6.4 Restructuring Plan for Mining Machinery

6.4.1 Key Products Development

Judging from Current trends of minerals production (see section 3.6.1), it is unlikely that the demand for machinery will increase. In order to expand production, it is necessary to start by localizing the production of currently imported parts which are relatively easy to manufacture.

(1) Development of parts and components

Major parts and components used in mining machinery such as bulldozers, scrapers and shovels are hydraulic pumps, engines, transmissions and cylinders.

Hydraulic pumps, engines and transmissions are currently imported, but it is thought that local production is possible. Concerning these hydraulic machine parts, if a cooperative production setup can be established centering around the two companies of Vostokzavod (maker of prototype front end loaders) and Karagormash (maker of hydraulic equipment), it is thought that parts procurement sufficient for production can be achieved in the two regions of Ust-Kamenogorsk and Karaganda.

There are three major kinds of Loaders used in the development of Underground Mines in Kazakhstan, such as Jambos, Lorder, Dumptruck. For Open-cut Mines, those of Drills, Shovels, Lorders, and Dumptrucks (42t, 110t) are popularly used.

(2) Potential products

There are major kinds of mining machinery used in the development in Kazakhstan

- For underground Mines: Jambos, Lorder, Dumptruck.
- For Open-cut Mines: Drills, Shovels, Lorders, and Dumptrucks (42t, 110t) are popularly used.

Moreover, over the medium to long term, the development and production of surface wheel loaders (refer to fig. 6.4.1) is considered to be a promising area for the following reasons:

1. Manufacturing technology already exists for underground wheel loaders.

2. Surface wheel loaders and underground wheel loaders differ in terms of their bucket arms and cabins, etc., but the same components and parts can be used.
3. Mining methods are shifting from underground mining to surface mining.
4. Until now companies have focused on the manufacture and processing of casting and forging materials, however, if efforts are made to develop the manufacture and processing of hydraulic equipment, it will be possible to foster makers of wheel loaders and machinery that utilize a lot of such equipment.

A target is set for the manufacture of wheel loaders. Until then companies should seek to conduct transfer of technology and raise the quality of key parts and components through binding tie-ups with top-class foreign machinery makers.

(3) The market size of wheel loaders

There was a limitation of information about the market for wheel loaders, because the majority of the domestic market for wheel loaders is covered by imports. The market size, however, is analyzed as below.

According to the data of Khezkazantsvestment, the production volume of West mine is 4.7 million ton and 14 loaders are under operation. South Mine has 6.2million ton yearly production and 51 loaders. From the loading volumes data (West mine: 4.7 million tons/14 loaders = 336000t, South mine: 6.2 million tons/51 loaders = 122000t), it is assumed that small size loaders are used in South mine.

If underground loaders are used with $2m^3$ middle size bucket, the yearly loading capacity would reach 336000 – 360000t with under listed conditions:

Where:

- Mine weight for each bucket :
  4 tons (capacity: $2m^3$ x 80% x unit weight: 3 tons/m^3 x 20%),
- Yearly work force of one unit of loader:
  300 days x 10 hours x 60/2 minutes = 90,000

4 tons x 90,000 = 360,000 tons

Then, it is estimated that market for middle and small loaders, which are used in 75 million tons of mine production, are 42 – 45 units and 116 - 124 units respectively.

Those estimates are based on under listed conditions;

1. coal mine:	25 million tons (coal: 20 million tons, raw coal: 5 million tons)
2. non- ferrous metal mine:	45 million tons (copper, zinc, lead: 35 million tons, raw metal: 10 million tons)
3. others:	5 million tons
Total	75 million tons

Necessary loader units are;

75000 / 336 million tons = 223 units of loader/5 years = 42 units/year

75000 / 360 million tons = 208 units of loader/5 years = 45 units/year

(Note: Assuming that loader's life is 5 years.)

