the tightening torque of bolts in the assembly processes of parts important for safety are controlled by means of fool-proof devices, the specified range of tightening torque values should be posted in the workplace where it can be easily seen.

(c) In the assembly processes of parts important for safety, the assembly jigs equipped with fool-proof devices should be checked regularly to ensure that they are functioning normally. A daily inspection sheet listing error preventing functions to be checked should be put up in the workplace.

(d) In the assembly processes where torque must be controlled, although inspectors check the tightening torques of the products regularly, the check results are not posted in the workplace.

(e) In the production processes, to prevent recurrence of faults, a "quick check procedure" should be initiated.

5-7 Logistics

In order to maintain and improve quality, costs, and delivery times, it is important to control not only the production processes, but also the logistics that is the flow of materials from the receipt of materials to the delivery of products to customers. In particular, the production of seats requires many kinds and quantities of parts as well as a large number of processes, such as the sewing, cushion, metal frame, painting, and assembly processes. Since the volume of the flow of materials depends greatly on the methods of handling, transfer, and storage of these parts, it is necessary to consider how to control the flow of materials between processes and the shipment of products.

5-7-1 Present State of Flow of Materials between Processes

1) Bus I Division

(1) Personnel assignment for logistics

The Bus I Division deals with the metal work of bus and passenger car seats. The frames are completed in seven processes starting from the receipt of materials. The present flow of items and distances transported are shown in Table 5-7-1 for the purpose of understanding what is necessary to improve the logistics within the factory.

The handling of materials is undertaken by a total of three materials handling workers (full-time): one worker posted to the materials warehouse, one worker to the pipe working process, and one worker to the welding process. They work under the direction of staff of Bus Coordination Department. All the processes of the Bus I Division from the materials warehouse to the painting process are located in one building. The distances between the processes are short and the frequency of transport presents no particular problem. The handling of materials is managed by three persons, which is not a large number. However, there is one negative feature: the amount handled at one time is large which increases the volume of in-process stocks and requisite use of a forklift.

Table 5-7-1 Personnel Assignment for Flow of Materials in Bus I Division

Process	Duties	Total distance (*m*)	Full-time worker (*persons*)
(a) Materials warehouse	Storage and issue of materials	10×3 = 30	1
(b) Cutting process	Storage and transport of cut pipes	10×10 = 100	
(c) Pipe bending process	Storage and transport of bent pipes	10×5 = 50	1
(d) Butt welding process	Storage and transport of butt-welded parts	50×5 = 250	
(e) Press working process	Storage and transport of press-workedparts	50×2 = 100	
(f) Welding process	Storage and transport of finally welded parts	40×10 = 400	1
(g) Painting process	Storage and transport of completed frames	50×20 = 1,000	
Total		1,930 m	3

Pipe materials

Coiled materials

Note *: Total distance = distance of one trip X number of trips per day

(2) Present state of flow of materials between processes

(a) Materials warehouse

Normally, two months' stock of pipe material is stored in the warehouse which is equipped with a 5-ton crane. Material is issued, as required, at the request of the cutting process. Bundled pipes are loaded by the crane onto a dedicated vehicle that shuttles to and from on rails through a gate. Then the pipes are carried automatically to the cutting process by the vehicle. This operation is handled by a storekeeper (concurrently a crane operator).

(b) Cutting process

After carrying in all the pipes are cut and placed on pallets. One bundle of pipes constitutes one lot. However, there are many types of pallets whose capacities are not uniform, so quantity control is inadequate. The cut pipes are stored, by being piled up in the pallet yard by the materials handling worker using a forklift. The transport to the next process is undertaken by the materials handling worker. Since the pipes are piled up, FIFO (first-in first-out) is not always followed.

<Problems>

- The capacities of the pallets are not uniform (visual quantity control is impossible).
- There is a large stock.
- First-in first-out is not used.

(c) Pipe bending process

The cut pipes are carried pallet by pallet to the pipe bending process by the materials handling worker on a forklift according to the working plan. Bending is performed piece by piece. The bent pipes are either stored on a dedicated hand truck, or placed in iron boxes, carried to the yard near the welding process, and piled in stacks of two using a forklift.

<Problems>

- The capacities of the pallets are not uniform.
- The hand truck is heavy.
- There is a large stock.

(d) Butt welding process

The bent pipes stored on the dedicated hand truck are carried to the welding process according to the working plan by the materials handling worker, butt-welded, and checked: these operations do not pose any problem with respect to materials flow since the equipment is laid out for one worker. Also, because the pipe bending and butt welding processes are next to each other, there is no particular problem with the flow of materials, either.

(e) Press working process

The coiled material and sheet material are carried in, by the coil and by the package respectively, from the warehouse on a forklift. The carrying-in operation is performed by the storekeeper. The materials are processed either by the coil or by the package.

The processed parts are put in an iron box (1,000 mm W X 1,000 mm D X 800 mm H), and stored near the wall by the materials handling worker.

<Problems>

- The capacity of the iron box is so large that the quantity of parts cannot be seen clearly.
- There is a large stock.
- First-in first-out is not used.

(f) Welding process

The materials are carried in from the previous processes by forklift. The carrying-in operations are performed by two full-time workers. Instructions are given by the Bus coordination staff. However, if the instructions are out of step with the workers' progress, workers' line is wasted while waiting.

Since the press-worked parts are carried in an iron box, workers transfer them to a small box and carry it around to the jigs. Thus, more parts than necessary are supplied. In the case of

press-worked parts procured externally, workers go and get them from the parts yard. After welding, the parts for buses are put in iron boxes and parts for passenger cars are on special-purpose pallets, respectively, and stored in the shop. Later they are carried to the painting shop or Suzuki Seat Assembly Plant by the materials handling worker on a forklift.

<Problems>

- The quantity of the press-worked parts in an iron box issued to the welding line is too large.
- First-in first-out is not used.
- The communication with the materials handling system common to the entire factory is poor. As a result, worker's time is wasted while waiting.
- While the workers are away to fetch press-worked parts, the work is interrupted.

(g) Painting process (seat frames for buses and railway vehicles only)

The painting process consists of shot blasting (pretreatment) and electrostatic powder coating. The frames carried in from the welding process are hung on the chain conveyor one by one, and transferred to the painting booth. The workpieces are transferred from the shot blasting process to the powder coating process by switching from one chain conveyor to another.

After painting, the products are separated from each other by pieces of newspaper to prevent damage, put in iron boxes, and stored within the shop.

<Problems>

- It takes too much time to store the finished products. (Some method should be devised to eliminate newspaper.)
- The packing should be changed from disposable to returnable material.
- The place where the finished products should be put is not indicated. Also, the capacity of the iron box is not clear.
- Since the iron boxes do not have wheels, a fork lift must be used to move them to the assembly process.

2) Bus II Division

(1) Duties and personnel assignment

The Bus II Division is in charge of the processing that requires machinery except for metal working. It performs cushion processing and press cutting for both buses and passenger cars. We studied the flow, distance, and frequency of handling materials and found out that although the distance from (a) the materials warehouse to (b) the cutting process was long, the number of trips was small and the total transport distance per day was short as shown in Table 5-7-2. In

view of this, the full-time materials handling worker of two is excessive. Between (c) sewing and (e) assembly processes, the distance, number of trips, and total distance are all great. Improvement is needed from process (c) on-wards.

Table 5-7-2 Personnel Assignment for Flow of Materials in Bus II Division

Process	Duties	Total distance (m)	Full-time worker	Remarks
(a) Materials warehouse	Storage and issue of materials	140×2= 280	1	
(b) Cutting process	Storage and transport of cut parts	60×2= 120	} 1	
(c) Sewing process	Storage and transport of sewn parts	100×5= 500		
(d) Cushion process	Storage and transport of cushions	40×24= 960	1	Forklift
(e) Assembly process	Storage and transport of frames and other	135×7= 945	1	Forklift
Frames / Parts	Storage and transport of finished products	530	1	
Total		3,340 m	5 persons	

(2) Present state of flow of materials between processes

(a) Materials warehouse

The warehouse stores the PVC leather and cloth for seat surfaces and the wire harness parts for buses, and is managed by one person. The issue of materials to other processes is handled by one worker who concurrently holds another post. The surface materials that are handled in great quantities are transported over a distance of 140 meters once or twice a day.

(b) Cutting process

This process cuts the PVC leather for passenger car seats as well as the entire quantity of bus seat surfaces. The rolled sheets to be cut are carried in from the materials warehouse on a forklift two days ahead of the cutting operation. The PVC leather is punched, while the cloth for buses is cut manually with scissors.

The cut cloth is carried to the next process (i.e., the sewing process) on a hand truck by the machine maintenance worker of the cutting process once a day. The punched PVC leather is carried in bulk to the sewing processes of bus seats and the Suzuki Division on a forklift by the materials handling worker once in three days.

<Problems>

- In relation to the volume handled, two persons -- one storekeeper and one materials handling worker (holding concurrently the post of maintenance worker) -- are excessive.
- The distance from the cutting process to the sewing process of the Passenger Car Seat Division is too long.

(c) Sewing process

The storage areas for cut parts and sewn parts are allotted in one corner of the sewing shop. Normally, there are five to six workers. They receive sewn parts on their own wagons (the upper section is allotted for cut parts, the lower section for sewn parts) according to the work instructions. They inspect the finished products by themselves, enter the product name, quantity, and manufacturing date on a slip, sign the slip, and take the products with the slip to the storage area for sewn parts using the wagon, and store them. In the assembly shop, the products are received by the materials handling worker on a hand truck.

<Problems>

- The workers transport cut parts and sewn parts by themselves.

(d) Cushion process

The urethane raw materials are delivered by a tank lorry and stored in storage tanks. They are fed automatically from the tanks to the foaming process. The inserts, i.e., frames and plywood, are placed on pallets and transported to the sides of the assembly lines on a forklift by the materials handling worker. The finished cushions undergo the crushing process, are loaded on dollies by type, cured in the warehouse for 24 hours, and then stored. On average, one dolly can carry the following number of cushions:

For buses	28
For Suzuki front seats	26
For Suzuki front backs	32
For Suzuki rear seats	10
For Suzuki rear backs	24

The cushions for the assembly processes of the Bus II Division and Suzuki Division are transported two truck loads at a time on a forklift. The cushions for the Suzuki Division are received and transported by the materials handling workers of the Suzuki Division.

<Problems>

- The transport to the Passenger Car Seat Division is inefficient.

- Although the cushions are light, all of them are handled with forklifts.
- First-in first-out is not used fully.

(e) Assembly process

The assembly process is the final process in which the parts produced in various processes are assembled into complete seats. The assembly process has two assembly lines: the assembly line for the seats for long-distance buses and the assembly line for the seats for municipal buses. The seats are assembled mainly from sewn parts, cushions, frames, and small parts such as screws. The sewn parts are carried in from the sewing process on a hand truck approximately five times a day. The cushions are brought in, piled in stacks on two special-purpose pallets, on a forklift by the materials handling worker. Since the cushions are bulky, they require frequent transportation. The frames are carried in iron boxes from the painting shop on a forklift by the materials handling worker. In the case of small parts such as screws, the workers fetch them from the parts yard as required.

<Problems>
- Necessary parts are not brought in according to the assembly plan (on time). As a result, the workers' time is wasted while waiting.
- Since the pallets do not have wheels, they can be carried only by a forklift.
- While the workers are away fetching parts, the work is interrupted.