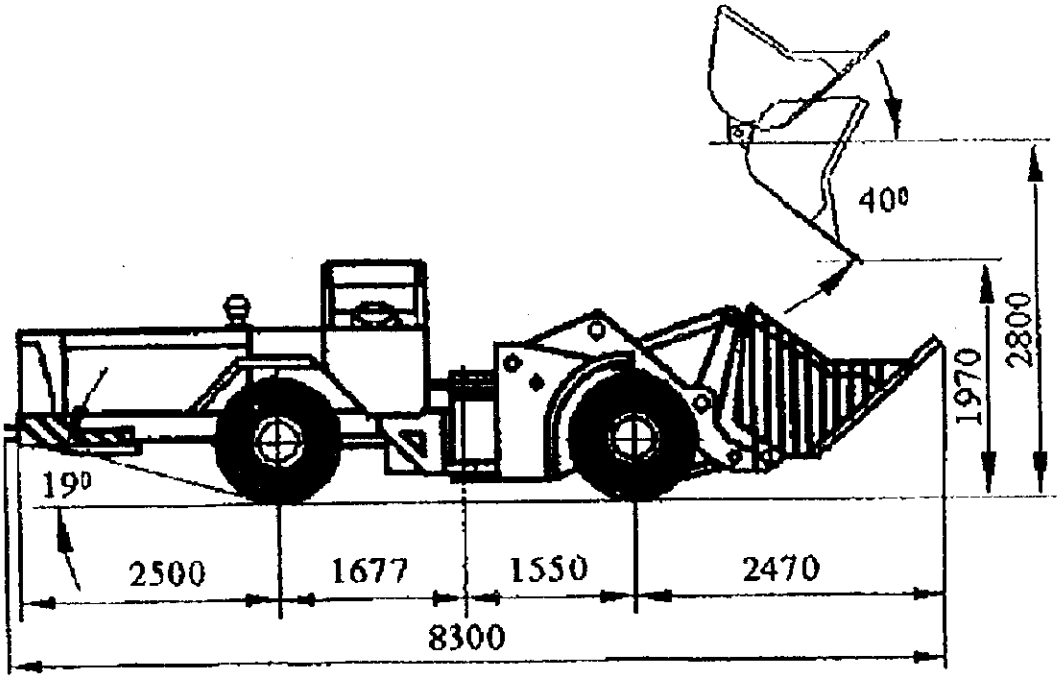
Because the domestic market for underground loader is small, market for construction purpose should be researched. Vostokmashzavod already made prototype of construction loader.

It is expected that Vostokmashzarod can produce ground wheel loader for mining and construction works.

As for the domestic market, there is a high competition with foreign maker, on the other hand, however, increase for the demand is expected. There is a huge potential market in improvement of infrastructures such as railway, road net work, and snow sweep. Improving their existing products in cooperation with foreign entities may attain those potential markets.

Generally, middle class loaders, $2m^3$ capacity, are used in construction and excavation and large class loaders ($3\text{-}5m^3$) in open cut mine. Therefore, there is also a potential market for the large class loaders.

<For Underground>



<For Ground & Construction>

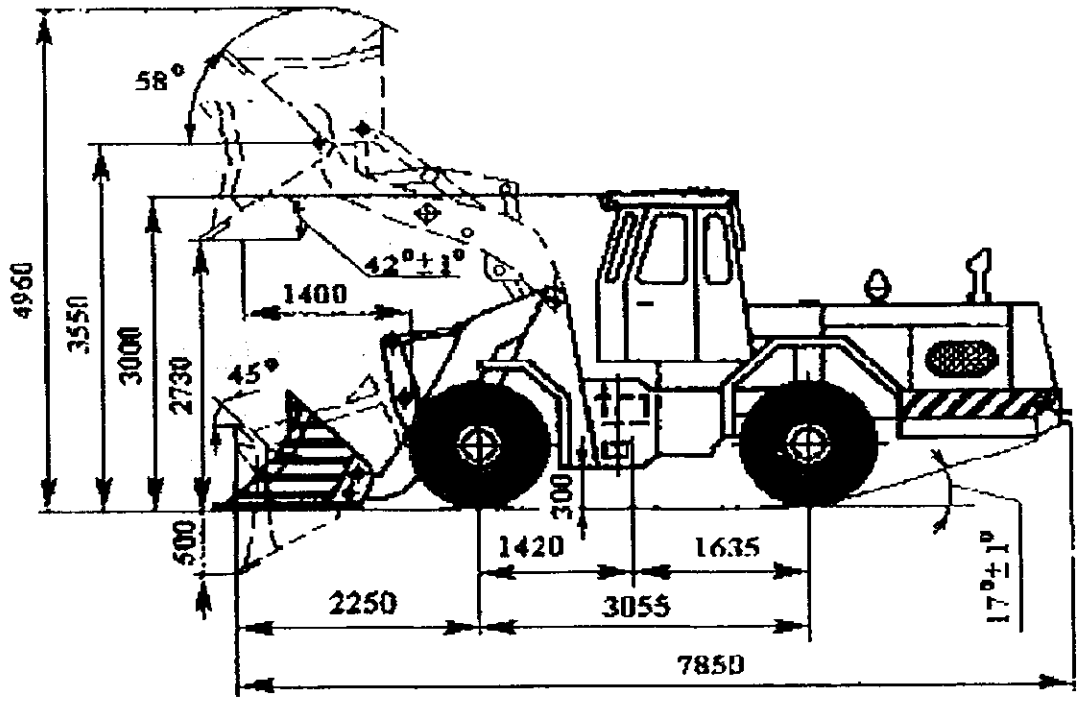


Fig. 6.4.1 Wheel Loader

6.4.2 Implementation Plan

(1) Development and Production Implementation Plan

The development and production plan for wheel loaders and components is shown in Table 6.4.1.