3) Passenger Car Seat Division

(1) Duties and personnel assignment

The division manages the production from the procurement of materials to shipment. Materials such as rolled cloth and CKD parts are received into the materials warehouse, stored there, and issued to the temporary storage area of the shop as required. The cushions and frames are processed in the Bus Division. These Divisions have high distribution costs because of the long materials handling distance and the quantities. Although there are only 5 main production processes, twelve inter-process transfer and storage operations are required to complete the seats.

The quantity produced is going up each month, the shop is running at full capacity, and the distance and frequency of handling materials as a whole are large. This shop has thirteen full-time materials handling workers, and the flow of materials needs to be improved.

Table 5-7-3 Personnel Assignment for Flow of Materials in Passenger Car Division

Process	Duties	Total distance (m)	Full-time worker	Remarks
Cushion process	Transport to and storage in wardhouse for cushions	20×50 =1,000		
Warehouse for cushions	Transport from warehouse for cushions	350×25=8,750	3	
Frame process	Transport of frames	200×12=2,400	2	
PVC cutting process	Transport of cut PVC parts	250×1= 250		
(a) Materials warehouse (cloth)	Transport of cloth to be cut	130×8= 2,340	1 person ×	
(b) Temporary storage area	Storage and issue of *materials yet to be set up*	44×10= 440	2 shifts	
(c) Cutting process	Transport of cloth from, and storage of cut parts in,	20×13= 260	= 2	
(d) Sewing process	Storage and transport of sewn parts	50×15= 750	2 person ×	
Cushions	Transport of cushions from temporary storage area	35×25= 875	2 shifts	
Frames	Transport of frames from temporary storage area	35×20= 700	= 4	
(e) Sewing process	Transport of assembled products	30×80= 2,400		
Warehouse for finished products	Storage and shipment of finished products		2	
Total		20,165 m	13 persons	

(2) Present state of the flow of materials between process

(a) Materials warehouse

This warehouse receives and stores materials of 300 types in sufficient quantities for the monthly production of 4,000 cars. As for rolled cloth and CKD parts, since they require delivery times of 2.5 to 3 months, there are naturally large inventories and long storage times, and they are stored by being piled in heaps for lack of space. As a result, it has been impossible to specify or arrange their storage areas, and it is difficult to tell what is stored in which place.

The materials are handled by four receiving workers and three issuing workers. Since storage areas for received goods were not arranged in advance, the materials were unloaded

outdoors, and then carried in after arranging inside. The situation was such that in order to take out materials from the lower layers, all the pallets at the entrance had to be removed. Materials handling required several times more time and labor than it normally would, and the shop was in need of immediate improvement. However, a short-term improvement plan has nearly doubled the storage space, and the articles have been put in order: for example, dead stock has been identified. As a result, the receiving and issuing of materials are performed smoothly now.

(b) Temporary storage area for materials

A temporary storage area is provided where the necessary quantities of rolled cloth to be used in the cutting process and materials and parts to be used in the assembly process can be placed. The items carried in include rolled cloth and CKD parts from the materials warehouse, frames from the Bus I Division, and cut parts and cushions from the Bus II Division. They are loaded on dollies or pallets and carried in on forklifts by the respective materials handling workers. Both the distances and quantities of materials handled are large, causing high distribution costs.

<Problems with both warehouses>
- There are large inventories.
- Places to put items are not indicated.
- One cannot tell where each item is stored.
- First-in first-out is not used.
- Management of movement of actual goods is unclear.
- Material handling distances are long.
- Packing styles and capacities are not uniform, making it difficult to grasp the quantities.

(c) Cutting process

In this process, thirteen female workers (in two shifts) are engaged mainly in cutting the cloth for passenger car seats. For their work, they carry in rolls of cloth, prepared according to the work standards, one roll at a time from the temporary storage area on a hand truck.

The work proceeds one day ahead of the sewing process. The cut parts are carried and stored in a storage area beside the sewing shop on the second floor. The cutting and sewing shops are located on the first and second floors of the same building, and the inventory, sufficient for one day, is appropriate. Thus, there is no particular problem with the flow of materials.

(d) Sewing process

This process consists of three lines, to which 56 workers are assigned (two shifts). One worker is assigned to supply materials and store finished products. Since there is no one exclusively in charge of setup operations, the workers themselves have to leave their seats frequently in

order to pick up materials or transfer semi-finished products. This results in lowered operating efficiency. On the other hand, the shop is located on the second floor of the same building as the assembly and cutting processes, and as it is close to the previous and following processes, this process poses no problem with respect to flow materials.

The work proceeds one day ahead of the assembly process. It is carried out efficiently in a small space with a small inventory volume.

<Problems>

- Since there is no one exclusively in charge of setup, workers themselves have to leave their seats frequently to pick up materials or transfer semi-finished products.
- The PVC leather is cut in the Bus II Division, resulting in materials being handled over a long distance.
- The sewn parts (finished products) are placed directly on the floor.
- Lot production is not always followed in the cutting process (the lot size often fluctuates.)

(e) Assembly process

This process consists of two lines, the front seat and rear seat lines, to which a total of 42 workers (in two shifts) are assigned. It produces seats for 240 cars a day. The production lines employ flow production in which processes are divided among workers. The materials and parts to be assembled, prepared beforehand in the previous processes, are stored in the temporary storage area, and delivered to the sides of the lines by two setup workers assigned exclusively to the assembly process.

Large parts such as frames and cushions are supplied on dedicated dollies while small parts are supplied in boxes to predetermined places in each process.

<Problems>

- Although workers are assigned exclusively for setup, the production workers themselves often have to pick up materials.
- Although flow production is employed, these are large in-process floating inventories.

5-7-2 Present State and Problems of Shipping Management

1) Bus II Division

All the bus seats are produced for orders received from IKARUS. Although there are variations in the monthly orders, seats for five municipal buses (for 40 passengers) and one long-distance bus (for 45 passengers) on average are produced in a day.

Seats for one bus are produced as a unit. They are planned to be completed one day ahead of the delivery date. The seats and frames for municipal buses are shipped separately. When simple seats for one bus are completed and inspected, they are put in a container and shipped on a truck. The frames are shipped from the painting shop also in a container.

Regarding the seats for long-distance buses, when seat assemblies are completed and inspected, the quantity corresponding to one bus (25 sets of 2-person seats) is put in a container and shipped on a truck.

The loading of the seats into a container is performed by one materials handling worker.

The completed seats are placed directly on the floor, and the quantity corresponding to one bus is loaded at a time in one container. When the distance from the container is large, a hand truck carrying three seats is used. Although consideration is given to efficiency, considerable time is spent on padding the bulk load to prevent it from shifting.

<Problems>

- Basically, products corresponding to one bus are put into one container. This may result in inefficient loading.
- The efficiency of loading the containers is low.
- Finished products are placed directly on the floor, and then the quantity corresponding to one bus is loaded into a container at one time. This method of loading should be reviewed.

2) Passenger Car Seat Division

All the orders for passenger car seats are received from Magyar Suzuki. Seats for 240 cars are produced in a day including four models of sedans and three models of hatchbacks. The seats produced half a day ahead of the delivery date are shipped by a truck five times a day according to Magyar Suzuki's weekly production plan.

After assembly and inspection, completed seats for four cars are loaded on a dedicated dolly and carried to a predetermined storage area by a shipping worker. Two shipping workers manage the shipping warehouse, transfer and store finished products, bring back empty dollies, and load the products to be shipped.

From the dedicated dollies, the finished products are loaded on a truck by a forklift and shipped. Since the assembly operation is half a day ahead of shipment, the stock is small. Also, the loading efficiency of the truck is almost 100%.

<Problems>

- The loading and unloading of the truck is inefficient. (The struck is parked a long way off.)
- Empty dollies get dirty since they are parked outdoors.

Chapter 6

Present State and Problems of Prodution Control

Chapter 6 Present State and Problems of Production Control

Production control deals with such areas as design aspects associated with production in a wide sense, procurement (purchasing and subcontracting), inspection (quality control), warehousing, transportation, and management of equipment and tools. The basic functions of production in these areas can be divided into three parts: design, procurement, and operations. Production control can be defined as the overall control of the plant's production activities to give cost effective utilization of the plant's resources including labor, equipment, and materials to produce products of a certain quality in a certain quantity by a given delivery date.

The issues IMAG was concerned about were studied from the above standpoint. They included the company's product development and design, inventory control, quality control, information processing system, and the production control which controls the production activities in the plant.

6-1 Product Development and Design

Development and design are activities for creating of goods that satisfy the customers needs, and have two aspects. The first is to provide the quality that the customers demand, in the functions of the product. The second is to plan the product to ensure that the resources to be used in its production are appropriate from the point of view of cost.

6-1-1 Organization and Assignment

The Development Department in charge of the development and design of products and the Technical Department are under the authority of the Vice President of Technology.

The Development department deals with the development, improvement, and specification changes of the seats for buses, railway vehicles, and electric trains. However, it does not deal with the other products including passenger car seats since these products are made to order. The organization chart of the Development Department is shown in Figure 6-1-1.

The Development Department is consisted of two groups of the product development group and the technical development workshop as described below.

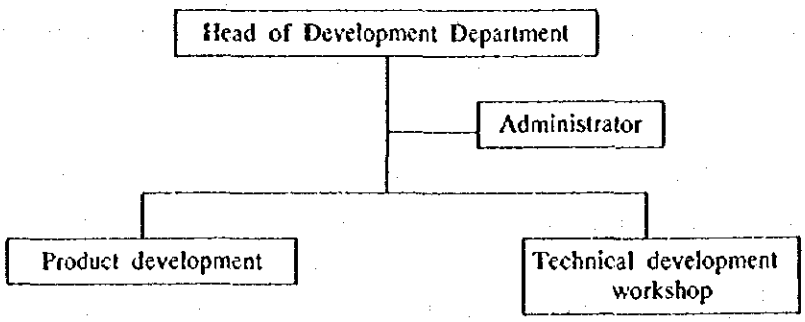


Figure 6-1-1 Organization Chart of the Development Department

1) Product Development group

The group is composed of four persons who are in charge of the following tasks:

Member A (engineer):	Seats for long-distance buses and seats for railway vehicles
Member B (engineer):	Seats for municipal and interurban buses and seats for electric trains
Member C (engineer):	Improvement and specification changes of various seats, including seats for bus guides
Member D:	Drawing

In addition to the above members, there is a post of development engineer for bus driver's seats which is vacant.

2) Technical Development Workshop

The group is composed of three workers including a coordinator. It creates prototypes based on the drawings and specifications provided by the Product Development group.

6-1-2 Present State of Product Development and Design

The types of buses the company is developing are (1) municipal buses (microbuses with up to 9 seats, minibuses with up to 17 seats, motor coaches with an overall length of 6 meters or more, and trailer buses with an overall length of 14 meters or more), (2) interurban buses, and (3) long-distance buses. The development work is divided among the three engineers.

Recently, the company developed a seat for railway vehicles. It went into production in 1993 and seats for 120 vehicles have already been produced. Now the company is developing a seat for the Hungarian National Railway and plans to complete a prototype by March 1996. It aims at expanding its market in this area.

1) Capacity for development and prototyping

Only three engineers are engaged in development and design. In addition to the development of new products, they deal with user demands for specification changes and improvements. The Product Development group has a state-of-the-art CAD system, which it uses for design and improvements. The seat (which complies with IRU, three-star-class specification) for long-distance buses, that began to be sold in 1995, took the company nearly one year to develop, including the initial 3 month trial operation period of three months.

The Technical Development Workshop has its own technical development laboratory (approx. 200 m^2) equipped with basic equipment and tools such as a drilling machine, hydraulic press, bench grinder, electric welder, pipe bender, and hand drill. Three persons are engaged in making prototypes of new, modified, or improved products. However, the prototypes that can be manufactured in the production lines are entrusted to the factory.

The workshop does not have laboratory equipment exclusively used for development: tests and experiments are entrusted to the Quality Assurance Department described later. Since the range of development work is very wide, and also because there are limits to the current development capacity of the workshop, it is difficult for the workshop to handle all the development work.

2) Design standards

The company adopts the ECE rules established by the United Nations Economic Commission for Europe based on the "Agreement on the Adoption of Uniform Conditions for Automobiles and Automotive Parts" concluded in the 1958 Geneva Convention. These rules spell out regulations and standards concerning buses, such as the types of buses, seat grades, regulations and standards for development of seats, and quality inspection standards.

Company standards for design remain to be established. For materials and parts, the company adopts valid domestic and foreign standards as they are. Also, it has not defined design standards or standard parts specifically. For design standards and criteria, it depends on the broad experience acquired when it belonged to IKARUS.

3) Development of new products

The important roles of the development department in a company include product planning and product projects. Companies must always strive for the continuation and growth of their business activities by developing new or alternative products, to allow for the product life cycle caused by the obsolescence of existing goods or products. Product planning is the activity of planning the basic concepts of products based on the analysis of the trends in market needs and

changes in the target market. A product project is the preparation of specific plans, based on the product planning, giving consideration to the technical requirements, components, and cost factors that the products to be produced must satisfy.

Based on the above understanding, the creation of a new commodity is planned by means of a commodity scheme. This scheme is followed by a commodity project that broadly defines the commodity, and then the product project comes into play: it plans what components should actually be used to make the product, and indicates the specific requirements the product must satisfy. IMAG's Development Department directly starts product development, based on information from the Marketing Department, without going through the stages of such a scheme and project.

4) Design changes and drawing management

The design changes of bus seats and ensuing changes in drawings are made by the personnel described in the previous section. The modified drawings are sent to the drawing depository in the Bus Coordination Department. The drawing numbers and the details of the changes are entered in a personal computer (PC) and the drawings are put in dedicated drawers for storage. As regards drawings from outside sources such as Magyar Suzuki and IKARUS, their drawing numbers and data are also entered in the PC, and they are stored in racks. At present, 15,000 drawings are stored and are in a good state of preservation.

As shown in Figure 6-1-2, the drawing numbers (part numbers) of bus seats (including seats for railway vehicles) are defined by the "Numbering Rule of Drawings: No. 2/1995" established in July 1995.

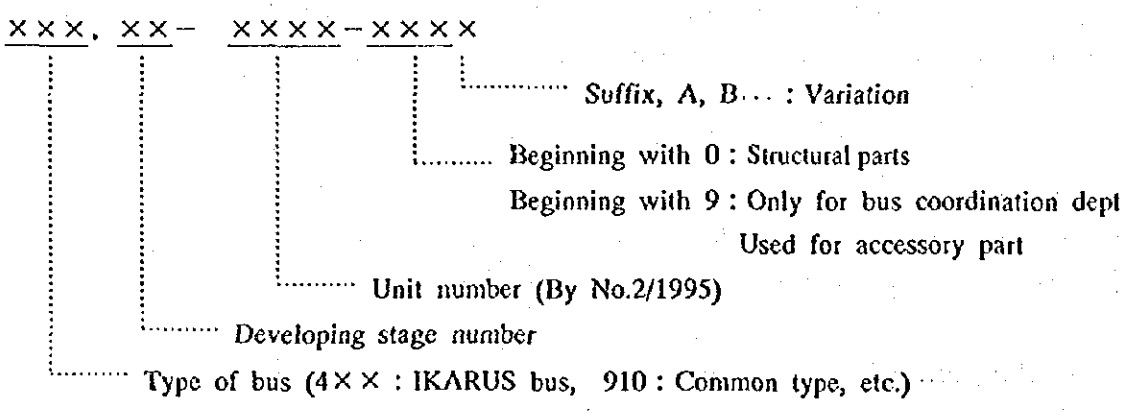


Figure 6-1-2 Numbering of Drawings

This numbering rule was provided by IKARUS and has the disadvantage that it does not identify products. Presently, a revision is under consideration. Regarding the part numbers of

passenger car seats, IMAG uses the 11-digit numbers of Magyar Suzuki, with three zeros (0) placed at the end so that they will have the same number of digits as the drawing numbers of IKARUS.

5) Sharing of development and design with IKARUS

IKARUS does not carry out the development and design of bus seats. It leaves their development entirely up to IMAG. In developing new products, IMAG is provided with information about their concepts and the conditions and needs of the market by IKARUS. Also, when the necessity arises to make additions or changes to the design, IMAG discusses the specification directly with the client. Being in such a cooperative relationship, IMAG's Development Department confers with IKARUS on development and design once a year to exchange information.

Currently, about 90% of the bus seats are delivered to IKARUS. Basically, these are standardized products, so there are few major design changes. However, requests are often made for specification changes with respect to price.

IMAG is strengthening its development technology, based on the above mentioned experience and track record, and shifting its manpower to the development of seats destined for West European companies and seats for railway vehicles.

6) Countermeasures for complaints

In the last half year the Development Department received only one complaint, and this is typical. The ISO 9001 Quality Assurance Manual defines the roles and procedures for dealing with complaints, so that complaints are handled without fail. Also, after the publication of this manual, all the tasks have been performed with more care and attention; consequently, the management work load has increased.

7) Education

Although there is no long-term education plan, one of the three engineers is sent to college, as required, to learn how to reduce the production cost of seats. Also, three persons in the department participate in language courses (English and German) provided within the company. Further, following the introduction of CADs a training scheme is being drawn up. In these ways, the company is interested in and enthusiastic about education.

6-1-3 Problems with Product Development and Design

1) Organization

Within the Development Department, the Product Development group currently takes charge of development and design. However, the department does not have a development project function. Since this function is extremely important for the commodity strategy of a company, it should be provided separately from the development and design function.

The development staff is extremely important for supporting the growth of a company. With IMAG's present situation, it may be too much to hope for a rapid and major expansion of its development staff. However, the company should review the direction, range, and objectives of development to implement a medium to long-term plan for reinforcing its development staff.

2) Staff

The Development Department has only eight persons in total, which constitutes only 1% of the whole personnel of the company. This is too weak for a company that aims at future growth. Even if development is limited to seats for buses and railway vehicles, the company covers a wide variety of products and the total number of staff is small. Since IMAG is committed to order production for passenger car seats, it does not have any staff developing such seats. However, in view of the fact that passenger car seats form a large fraction of the company's sales and there will be a good marker for them in future, it is necessary to have a staff to develop passenger car seats.

3) Capacity to develop new products

Test and laboratory equipment will be discussed in detail in Section 6-4-2 "Tests and Inspections." The Development Department does not have its own laboratory. When tests or experiments are necessary, they are entrusted to the quality inspection group of the Quality Assurance Department. The equipment is not used exclusively for development: it is also used for production and quality assurance testing. The types and capacity of the equipment is not sufficient for product development and performance testing.

It is too much for three engineers to develop seats for small- to large-sized buses and for municipal buses to deluxe interurban buses: the range is too wide for them to deal with everything. However competent each engineer may be, not much can be expected of the present development capacity (including the equipment).

4) Standardization of design

Regarding design standards, the company adopts European and national standards (MSZ), which provide international compatibility. However, company's own standards are yet to be prepared. Also, it has not defined design standards or standard parts. In order to accumulate expertise, speed up engineering work, and improve quality, it is essential to establish company standards.

5) CAD/CAM

An expensive new-type three-dimensional CAD system has been installed for designing seats. It is very effective in checking for defective appearance or interferences, and useful for improving design quality. It also contributes by reducing the time to design and the labor of drawings. However, the CAD system will prove its worth when it shares databases with the host computer for design work and the CAM systems of the subsequent processes through networking. The CAD system installed in the Development Department is used only for designing, and it is not likely to produce much benefit as it is now. Seat makers such as IMAG can expect good results from introducing CAM into such processes as the production of patterns and cutting of sewn parts. This should be taken into consideration in the use of the CAD system.

6-2 Inventory Control

Inventories are divided into the following three types:

(a) Raw material inventory
(b) In-process inventory
(c) Finished product inventory

Although these inventories mean stagnation in the production flow, a certain amount must be held for production: they are a necessary evil. Thus, by optimizing the size of the inventories, operations such as procurement, production, and shipment can be rationalized. In this way, inventory control is very important for facilitating the production flow and reducing the costs and interest payment burdens.

6-2-1 Organization and Assignment

The Seat Production Department of IMAG consists of three divisions: the Bus I Division, Bus II Division, and Passenger Car Seat Division. The seats for buses and seats for passenger cars are produced in different divisions. The metal working, cutting of PVC leather, and production of cushions for passenger car seats are performed both in the Bus I and BUS II Divisions. Each division manages their inventories independently. There are slight differences in the structures associated with inventories and in the methods of inventory control among the divisions.

1) Seats for buses

The production orders for bus seats are issued by the production preparation staff (two persons) in the Bus Coordination Department. Based on these orders, both Bus I and Bus II Divisions check the quantities in inventory and draw up a plan for the procurement of parts. The system concerned with production ordering and inventory control is shown in Figure 6-2-1.

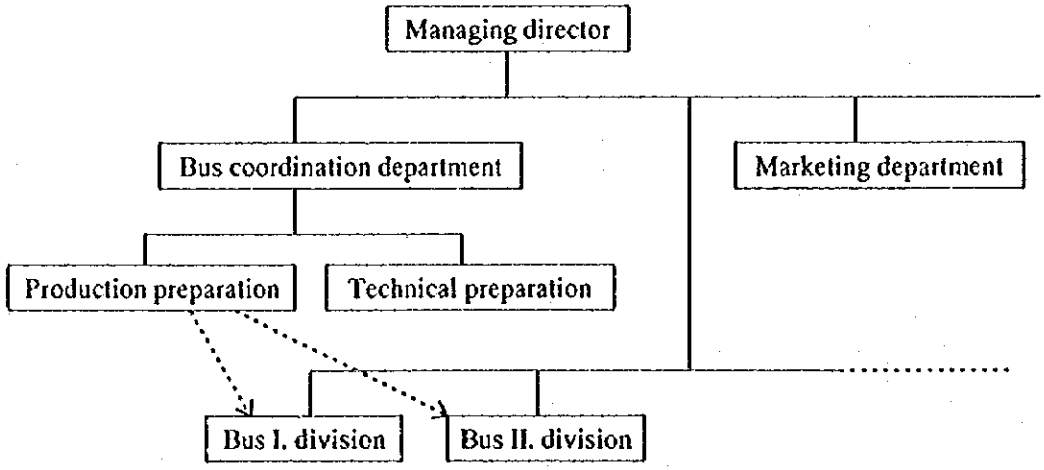


Figure 6-2-1 Organizational Structure of Bus Production

The organizations of Bus I and Bus II Divisions concerned with inventory control are shown in Figures 6-2-2 and 6-2-3.