Table 6.4.1 Implementation Plan for Wheel Loader Development and Production

Implementation Item	1999-2001 (short term)	2002-2004 (medium term)	2005-2010 (long term)
[Product Development]			
1. Wheel loaders	○——▲	——→●	
2. Components (engines, transmissions, hydraulics)	○—▲	——→●	
[Retailing Setup]			
1. Preparation of materials and public relations for introducing products	○	——→●	
2. Expansion of the service setup	○	——→●	

Note ○: Plan commencement
●: Completion (final product development is the point of completion)
▲: Introduction of technology

Massaget is the only producer of small size loader in CIS region and has just stopped its production in 1995. Vostokmashzavod is also the single producer of middle size loader in CIS region and the production level is almost negligible, had made 300units for last 15 years.

Both of those loader producers depend on import for most important and major parts.

Major components such as engines and missions, and hydraulic systems are almost same as ground loader, only cabins and arms are different between them. So technically it is possible for those manufacturers to produce (see Fig. 6.4.1).

(2) Specification of wheel loader

There are two kinds of loaders, namely Wheel Loader(with tire) and Crawler Loader. In Japan, wheel loaders account for 98%, wheel loader is used more than Crawler type in Kazakhstan.

Small (0.7-1.0m^3) and middle (2m^3) size loader are popularly used for underground.

Recommended specification of wheel loader is shown Table 6.4.2.

Table 6.4.2 Specification of wheel loader

Item	Unit	PN-1	MPD-1M
Backet Capacity	m^3	2	2
Lording Weight	t	4	4
Total Length	m	7.85	8.3
Width	m	2.36	2.36
Height	m	3.00	2.25
Weight	t	10.5	12.0
Engine	HP	94	94
Engine revolution	r.p.m.	1,900	1900
Speed	km/h	26	22
Usage		For Construction	For Underground

The present price of a loader is USD60,000. This is the approximate average in the CIS region. This model is convertible to other kinds of loaders by changing its attachment parts, particularly in the use for clearing and removing snow. Next to use as a snowplow, application to boring and excavation could be considered.

6.5 Industrial Restructuring plan for Railway Rolling Stock

6.5.1 Railway Rolling Stock Manufacturing Plant Construction

(1) Electric locomotive (EL) and diesel locomotive (DL)

With regard to DL, a project for replacing the old engine by a new powerful GE engine is under way. However, local manufacture of EL and DL should be avoided before confirmation of the technical capability for the production and the profitability. New EL and DL may be imported from Russia and Ukraine as hitherto.

(2) Electric railcar (EC)

The projected new passenger coach (PC) manufacturing workshop mentioned in 6.5.2 can produce EC depending on the demand. However, introduction of foreign technology may be necessary for acquiring production technology.

(3) PC

Please refer to 6.5.2

(4) Freight car (FC)

The above-mentioned new PC manufacture workshop or restructured FC repair workshop mentioned in 6.5.2 or 6.5.3 could also produce FC. However, AWRZ in Astana, having much experience of FC repair, and DZMK in Taraz, remodeling open

type wagon to tank wagon, have sufficient capability and a keen desire to manufacture FC. It is therefore recommended that the fostering of both companies is pushed forwarded.

It is recommended for AWRZ that existing FC repair lines should be improved as mentioned in detail in 6.5.3. According to the spare capacity and surplus facilities produced by this improvement, new FC manufacture in AWRZ may be feasible.

DZMK is undertaking the repair of oil tank wagons and the above-mentioned remodeling work in which a new tank is fitted on the remodeled undercarriage an open type wagon. Both the existing facilities and the technical ability are sufficient to manufacture FC. Namely, new production of the undercarriage for tank wagons may be possible in the existing metal working facilities in the existing building. However, in case bogie repair or new bogie manufacture is in future needed by DZMK, cooperation of another company will be necessary, because DZMK has no bogie shop. DZMK is the best enterprise in the field of metal working and welding technology the enterprises visited. DZMK should be fostered as a manufacturer of FC, including tank wagons, and of car bodies for PC. In any case, DZMK should be modernized so as to increase production efficiency and to improve production quality, because existing welding facilities for tank manufacture, facilities to remodel the undercarriage of tank wagons and production control systems are old fashioned. With regards the modernization, it is recommended that the manufacturing method for low and high-pressure tanks along with improvement of metal working for new manufacture and heavy repair of PC and FC should be examined. To foster an all-round manufacturer for metal working in Kazakhstan is an example of creating an highly efficient enterprise.

6.5.2 Passenger Car (PC) Manufacturing Plant Construction Plan

(1) Steps in the Manufacture of new PC

Almost all of the materials and parts which are being used for railway rolling stock are not manufactured in Kazakhstan. So, at the present stage, if new PC production is planned, it will become necessary to import most parts, components and materials. Therefore, it is necessary to envisage the domestic manufacturing of the rolling stock parts, components and materials, if the construction of a new PC manufacturing factory is planned in Kazakhstan.