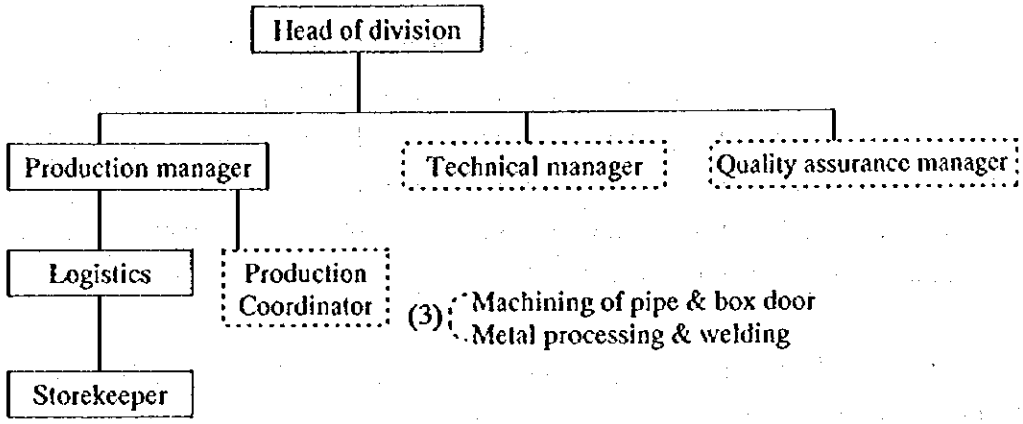


Figure 6-2-2 Organization of Bus I Division Concerned with Inventory Control

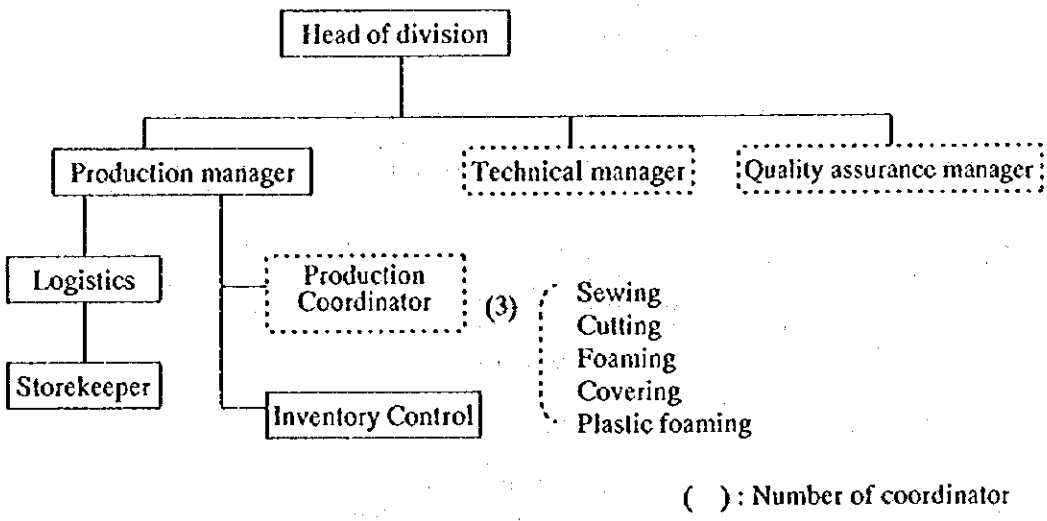


Figure 6-2-3 Organization of Bus II Division Concerned with Inventory Control

As shown in the figures above, each division has, under the production manager, staff for actual logistics (one person) who manages the material transference into and out of the warehouse by directing the storekeepers (two workers). Unlike the Bus I Division, the Bus II Division has in-process (such as cushions being cured) and finished-product inventories. Since the Bus II Division has the assembly lines as well, in addition to the storekeepers, the Division has an

inventory controller (two workers) which manages the inventory and procures materials within the lines. Both divisions produce parts for passenger car seats and manage the inventories of these parts on their own, as is the case with the parts for buses.

2) Seats for passenger cars

The inventories for passenger car seats are managed by the Bus I, Bus II, and Passenger Car Seat Divisions separately. The production orders are issued by Magyar Suzuki to the Passenger Car Seat Division directly. Having received a production order, the Passenger Car Seat Division checks the amount in stock and orders and receives the necessary materials, according to the production order. Also, the division draws up a production plan, issues a work order within the division, and orders parts from the Bus Coordination Department and vendors.

Having received the order, the Bus Coordination Department issues a production order to the Bus I and Bus II Divisions. Both divisions handle the parts for passenger car seats in the same manner as the parts for bus seats. The organizations of the Bus I and Bus II Divisions were described earlier. The organization concerned with inventory control in the Passenger Car Seat Division is shown in Figure 6-2-4.

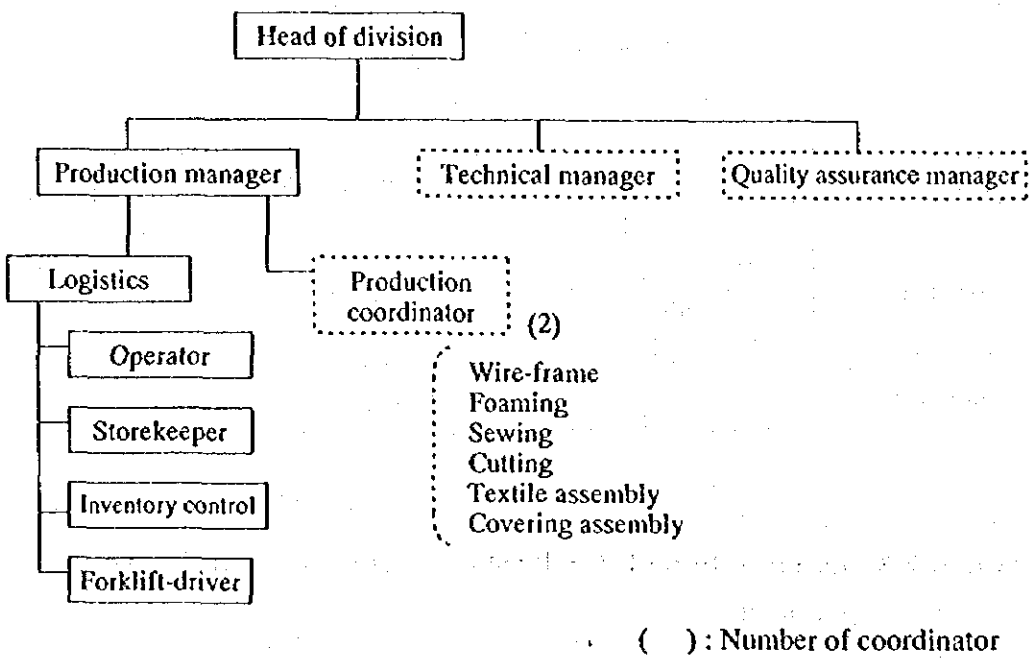


Figure 6-2-4 Organization Concerned with Inventory Control in the Passenger Seat Division

As shown in the figure above, the Passenger Car Seat Division has two storekeepers and an inventory controller (one person), as is the case with the Bus I and Bus II Divisions. Their

duties are the same as those in the Bus I and Bus II Divisions. The logistics also employs an operator in charge of actual distribution. This post was created following the introduction of the computer system for order management in October 1994. Four to seven forklift drivers are employed for such operations as the arrangement, transport, unpacking, and picking up of packaged products procured from abroad.

6-2-2 Present State of Inventory Management

As described above, the inventories concerned with seats are managed separately by the Bus I, Bus II, and Passenger Car Seat Divisions. Both Bus I and Bus II Divisions manage and store the parts for buses and passenger cars by classifying them by control numbers.

Because both Bus I and Bus II Divisions engage in production under the direction of the Bus Coordination Department, and also because they conduct operations according to the work procedures prepared to acquire the ISO 9001 certification, the contents of their operations are similar.

The Passenger Car Seat Division also follows a similar work procedure. Thus, the methods of management are basically the same. However, since the Passenger car seat division uses a different computer system for inventory control from that of the Bus Divisions, the actual management situations are not exactly the same.

1) Seats for buses

Mainly, the Bus I Division handles steel products and the Bus II Division handles the rolled sheets for sewing.

(1) Materials procurement

When a production order and materials procurement order are issued by the Bus Coordination Department, the logistics staff and production staff verify the specifications and quantities of the materials to be procured. The ordering and receiving are performed by the logistics staff. Regarding the procurement of materials, the work flow from ordering to delivery as well as the offices in charge are specified in "Procurement Quality" of the "Quality Assurance Handbook" that is based on ISO 9001. This work flow is shown in Figure 6-2-5. The work (including quality inspection) is carried out as specified.

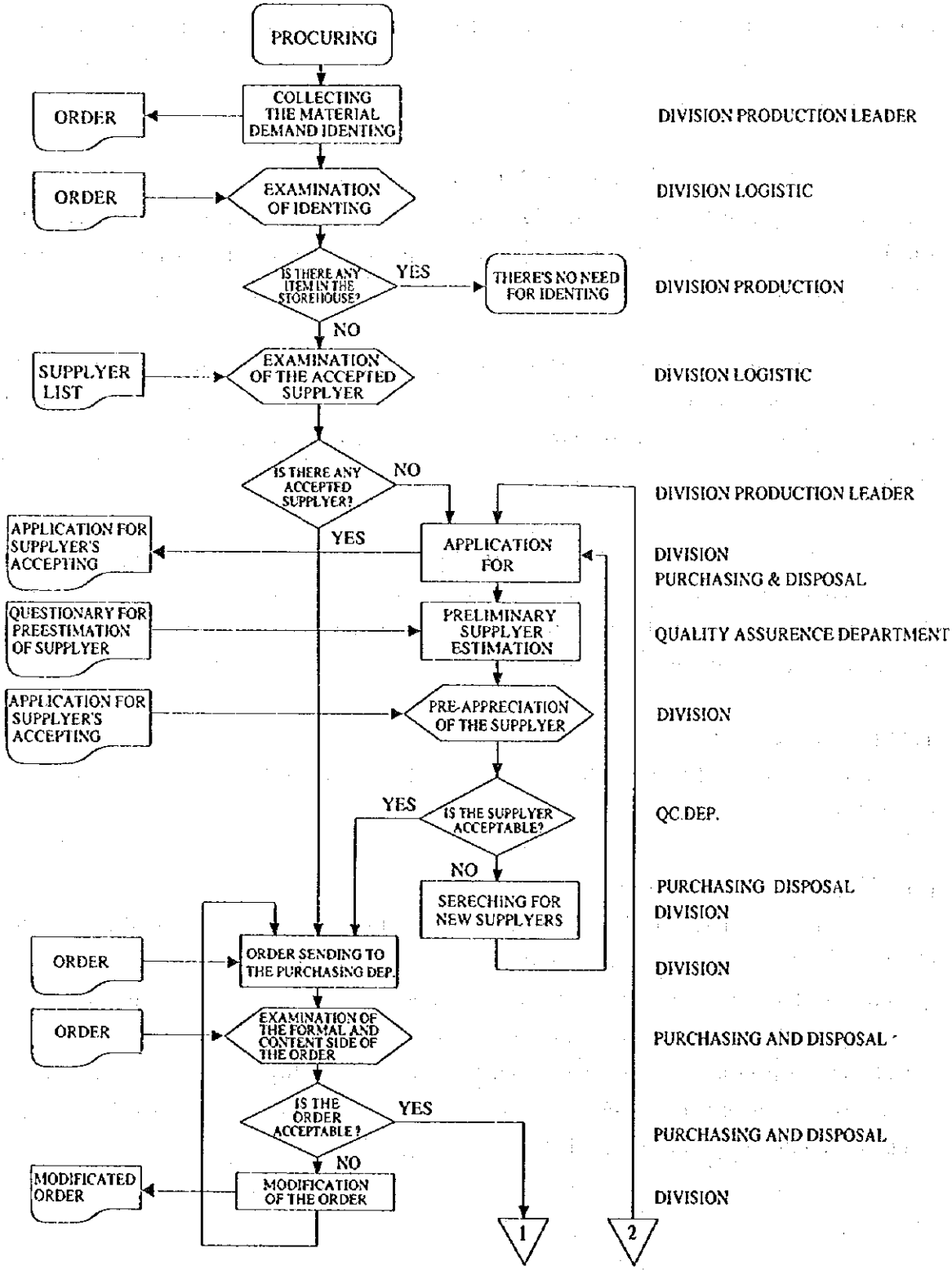


Figure 6-2-5 Work Flow of Materials Procurement (1/2)

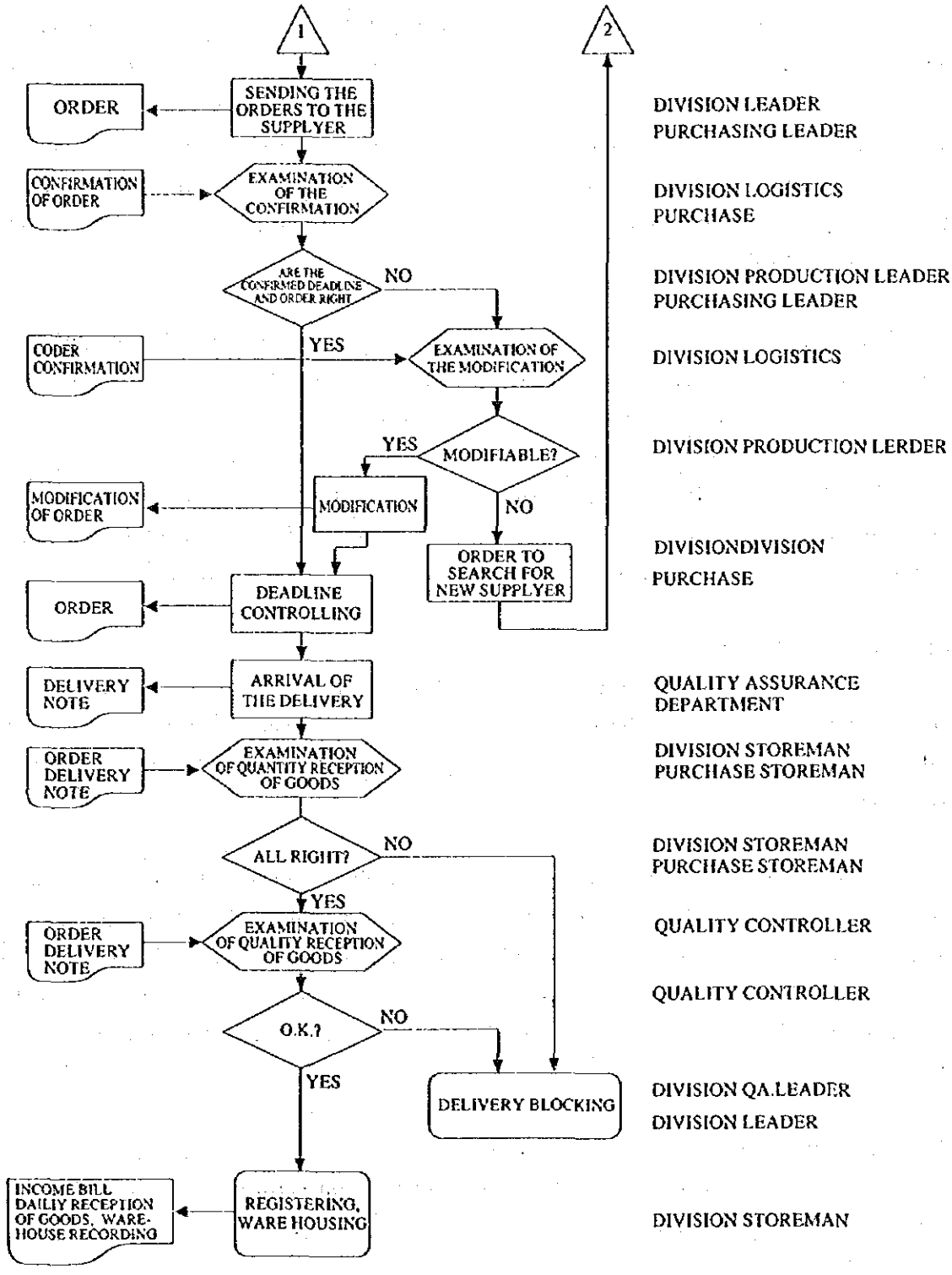


Figure 6-2-5 Work Flow of Materials Procurement (2/2)

(2) Method of Inventory Control

For inventory control, the Bus Divisions have installed a computer system called KOROS. This system is different from that for passenger car seats. However, the inventories for passenger car seats handled in the Bus Divisions are managed by KOROS. The Bus Divisions check inventories, draw up a materials procurement plan, and procure materials with an order sheet, according to the materials procurement orders issued by the Bus Coordination Department. Regarding order quantities, a considerable margin is allowed for: usually 15% to 20% is added to the theoretical value.

Goods receipts are processed by entering the vendor code, order number, quantity, and delivery date from the delivery statement into the computer. At this stage, no document is created. However, the Bus II Division also enters this information into a hand-written file and use it for other operations. The use of computer systems here often involves such wastefulness. Regarding the issuing of goods, the Bus Divisions issue the raw materials for the planned number of buses according to the list of required materials per bus handed by the Bus Coordination Department, record the issue of goods on the list, and enter the data from the list into the computer.

(3) Present state of storage

Raw materials such as steel materials, rolled sheets, and subcontract goods are stored in three separate locations. Since the amount of stock for passenger car seats is increasing, moves and relocations are made frequently. In each division, two workers are assigned to receiving/ issuing and warehousing operations.

The steel materials warehouse of the Bus I Division is kept in relatively good order, although there are some scattered pipes. Regarding the warehouse of the Bus II Division, some improvements have been made: for example, racks for storing pallets have been installed to facilitate the transference of materials. However, management techniques such as FIFO (first-in first-out) and address assignment are not used. As a whole, the warehouse is in relatively good order.

(4) Stock value

The value of the stock associated with bus seat parts is on a downward trend. The monthly average quantities stored and used for the last three years are as follows:

Year	Quantity stored (Million HFT)	Quantity used (Million HFT)	Turnover (times/month)
1993	88	35	0.40
1994	87	27	0.31
1995	81	31	0.38

About 90% of the seats produced are for IKARUS, which places orders on the basis of a yearly contract. Materials procurement orders are issued when the three-month plans are received. The turnover cycle is three months. Even considering the fact that changes to orders are made frequently, the turnover rate is very low.

(5) Present state of the amounts in inventory and methods of keeping track of it

Basically, the volume of inventories is kept track of by using the computer to calculate the theoretical amount of an inventory. The inventories related to IKARUS are taken once a month to check the volume. No standard has been established for the volume of inventories. This is because the quantities required and the number of specification changes made by IKARUS are large. An ample stock is kept in order to respond quickly to orders.

(6) Inventory time

A stock for two to three months is kept on average, and inventory data is output from the computer. However, no attempt is made to control the amount in inventory because of the absence of standards.

2) *Seats for passenger cars*

The inventories for passenger car seats are managed separately by the Bus I, Bus II, and Passenger Car Seat Divisions, which have their own independent warehouses and personnel.

(1) Materials procurement

The production orders are issued by the Magyer Suzuki to the Passenger Car Seat Division directly. Having received a production order, the Passenger Car Seat Division enters the information in the computer system, checks the progress of production and the amount in stock, and orders and receives the necessary materials. The raw materials for the Bus I and Bus II Divisions are received by the respective divisions. The materials are procured from three sources, Hungary, Europe, and Japan, by using each order sheets.

Materials are procured in accordance with the work procedure spelled out in "Procurement Quality" based on ISO 9001, as is the case with bus seats. For procurement, the logistics staff and production staff verify the specifications and quantities of the materials to be procured. Then the logistics staff orders them. Regarding the materials for the Bus I and Bus II Divisions, no information is provided by these divisions and it is difficult to coordinate with them. Therefore, generous quantities are ordered to allow for a margin.

(2) Method of inventory control

The raw materials procured are placed into the materials warehouse of the division that uses them. In the Passenger Car Seat Division, the operator in charge of logistics enters the necessary data into the computer from the delivery statement given by the vendor. No document is created, nor is the data recorded in any other document. The inventories are managed by this computer.

Regarding the issuing of goods, the storekeeper takes the materials for one day out of the warehouse, and places them on a dolly, taking the quantity for one seat at a time, according to the materials requirement list output from the computer. The issue of goods is recorded on the list. Then it is entered into the computer by the operator. In the Bus I and Bus II Divisions, the transference of the materials for passenger car seats are processed in the same way as the materials for bus seats.

(3) Present state of storage

The issuing and warehousing operations are carried out by two storekeepers. Also, a person in charge of inventory control unpacks the delivered goods.

The first field survey witnessed the fact that received goods had been stuffed into the warehouse by force and piled up because the storage space could not be expanded to keep up with sudden increases in the inventory volume. In particular, the goods procured from Japan are transported by sea, which makes it necessary to hold an additional stock to last two months or more. Partly for this reason, the volume of the inventories was very large, making it impossible to practice FIFO. However, following the short-term improvement plan submitted at the end of the investigation, the warehouse has been expanded and the inventories have been put in order. However, the locations of goods are marked on the surfaces of used cardboard boxes with a pen at best; addresses have not been assigned to goods. Little progress has been made in improving and arranging the storage place.

(4) The value in stock

The value of the stock associated with passenger car seats is rapidly increasing. The monthly average quantities stored and used for the last three years are as follows:

Year	Quantity stored (Million HFt)	Quantity used (Million HFt)	Turnover (times/month)
1993	157	33	0.21
1994	156	75	0.48
1995	264	153	0.58

In the one year since 1994, the value of the stock has increased to a little more than 100 million forints. The turnover cycle is two months, which is very long.

(5) Present state of the amount of the inventory and method for keeping track of it

Basically, the volume of inventories is kept track of by using the computer to calculate the theoretical amount of an inventory. However, it is also checked by stock taking. Stock taking is done once a month for large packaged goods that consist mainly of imports from Japan, and once in three months for the other goods in stock.

(6) Inventory time

As can be seen from the inventory turnover, the inventories are sufficient for two months production on average. The packaged goods imported from Japan are stacked up for more than two months. The company has the intention to keep sufficient imports from Japan for 0.6 months, and rolled cloth for 0.5 months, but no steps have been taken so far to achieve this.

6-2-3 Problems with Inventory Control

Under economic conditions in which very high interest rates are charged on borrowed money, IMAG's inventory control is full of problems, including the size of the inventories.

1) Organization and functions

The control of inventories is the responsibility of individual divisions. Different computer systems are used for the inventory control of bus parts and passenger car parts. The Bus I and Bus II Divisions, which assemble bus seats and process the parts for buses and passenger cars and have inventories of both of them, are only interested in the inventories of bus parts and have little interest in the inventories of passenger car parts. This is probably because the channels of control and direction differ between bus parts and passenger car parts and also because the Bus Coordination Department is not involved with inventory control.