Fig. 6.5.1 examines the flow of manufacturing new PC. As shown in Fig. 6.5.1, there are many kinds of main construction components of the PC and their manufacturing and the procurement of parts must be examined together.

Table 6.5.1 shows the recommended steps for the new PC production project. The details of the steps are shown below

Table 6.5.1 Step of New PC Manufacture Construction

Target	1'st step	2'nd step	3'rd step
Output (temporarily) (with one shift)	175 cars/year	175 cars/year	175 cars/year
Specification of PC Car	Same specification car as present	Developed PC, light body, high speed car, cheaper car	EC,LRT
Main investment	Reorganization of present repair line (to achieve minimal investment)	Automatic machines	Metal work machines, & Computer, test equipment
Introduction of technology	Management tech, and production tech.	Management tech., Production tech., quality control.	Design tech.,
Spare parts	Increase of in terms manufactured parts	Coupler, Brake divice, Interial Panel , Bogie parts, Hood	Electric parts

(a) The 1st step

"To establish a the system which can produce the new PC with the same specification as that of present PC".

1. The organization and the production facilities are based on the assumption that annual production of 175 cars is achieved.
   If the requirement for production of more cars than given in the basic assumption arises, because of requirements from Central Asian railways and so on, production quantities can be adjusted by use of over time or 2 shift system.
   As for the bogies, in the 1st step, they will be imported.

2. In this early stage, facilities investment shall be kept to a minimum, by the effective utilization of the present facilities.
   By keeping the structure and the specification the same as that of the present operating PC, the same method for procurement of parts and materials and the same technology and facilities used at present for repairing cars can be used.
   Arranging of production line in this 1st step shall be such that, for example, heavy repair work can also be done, and when the specification of PC or the body structure is altered, it can be accommodated by a slight modification of the production line, and also any negative effect on production shall be held to the minimum.