The Bus I and Bus II Divisions receive the production orders for bus seats from the Bus Coordination Department but they receive the orders for passenger car seat parts directly from the Passenger Car Seat Division as intra-company subcontracts. Thus, the bus parts and passenger car parts have different channels of command, although they are produced in the same shops. Structurally, the production orders are received from the Bus Coordination Department. However, the bus parts and passenger car parts have different methods of documentation and materials procurement. This also seems to be the reason why the Bus I and Bus II Divisions have little interest in passenger car seats. These problems need reviewing structurally.

2) Method of inventory control

The work procedures for inventory control have been documented and the material

transference are controlled by computers. There seems to be no problem with documents and forms. However, the rapid increase in the size of the inventories for passenger cars poses a major problem.

As described in the paragraph "Present state of storage," every division holds an overstock and is taking great pains to expand storage space without taking any actions to reduce the inventories. There is basically no problem with the rules or systems. The problem lies in their administration.

The company says that stock taking is done at predetermined intervals. Actually, some inventories are not checked. Also, if differences are found between actual and theoretical inventories, no efforts are made to investigate the cause, nor measures taken to prevent recurrence of the problem. Moreover, the company does not consider the increased stock to be its problem. Instead, the idea prevails that the changes in the client's plans are to be blamed. This does not solve the problem. It is important to go back to the starting point and consider the problem of inventories as a company problem. And the company should make efforts to reduce them by itself.

3) State of preservation of goods in stock

Although the situation is fluid, with expansions and transference caused by increasing inventories for passenger car seats, the warehouses of the Bus Divisions are in relatively good order.

(1) Seats for buses

Many of the purchased goods and subcontract goods are put on pallets, and each pallet is placed in a rack. They are kept in good order. However, some large-sized goods such as rolled sheets cannot be taken directly out of the racks. First-in first-out is not used. The facilities (racks) should be used more effectively. Also, addresses are not indicated on the racks, banks, or floors. It is strongly recommended that addresses should be used since they make it possible to identify the locations of goods quickly and correctly.

(2) Seats for passenger cars

Preservation conditions in the large warehouse are poor. The warehouse was expanded after the first field survey, and the packaged goods imported from Japan are no longer piled up so badly. However, it is very difficult to take goods out of the inner part of the warehouse. The racks and banks are in disorder. Goods are often piled up, making it difficult to take out something necessary. Naturally, first-in first-out is not used. To record the locations of goods under such conditions, storekeepers make memos on the surfaces of used cardboard boxes with a pen. Some

improvements should be made such as the installation of racks or indication of addresses, following the example of the warehouses in the Bus Divisions.

Although the warehouse has been expanded; as more space becomes available, it is immediately used, resulting in further need. Reduction of floor space should be planned together with a reduction of inventories. While more room is available now in the warehouse, shipping containers are used to store some of the parts for bus seats: this situation should be corrected.

(3) Common matters

All the warehouses have a common problem: visual methods of management is not being used. Entering the warehouses, one cannot tell, where anything is, how much is there and whether there is a shortage or surplus. The introduction of addresses mentioned above is one way of improvement. Besides, some indications should be provided, such as locations, signboards, tags, color codes, or numbers of pallets, from which anyone can tell whether the inventory is at a reasonable level.

6-3 Process Control

Process control quantitatively controls the daily production activities of the shop, coordinating them with sales plans; prepares specific production plans based on the sales plans and controls the progress of daily production. The sales planning of bus and passenger car seats is managed by the Sales Management Department. Based on this information, the Bus Coordination Department and Passenger Car Seat Division prepare their respective production plans.

6-3-1 Organization and Assignment

1) Seats for buses

(1) Bus Coordination Department

The production plan for bus seats is prepared by the Bus Coordination Department. Reporting to the head of the department, are a production preparation staff (two persons) and a technical preparation staff (three persons), who make preparations for production in the Bus I and Bus II Divisions. The production preparation staff determines the required time, load factor, and required number of men for each process, while the technical preparation staff prepares the required equipment and tools. The organization chart of the Bus Coordination Department is shown in Figure 6-3-1.

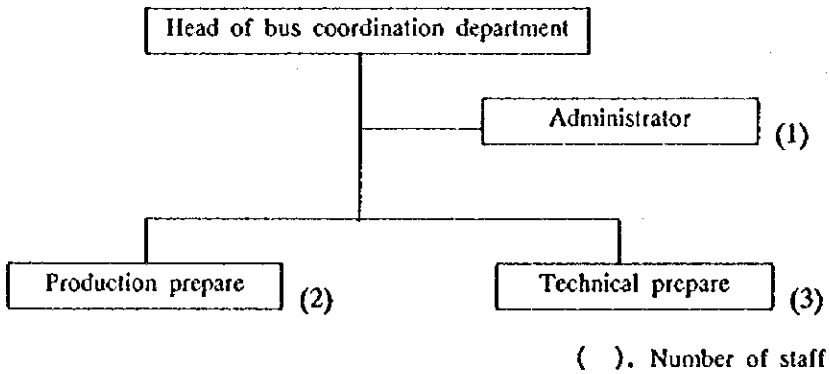


Figure 6-3-1 Organization Chart of the Bus Coordination Department

(2) Bus I Division

The processes in the Bus I Division are controlled by the Production Section shown in Figure 6-3-2. The Production Section gives production orders according to the production plan prepared by the Bus Coordination Department. The processes are also controlled by the Production Section: there is no special control unit for this purpose.

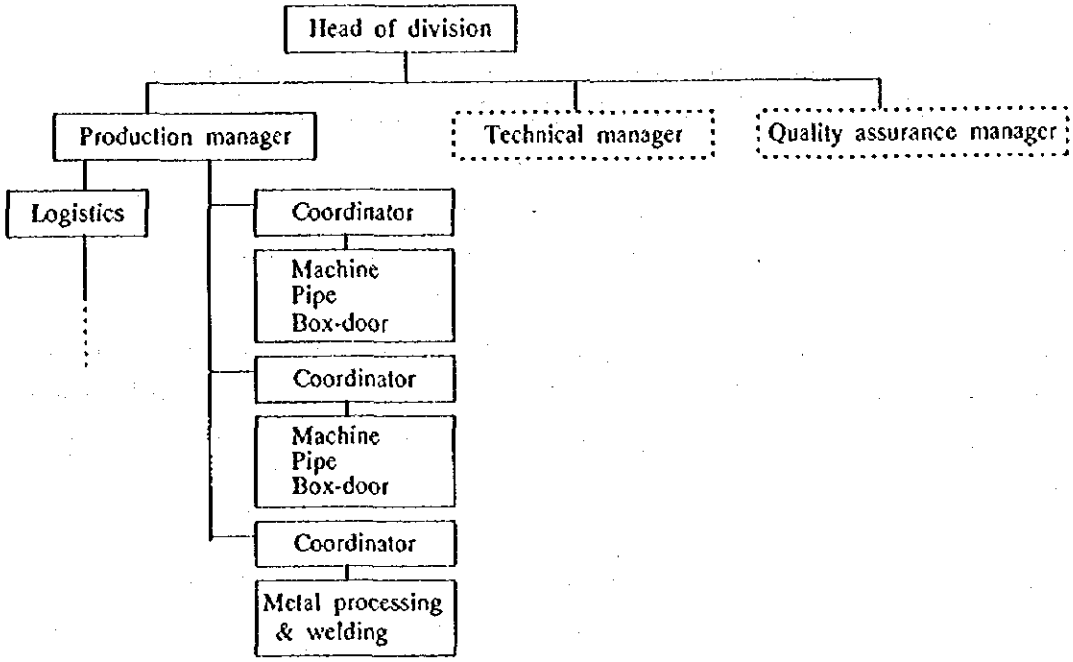


Figure 6-3-2 Organization Chart for Process Control in Bus I Division

(3) Bus II Division

For process control in the Bus II Division, the production manager prepares production orders and the coordinators control the processes according to these orders. The organization chart for process control is shown in Figure 6-3-3.

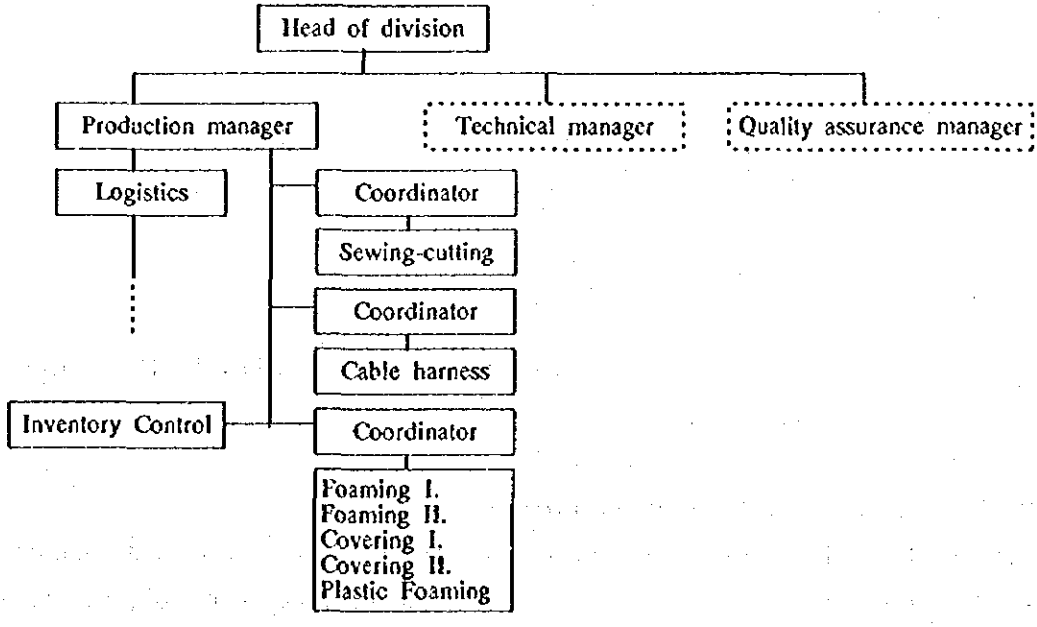


Figure 6-3-3 Organization Chart for Process Control in Bus II Division

2) Passenger car seats

Customer information about passenger car seats is provided to the Passenger Car Seat Division directly by Magyer Suzuki. Based on this information, production plans are created. The computer system checks the inventories and calculates the required raw materials, load factor, and required number of men. Then the production orders are issued. The Passenger Car Seat Division orders some parts internally to the Bus I and Bus II Divisions.

The processes are controlled by the Production Section of each division, as is the case of inventory control. Therefore, the Production Sections of the Bus I and Bus II Divisions are responsible for the processes for both bus seats and passenger car seats which are directed through different channels.

In the Passenger Car Seat Division, two coordinators and a distribution staff (9 to 12 persons), who support manufacturing, are placed under the production manager, and handle the processing of wire frames, foaming of urethane, cutting and sewing of cloth and leather, and assembly of seats. The organization chart for production control is shown in Figure 6-3-4.

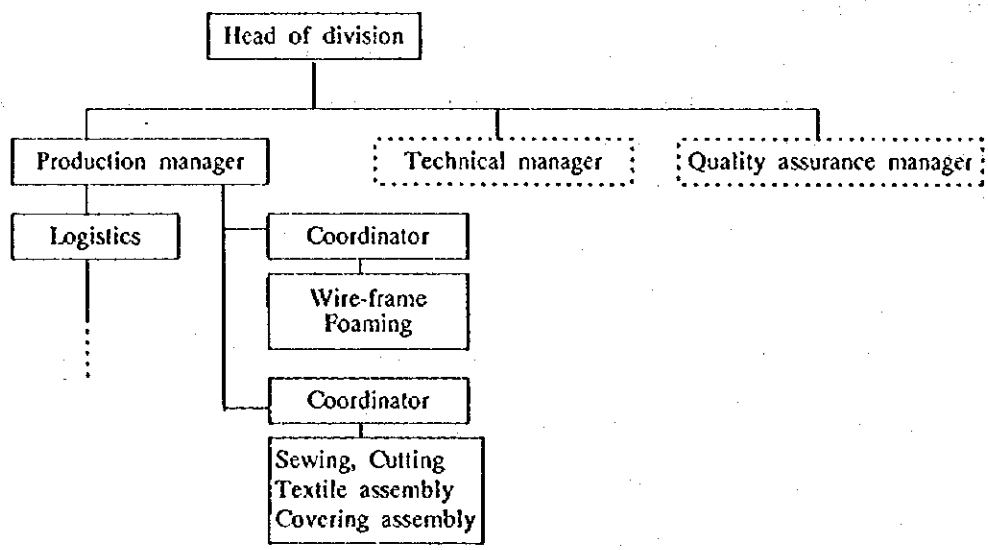


Figure 6-3-4 Organization Chart for Process Control in the Passenger Car Seat Division

6-3-2 Present State of Process Control

IMAG obtained the ISO 9001 certification in 1995. Therefore, process control procedures are specified separately for each division. As an example, the process control procedure of the Passenger Car Seat Division is shown in Figure 6-3-5.

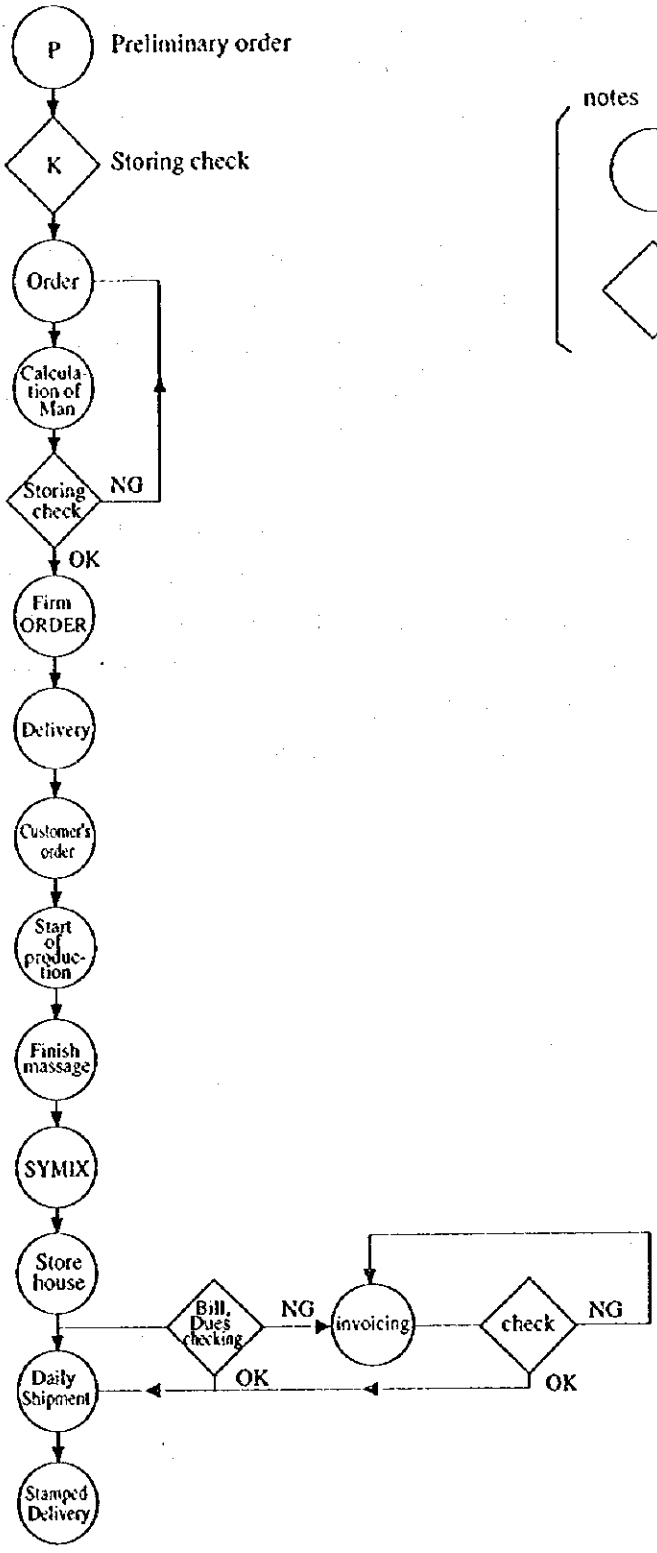


Figure 6-3-5 Process Control Procedure (Passenger Car Seat Division)

1) Seats for buses

The information from IKARUS about the production of buses is received in the form of annual plans, three-month plans, and monthly plans that are sent by the 25th of the month prior to production. Other orders are mostly single or the spur of the moments, except for those from a few specific companies.

In response to the orders from IKARUS, annual plans, three-month plans, and monthly plans are prepared by the Bus Coordination Department, based on the information about orders described above. Single orders are incorporated into production plans, as required. Annual plans are created in January each year, and three-month plans are created at the beginning of each quarter.

Regarding the monthly production plans; the theoretical installed capacity, load factor, and required processing time for each shop are calculated using the computer (technology system), and the personnel plans for every (first, middle, and last) ten days of the next month are prepared. Based on this, production orders are issued to the Bus I and Bus II Divisions. Table 6-3-1 shows a monthly production plan received from IKARUS, Table 6-3-2 shows the required processing times and personnel plans for each shop based on the monthly production plan, and Figure 6-3-6 shows the production order.

Table 6-3-1 Monthly Production Plan of IKARUS (for October 1995)

TYPE	Dest nation	Lot.No.	Products No			1995. OCTOBER																							Total
						2	3	4	5	6	7	9	10	11	12	13	14	16	17	18	19	20	21	24	25	26	27	28	30	31	
				Progr.	daily	6	6	6	6	6	4	6	6	6	6	6	4	7	7	7	7	7	3	5	5	5	6	4	6	6	143
					sum	6	12	18	24	30	34	40	46	52	58	64	68	75	82	89	96	103	106	111	116	121	127	131	137	143	
				Result	daily																										
					sum																										
				Dift	+-																										
280.33	Tusino	437301	0114-0312	Progr.	daily	6	5	6	6	1																				24
					sum	6	11	17	23	24																					
				Result	daily																										
					sum	83																									
280.33	Tusino KD	437301	0114-0312	Progr.	daily					5	4																				9
					sum					5	9																				
				Result	daily																										
					sum																										
280...	Katerp. bem.	437301	0114-0312	Progr.	daily							1																			1
					sum							1																			
				Result	daily																										
					sum																										
280.33G	St Petersburg	439001	0648-0747	Progr.	daily							5	6	6	6	6	1									3	6	4	6	6	55
					sum							5	11	17	23	29	30									33	39	43	49	55	
				Result	daily																										
					sum																										
280.33F	Argentin	437301	0114	Progr.	daily		1																								1
					sum		1																								
				Result	daily																										
					sum																										
256.74C	Russia	438801	0060-0095	Progr.	daily												3	7	7	7	7	7									38
					sum												3	10	17	24	31	38									
				Result	daily																										
					sum																										
253.56	Russia	437901	0051-0065	Progr.	daily																		3	5	2						10
					sum																		3	8	10						
				Result	daily																										
					sum																										

2/1.

Table 6-3-2 Required Processing Times and Personnel Plans by Shop (for the First Ten Days of October 1995)

1995 OCTOBER
PROGRAM

PRODUCT		BUS I	BUS II	TOOLS-MACHINE-P	TOTAL
SEAT MANUFACTURING		1377	1888	469	3734
CASE DOOR MANUFACTURING		994		7	1001
WIRE MANUFACTURING		—	752	—	752
MISC. EQUIPMENT MANUFACTURING		118	57	35	210
SPARE PART		13	1	2	16
WAGE WORK		160	—	—	160
TOTAL:		2662	2724	513	5899
LABOR NEED (PERSONS)		49	50	9	108
OTHER CUSTOMERS					
EGYEDT LTD.		453	432	135	1020
NABI LTD.		653	—	9	662
TOTAL:		1106	432	144	1682
LABOE NEED (PERSONS)		20	8	3	31
OTHER CUSTOMERS					
EXTERIOR COMPANY		383	630	129	1142
HUNGARIAN RAILWAYS		248	460	68	776
TOTAL:		631	1090	197	1918
LABOR NEED		11	21	3	35
CO-DIVISIONS					
SUZUKI SEAT MANUFACTURING		1488	139	—	1627
FOR TEVES		775	—	—	775
TOTAL:		2263	139	—	2402
LABOR NEED		41	3	—	44
TOTAL:		6662	4385	854	11901
WORKING HOUR NEED FOR 120% FULFILMENT		5552	3654	712	9918
EXECUTABLE HOUR FOR 1(one) PERSON		45,5	45,5	45,5	45,5
LABOR NEED TOTAL:		121	82	15	218
CAPACITY	PERSON	105	83	11	199
HOUR/PERSON	HOUR	4778	3776	500	9054
DIFFERENCE	+ - : PERSON	−16	+1	−4	−19
DIFFERENCE	+ - : HOUR	−774	+122	−212	−864

Koord. iroda 6-1407/95

PROGRAMUTASÍTÁS 95. okt. 4.

Munkaszám : 291116

Rendelő : Ikarus Szfv.
Rend.sz: vállalati program
Mv. 271
Gyárt.hai. operativ program
Garn.bontás 6-1399/95
Érv. rajz : rendben
Műv. terv : "

Tipus : 280.33G 100 gr.

egyes ülés fr.öá.	910.07-7630-930A	1100 db
	910.08-7630-930A	600 db
	-9300	2000 db
egyes üléslab	910.08-7631-001	1200 db
	280.87-7633-010A	100 db
kettes üléslab	910.14-7621-002A	700 db
	280.04-7621-010B	200 db
üléstartó	910.14-7621-005A	1000 db
	280.01-7642-001A	100 db
dobüléslab	280.01-7641-001	200 db
	260.01-7641-001A	200 db
	-001B	200 db
	280.01-7641-004	200 db
	260.01-7642-001	400 db
	280.01-7642-002	100 db

Szin: Grabona barna műbőr.

Kovács János
koord. irodavezető

Busz I.
Busz II.
Gyártm.
Utókalk.
Agfor
Arcsop.
Szersz. ..... divizió részéről a termelés indítható.

termelésvezető ..... műszaki vezető ..... MB vezető

Figure 6-3-6 Production Orders

(1) Schedule and work orders

Based on the monthly production plan released by the Bus Coordination Department, the production managers of the Bus Divisions prepare schedules for the various parts as shown in Table 6-3-3, and order the production. The coordinator of each shop instructs operations, based on the order, and keeps track of the results.

All the production orders and work orders issued by the coordinators are conveyed orally, there is no fixed format, and the production schedules for parts shown above is used. The form of the production schedule itself was adapted, hurriedly, from the attendance record form when the ISO 9001 certification was acquired. Forms and work instruction documents have not yet been prepared.

(2) Actual results of production

The actual production is entered in forms by the coordinators every day, handed to the Bus Coordination Department as slips at the end of each month, and processed there.