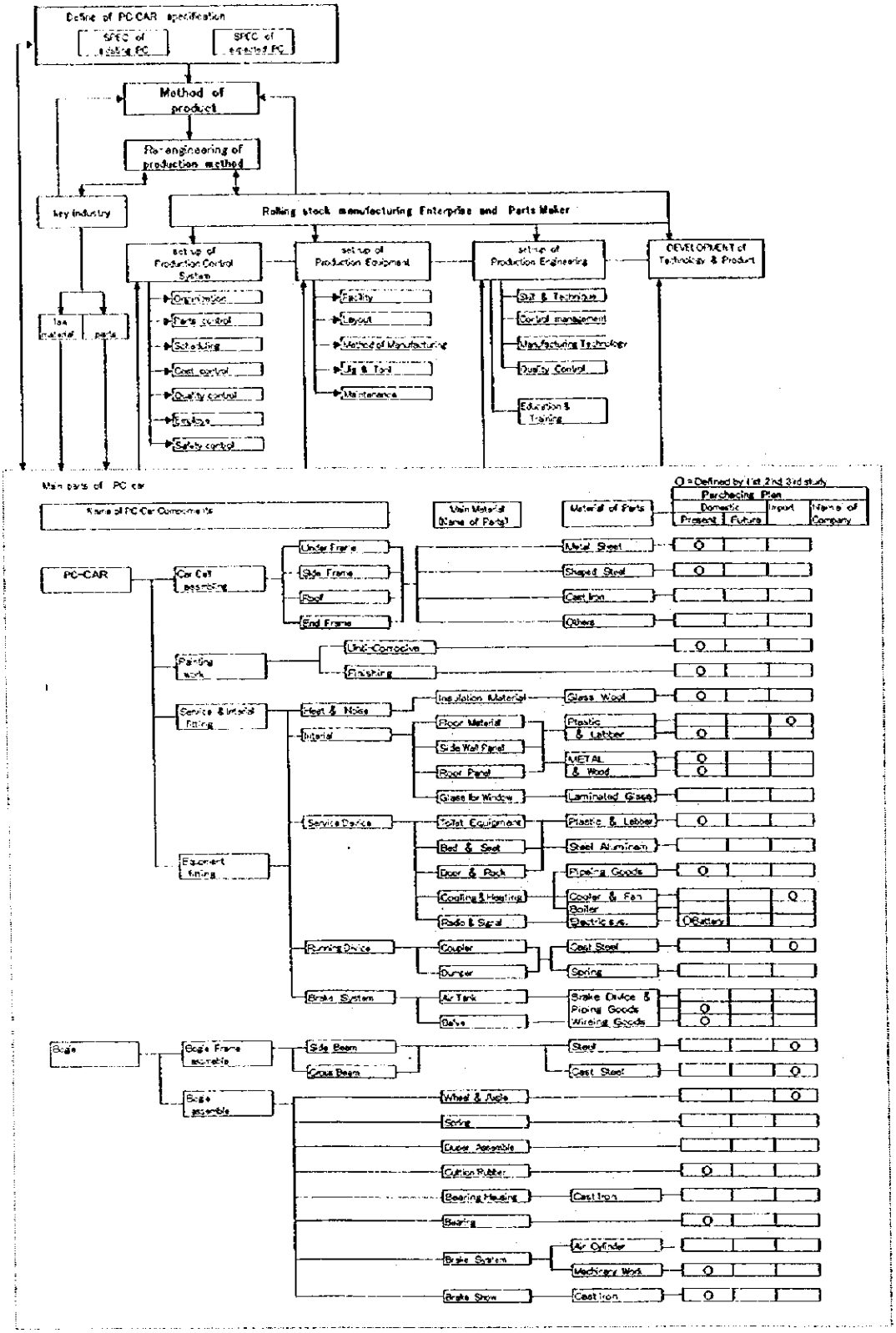


Fig. 6.5.1 Study Flow for New PC

3. Carrying out the following activities efficiently, i.e. material procurement, and parts management, production management, cost management and so on.
   If necessary, introduce technology from a foreign country.

4. Re-organize the material procurement system. Especially the manufacture of body components formed by cutting, pressing and welding steel sheets shall be done inside the company so that control of the production schedule and the quality control of the manufacturing process can be achieved easily.
   Other parts shall be decided in an individual basis- e.g. whether to procure them or make them, depending in much factors as delivery date, quality, price, etc.
   Improvement of domestic manufacturing range of parts for material presently imported, shall be taken into account by promoting domestic manufacturing including the development of the manufacturing technology to standards alive to satisfy the existing Railway Standard.

5. The education and training of engineers and technicians
   It is said that railway rolling stock production technology is "experience engineering".
   It is necessary for engineers and technicians to absorb such "experience". It is necessary to make order among all technical standards and work standards with regard to railway rolling stock, which each company and KTZ have in their possession at present.
   By putting these in order, the necessary technology for railway rolling stock manufacturing will be made clear. And also, by putting these in order, the necessary techniques and skills, which require education and training, will be identified.

(b) The 2nd step

"Establishing a system which can produce a PC which is more developed than the PC at present".

1 Technology development etc., which corresponds to a more developed PC, shall be undertaken. "More developed PC" is a PC, which is; from the view-point of the railway operating organization, good quality PC with improvement of service, improvement of maintenance (less frequent maintenance is desired), improvement of train speed and so on; from the view-point of the railway manufacturing organization, easy to manufacture (production cost to be reduced), guarantee of quality can be easily carried out.

For example, improvement of service means improvement of quality of ride, improvement of accommodation. Easy to manufacture means design of parts which can be automated, and structure which can be easily arranged preliminary. With regard to bogies, with the introduction of technique, bogie frame parts manufacturing, welding and assembly of bogies can be achieved.

2 Introducing modern automated machines and improving production efficiency. The production line will be able to accommodate. Both new PC manufacturing and heavy repair work and production techniques will be accumulated in the company.

3 Domestic manufacture of parts for railway rolling stock so that the domestic production range will be wider.

4 More developed parts will be available form domestic manufacture. Wider domestic production range means cast steel, interior panels, electric parts, bogie-related parts etc. More developed part means modern rubber bellows, damper equipment, door equipment etc

(c) The 3rd step

"Establishing a system which can produce modern type rolling stock such as for underground EC, new type LRT etc.

1. Improving the production line so that the change of work load will have minimal effects. This can be achieved by changing production line so that each type of rolling stock can be produced in series. And so it will be possible to manufacture railway rolling stock in mixed series. And produce railway rolling stock and undertaken heavy repair work also in mixed series.
   Fig 6.5.2 shows an example of the production line of a Japanese manufacturer of railway rolling stock. This company produces various type of electric passenger coaches in series, and sometimes they even produce freight cars in this line.

2 The main facilities to be added in the 3rd step are the follows.

- Computer of large capacity for analysis (Structural analysis and production management)
- Automated machinery for sheet metal (laser cutting machine, turret punching machine)
- Inspection equipment for electrical equipment

3 Promoting parts makers

In order to widen the domestic production range, the product development and production system must be improved.

(2) Tentative shedule of new PC manufacture work shop construction

At the present, both Rysty (is now undertaking PC repair) and PZTM group (has no facilities and experience in rolling stock manufacturing) have plans of new PC manufactue work shop construction respectively.

The former is able to produce new PC by the ultization of present repair lines and by the improvement of facilities, skill and so on, but the latter must set up new manufacturing lines, facilities and must acquire every production technique.

As shown in Table6.5.2, there are some differences between both companies on the first step at the start of this project.

(3) Production plan of new PC

(a) Estimation of necessary building area

Table 6.5.3 shows an estimation of necessary space for annual production of 175 cars based on the production line of Fig. 6.5.2. In case of producing PC in Kazakhstan, the production method and rolling stock specification are not the same as those in Japan. So the layout and area occupied will not be the same.

However a rough estimate of occupied area is made for reference purpose. This rough estimate is based on the area necessary for 80 cars and is:

80 cars x 6 meters (Width) x 30 meters (Length) = 14,400m^2

Table6.5.2 Schedule of New PC Manufacture

Detail of work	Year (STEP)	1999～2001	2002～2004	2005～2010
(1) Case of re-structure of repair line (Rysty)				
① Improvement of present rapair line		○▲→◎	···→●	
・Improvement of management system				
・Modernization of facilities				
・Modification of rapairline layout				
② Set up of new PC line(Mix Line)		○▲→◎	···→●	
③ Increasement of shop made parts		○ metal work parts → interisl parts→ another parts		
④ production				
・PC repair in Mix Line with new syste		⇦ repair & new PC production in Mix Line		⇨
・New PC production in Mix Line		⇦ Hard seat & Box car		⇨
		⇦ Soft seat & dining car		⇨
(2) Case of new Work Shop (PZTM group)	(FIRST STEP)			
① Build up of new management system		○▲→◎	···→●	
・Start of new PC production project				
・Settlement of master plan.				
② Introduction of design,manufacturing, inspection technology.		○▲	→●	
③ Set up of manufacturing work shop		○▲→●		
・Line & Facilities				
④Production				
・Car cell assembly				
start by KnockDown style		⇦		
evolution to Complete KnockDown		⇦	⇦ assembly in shop	⇨
Incereasement of shop made parts		⇦		⇨
・internal parts fitting & equipment		⇦	⇦ assembly	⇨
(3)Production of advanced new PC				
①Light weight car & Hi-speed car				
・design	(SECOND STEP)		○▲→●	
・invest of machines			○→●	
・education and training			○→●	
②Production			⇦ production	⇨
(4)Production of EC and LRT				
①Improvement of line(facility and machine)				○▲→●
②Introduction of total management syst				○▲→●
③Start of elctric parts manufacturing				○▲→◎→
④Production	(THIRD STEP)			⇦ ⇨ production
(5)Bogie				
・Assembly of bogie frame			○▲→● production in shop	
・Assembly of bogie		⇨ purchace	⇨ | ⇦	production in shop⇨
・Increasement of shop made parts			○metal parts →frame →brake parts	

Notes. ○: start ▲: introduction of technology ◎: intermediate check ●: completion
⇦⇨ : production(assembly)

Table 6.5.3 The space necessary for new PC production

The work name (name of the line)	The rough estimate space	Work details
Metal work	For 10 cars	Sheet metal work
Ditto preparation for above	For 4 cars	Welding of sheet metals
The body block manufacturing	For 20 cars	Manufacturing of under frame side and roof
Construction of body structure	For 6 cars	Body block welding and assembling work
Painting	For 8 cars	Painting of carbody
Equipment fitting and interior line	For 16 cars	Assembling work
Inspection work	For 6 cars	Inspection of the completed vehicle
Bogie manufacturing	For 10 cars	Bogie manufacturing
Total	For 80 cars	

(b) Construction plan of new PC manufacturing factory in Kazakhstan.

There are two (2) plans for construction of new PC manufacturing factory as described in 3.7.3. Consideration of each plan follows.