(3) Standard times and management by objectives

The management of standard times in the Bus Divisions is undertaken by the technical preparation group of the Bus Coordination Department. Standard times are determined from the standards for the standard times of fundamental motions and measurements of actual operations. The standards are quite old and are not changed, as a rule, unless the equipment or processes are changed. Although the question of changes to (reduction of) the standard times is also concerned with the labor unions, the company generally has little interest in standard times, and there is no move to change them. Also, the specified output must, of course, be achieved. However, there is no attempt to set and pursue goals (percentage achievement) regarding safety, quality, production, and delivery times.

Table 6-3-3 An Example of Production Schedule for Parts

A szervezeti egység megnevezése

Oldalszám: .....

19 95 év szeptember hó

Sor-szám	A dolgozó neve	beosztása	Munkanapok 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Ledolg. napok összesen
1	2181 513 mm									/	/						/	/	/					/	/					/	/		
27 2	256. FH Fig	22					5	SZ	D	/	/	T	T	T			/	/	/					/	/					/	/		
3										/	/						/	/	/					/	/					/	/		
4	2181 520 mm									/	/						/	/	/					/	/					/	/		
5	280 32 D	10							1	/	/	SZ	SZ	SZ	SZ	SZ	/	/	/					/	/					/	/		
28 6	280 38 B	1								/	/						/	/	/					/	/					/	/		
7	280 50 A	1								/	/						/	/	/					/	/					/	/		
8										/	/						/	/	/					/	/					/	/		
9	2181 524 mm									/	/						/	/	.					/	/					/	/		
29 10	255. 55. Fig	20								/	/			T	T	T	/	/	/	H	H	H	H	/	/					/	/		
11										/	/						/	/	/					/	/					/	/		
12	2181 538 mm									/	.						/	/	/					/	/					/	.		
13	280.52 F	2								/	/						/	/	/	1	SZ	SZ	SZ	/	/	SZ	SZ			/	/		
30 14	280.52 D	3								.	/						/	/	/					/	/					/	/		
15	280 54 B	4								/	.						/	.	.					/	/					/	.		
16	280 54 C	1								/	/						/	/	/					/	/					/	/		
17										/	/						/	/	/					/	/					/	/		
18	2181 552 mm									/	/						/	/	/					/	/					/	/		
31 19	256. FH	5								/	/						/	/	/					/	/	SZ	SZ			/	/		
20										/	.						/	/	/					/	/					/	.		

..... , 19..... év ..... hó ..... nap

..... az igazoló aláírása

C. Sz. ny. 60–4. r. sz. – Munkaidő igazolás (20 fő nyilvántartásra) – Pátria-Nyomdák. – (Fsz.: S-7852)

MSZ 16184

(napi prog.)

2) Seats for passenger cars

The orders from Magyar Suzuki are received as preliminary information four months in advance and as definite orders one month in advance. The raw materials are ordered three months ahead of the beginning of production. The goods to be procured from Japan are ordered four months in advance to allow for shipping time. The operations from preliminary information four months in advance to the beginning of production are shown in Figure 6-3-7.

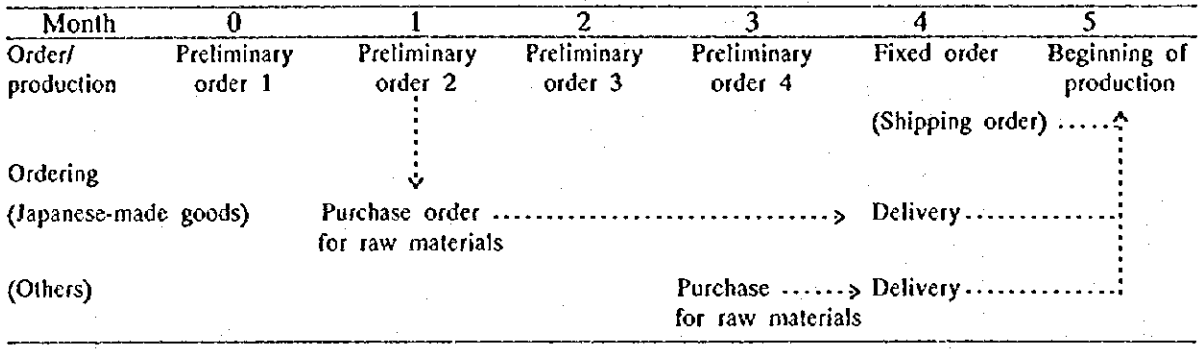


Figure 6-3-7 Operations from Preliminary Information Four Months in Advance to the Beginning of Production

The operations from ordering to production and completion are controlled by a computer system, as shown in Figure 6-3-5. When preliminary information is given, the inventories, installed capacity, required raw materials, required processing time, and required number of men are calculated by the computer system (SYMIX), and the number of men is adjusted in consultation with the Human development Department. When a definite order is issued, confirmation is obtained from Magyar Suzuki that shipment will be accepted in the week after next, and the shipping order for the next week is issued. Production is then started. The actual production results are entered into the computer.

(1) Schedules and work orders

The computer outputs data concerning each day's requirements of products and components and this is used as the schedule. Since these requirements are contained in existing lists, no specific schedule is made. The coordinators give work orders to the shops and check the actual production results.

For intra-company subcontracts, the form shown in Figure 6-3-8 is used and handed to the Bus Divisions by the fifth of the month of production. Bus Divisions create the same schedules as for bus parts, issue work orders, and check the actual production results.

Foaming PU HAB	AUTO	85160-80E00	85160-78C00	85360-63B50	85860-63B50	85361-80E10	85861-80E10	87160-80E00	87160-80E30	87160-80E40	87160-80E50	87160-80E60	87360-80E30	87360-80E50	87760-80E50	87360-80E60	87760-80E60	87360-80E80	87760-80E80	88360-80E50	88760-80E50
3D VAN	48	2				1	1														
1.0 GA	104	2				1	1	1					1								
1.0-1.3 GL	96	2				1	1	1								1	1				
1.0 GL	144	2				1	1	1								1	1				
1.3 GLX-C SPC	344	2		1	1			1								1	1				
1.3 GC -5DR	176	2		1	1			1								1	1				
1.3 GC -5DR AUTOLIV	296	2		1	1			1								1	1				
1.3 GC SPEC	48	2		1	1			1								1	1				
1.3GC, GX 2WD 5DR	96	2		1	1			1								1	1				
1.3GC, GX 2WD 5DR AUTOLIV	152	2		1	1			1								1	1				
1.3GC, GX 2WD 5DR P15	0	2		1	1			1								1	1				
1.3 GX 4WD	344	2		1	1							1				1	1				
SEDAN GLX	240		2								1			1	1					1	1
SEDAN GLX-C	240		2								1			1	1					1	1
SEDAN -3DR	296		2								1			1	1					1	1
1.6 SEDAN	0		2								1			1	1					1	1
5D PASS	48	2				1	1		1									1	1		
1.3 GLS B KORM. 5D 2WD	1152	2		1	1				1									1	1		
1.3 GLS B KORM. 5D 2WD SPC	104	2		1	1				1									1	1		
1.3 GLS J KORM. 5D 2WD P15	56	2		1	1				1									1	1		
1.3 GLS B KORM. 5D 2WD 3DR	240	2		1	1				1									1	1		
1.3 GX B KOR. 4WD -3DR	288	2		1	1				1									1	1		
1.3 GX J KOR. 4WD -3DR	48	2			1	1			1									1	1		
TOTAL	4560	7568	1552	3296	3344	488	440	1456	1936	0	776	344	104	776	776	1696	1696	1936	1936	776	776

Figure 6-3-8 Order Sheet Handed to Bus II Division (Example of a Foam Product)

The coordinators hand the list of required products and components for each day (described above) to the shops and give instructions about the work. This list is displayed in the shop and used for checking progress. A written work instruction has been completed under the direction of a Japanese company with which IMAG has a technical tie-up for passenger car seats: it is used for instructing the workers and improving quality.

(2) Actual production results

A manufacturing data sheet is attached to the actual articles and is passed from process to process, where actual results are entered in it. The coordinator recovers these sheets and hands them to an operator who enters them into the computer. Figure 6-3-9 shows an example of a manufacturing data sheet.

Process Chasing Sheet

TYPE :

GYARTO TERULET	NUMBERS	DATE	INSPECTOR
Cutting			
Sewing			
Assembling			

Comment

Final inspector

Figure 6-3-9 Manufacturing Data Sheet

(3) Standard times

Standard times are managed by the Technical Section of the Passenger Car Seat Division, which determines standard times based on the actual measurements of operating times. Since both the products and the division are new, there is no standard for standard times, unlike the Bus Divisions. The division is committed to the reduction of standard times, pressed by Magyar Suzuki for price cuts and by the shortage of plant capacity due to increased production.

(4) Management by objectives

The division does not have an intention to set targets for safety, quality, and production on its own. However, it is committed to the reduction of production costs because Magyar Suzuki is demanding price cuts. However, it will take time to implement systematic management by objectives.

6-3-3 Problems with Process Control

1) Bus Divisions

The process control in the Bus I and Bus II Divisions is entirely entrusted to the coordinators, who do only the minimum amount of work required for the management of present production. There is a strong impression that the processes are controlled by the computer, an awareness of the need to improve practical aspects, including working efficiency, has not been developed.

(1) Organization and functions

Structurally, process control is the duty of the Production Section of the individual divisions. The coordinators undertake the actual management of the production processes under the direction of the production manager and with the support of the logistics staff. However, the fact is that the coordinators, who are given the required processing time and personnel calculated by the computer, simply manage the quantity of daily production, which was also determined by the computer, according to the production plan of the client. Process control is the management of the production process (procedure) and schedule to ensure that the work proceeds as planned. Action must be taken if the production process deviates from the plan. However, the present structure does not function this way. It is necessary to train and assign a process control staff so that they will also act to reduce waste in the processes and raise the efficiency of production.

(2) Planning function

At present, all that is available are the load factors of the production lines, required processing times, ten-day plans, and client's production plans as output from the computer. In spite of these theoretical values, the basic functions of process control such as planning (process planning charts, written procedural plans, and written work instructions), scheduling, and standard manufacturing scheduling (lead times) are not being carried out.

(3) Control function

The basic functions such as work orders, unit control, loading control, available capacity planning, expediting, control of defective parts during processing, and prevention of their recurrence are not being carried out.

2) Passenger Car Seat Division

The process control in the Passenger Car Seat Division is structurally similar to that in the Bus I and Bus II Divisions. However, it is more flexible because the client is Magyar Suzuki and also because the division itself is new.

(1) Organization and functions

As is the case with the Bus Divisions, process control is the duty of the Production Section. The coordinators undertake the actual management of the production processes under the direction of the production manager and with the support of the logistics staff. The Production Section is given the required processing time and personnel calculated by the computer, and simply manages the quantity of daily production determined also by the computer, according to the production plan of the client. Also, its way of managing things is a little easy-going: for example, it orders more products to the Bus Divisions than necessary to allow for risk. As described above, process control is the management of the production processes (procedure) and schedules to ensure that they proceed as planned. The division is given some guidance on process control by the company with which IMAG has a tie-up. In this respect, it is more advanced than the Bus Divisions. However, it does not have the function of taking action if the production process deviates from the plan. It is necessary, as in the case of the Bus Divisions, to train and assign a process control staff to do this.

(2) Planning function

As is the case with the Bus Divisions, all that is available are the load factors of the production lines, required man hours, daily plans, and client's production plans as output from the computer. Although the division is given some guidance on process control by the company with which IMAG has a tie-up, and a written work instruction is in place, it needs improvements such as setting a schedule and standard manufacturing schedule (lead times).