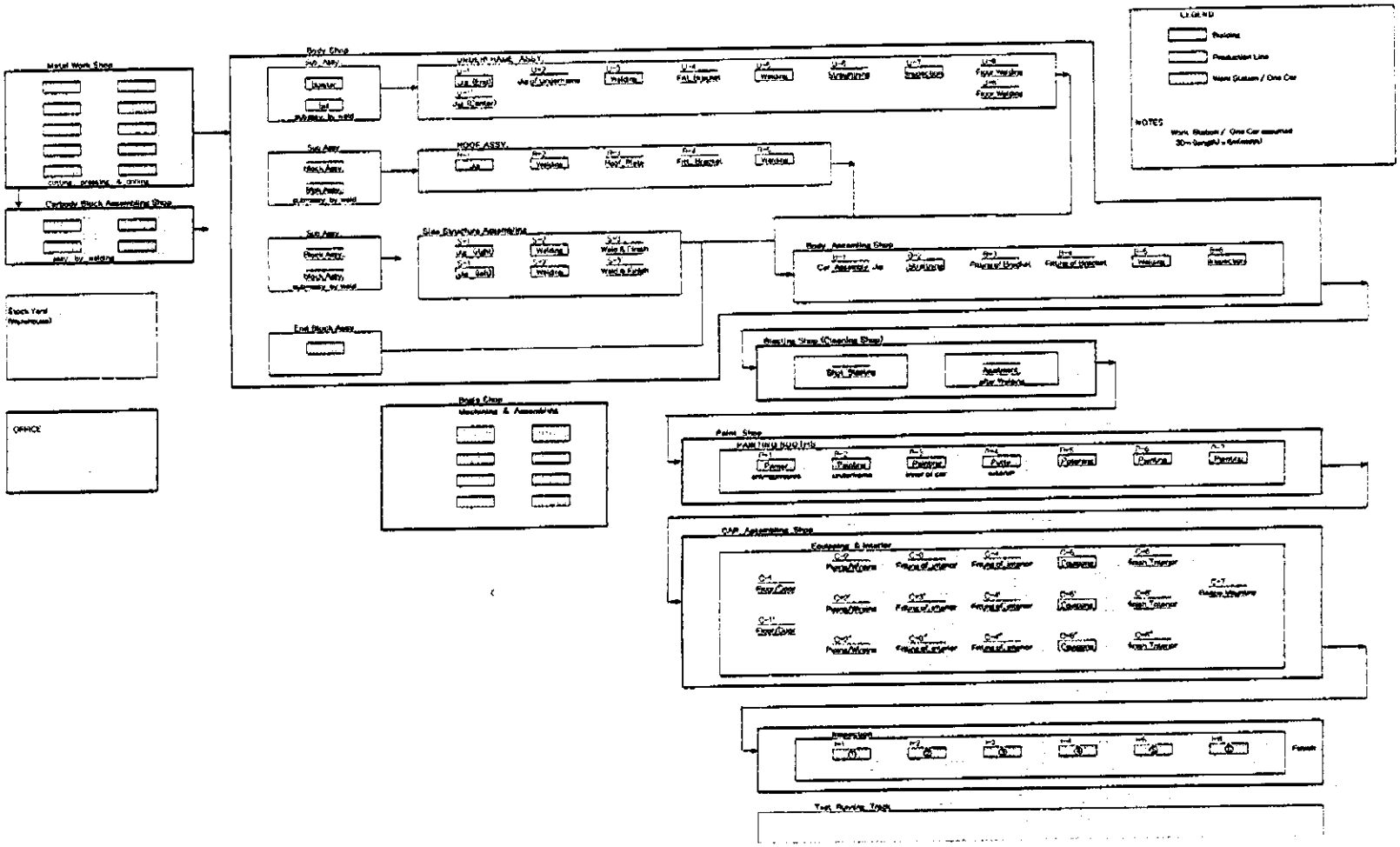


Fig. 6.5.2 Example for Production Line is PC Manufacture

1. PC production plan in the Rysty-AECRW enterprise

Rysty-AECRW Company has a building of Length 120 meters x Width 60 meter, and planning to produce PC in this building area. Regarding building area, there is only 1/2 of the roughly estimated area calculated in the preceding clause but it is possible to extend it. Incidentally, Rysty-AECRW company is doing heavy repair work of PC at the same site so the new PC manufacturing line and heavy repair line can be partly shared, and area for the new PC manufacturing can be secured.

The Rysty-AECRW Company is considering the following:

- Carbody shall be that of Russian or German style with a weight of 12 tons.
- Interior shall be formed by large size plastic panels.
- Steel shall be of domestic manufacture. (Karaganda), large size plastic panels shall be made in-house, electric parts shall be procured in Russia, Germany or the Almaty area.
- Carbody structure shall be of Russian or German style, which does not vary widely from that of the present PC. So existing machines for heavy repair can accommodate the new PC manufacturing, however, production management and quality control will need drastic improvement. This is common to all railway rolling stock manufacturing related enterprises in Kazakhstan.

2 PC production plan by PZTM company

PZTM Company Group consists of the following 7 companies.

PZTM Company:	Assembly of railway rolling stock
ZIKSTO Company:	Bogie and wheel (there is another plan for constructing tank car heavy repair factory).
KIROV Company:	Electric equipment
ZIM Company:	Electric equipment and plastic parts
MLD Company:	Heating equipment and watering system
PZEIM Company:	Interior panel, insulation material and heat insulating material
DOK Company:	Timber

PZTM Company Group has the following plan for factory construction for rolling stock manufacturing.

(i) Plan for manufacturing 150 cars annually

PZTM Company will assemble railway rolling stock using building already constructed, which is 192-meter long and 84-meter wide. The cost of assembling new PC in 7 companies of PZTM group will total 1,970 million Tenge.

(ii) Alternate plan for manufacturing 250 cars annually

In case the annual production is increased to 250 cars, it is possible to add another building of 192 meter length and 60 meter width in addition to the mentioned building. The cost in this case will be 2,481.5 million Tenge.

In regards to the building area, both areas are sufficient for manufacturing new PC. In this building area, if the manufacture of new Electric Passenger Car or new Freight Car is planned, it is possible to reserve sufficient space for them. (The building area is large enough to accommodate layout of Table 6.5.2 as it is.)

However, at present, PZTM group does not have equipment necessary for manufacturing new PC. It is necessary for them to examine this plan further including the manufacturing method of new complete PC and its parts and equipment.

(c) Comparison of Rysty AECRW and PZTM

The present new PC project plan of each enterprise is detailed as mentioned above. Table 6.5.3 is a comparison table between Rysty AECRW and PZTM.

Rysty AECRW has been doing PC repair work for a long time, and has much experience in rolling stock. So Rysty AECRW has a clear advantage for new PC manufacturing.

From the point of view of facilities, Rrysty AECRW has sufficient and even spare facilities and equipment because of the recent demand for repairig PC cars.

It will be possible to construct an effective and high quality new PC line with small investment, if some improvements to the present PC repair line are make, and in this line new PC can be produced.

Such Mixed Lines (repair PCs and new PCs produced in the same line) are usual in Japan, and are effective for production management and improvements in cost reduction.

But Rysty AECRW must get most of its parts from other companies (including import) at present, so, this company must develop new manufacturers to produce parts for new PC.

PZTM group has no PC experience at the present time. And they also have little technology, and few machines which would be useful for new PC production. If new PC would be produced, introduction of PC production technology is essential.

Since the PZTM group also has no technology for parts manufacturing, the new PC production project should include not only PC assembly but also parts development.

But if the extended schedule of new PC production, and the large investment are permissible, a new PC production project in PZTM group is more attractive than the Rysty AECRW project, because a new PC production system will start with newly introduced methods, and management system.

Table 6.5.4 Comparison Table : Rysty AECRW and PZTM

	Rysty AECRW	PZTM
Place	Almaty	Peteropavlosk
Experience in Rolling Stock	PC heavy repair & small spare parts	None But metal work & Machining work and electric parts
Facility & equipment	Additional investment to present facility	New installment of facility & equipment Except building
New PC production Technology		
: design	None	None
: metal work	Small parts	Small parts
: fundamental skill for PC	Have	None
: body assembly	None	None
: interior a'ssy.	Have	None
: equipping a'ssy.	Have	None
: inspection	Have	None
Parts procurement		
: important parts	Outside *1	Outside *2
: body cell	Inside	Inside *3
: interior parts	Outside	Inside *3
: equipping parts	Outside	Inside *3
: electric parts	Outside	Inside *3
Investment	Small	Big
Introduction of Technology	Management. Additional technology for new PC.	Management. Knowledge of Rolling stock. Every technology for PC & parts
Reality of present plan	Actual plan (realistic plan)	Future plan (not realistic plan)

Remark: *1 outside purchase will in future be same as at the present time.
*2 At the present time same as *1, but some enterprises in PZTM group are planning to make electric parts.
*3 It is necessary to introduce new technology or to develop new parts to increase their own work.

6.5.3 Freight Car Plant Reconstruction

Firstly the old repair lines which were constructed according to the demand for repair wagons in the former Soviet Union, and are not fully working at present, should be re-structured to the new Mixed Line mentioned below. At the same time, some of the wagon repair shops in Kazakhstan should be reorganized.

Then if KTZ needs new wagons, these wagons should be produced in the newly re-structured Mixed Line with minimal.

In the existing state of affairs, the wagon repair shops have several exclusive lines, and even the number of cars repaired are decreasing. Its lines are now in leisurely operation.

The operation efficiency of these lines is very low because of the shortage of wagons for repair, and it seems to be a inefficient production system.

This system is allowed to continue not only in wagon repair shops but also in almost all other industries including bearing manufacturing lines at Stepnogorsk in Kazakhstan.

In order to improve production efficiency in the face of the present low demand of repair wagons, the production lines should be replaced with a compact line. And in this line, every type of wagon should be repaired in lots of small size and high efficiency.

In general, almost all manufactures in Kazakhstan have exclusive lines for their products. If all types of wagons are repaired in one line, the production efficiency and production control and management of the enterprise will be improved significantly.

Fig 6.5.3 shows a mixed repair line for freight wagon. This example shows that all types of wagons except tank wagons, pass through the same line, and every programmed repair works should be finished at the same work station. Old facilities and machines are used in the new mixed line to decrease new investment.

Of course, improvements of jigs, tools, safety ladders and so on for the mixed line should be prepared thoroughly in the case of a special type of wagon.

The disparity in the required skills and adjustment of work time should not create large problems even with the current level of skill and management if this mixed line is supported by new technologies like Industrial Engineering, Quality Control.

It should be possible to repair all types of bogies in the present bogie repair line without any investment.

As a result of this improvement, one enterprise able to repair all types of wagons such as coal hopper, iron hopper, flat wagon, container wagon, tank wagon, etc, in a Mixed Line, and will not only improve manufacturing efficiency but also expand the range of wagon refined.

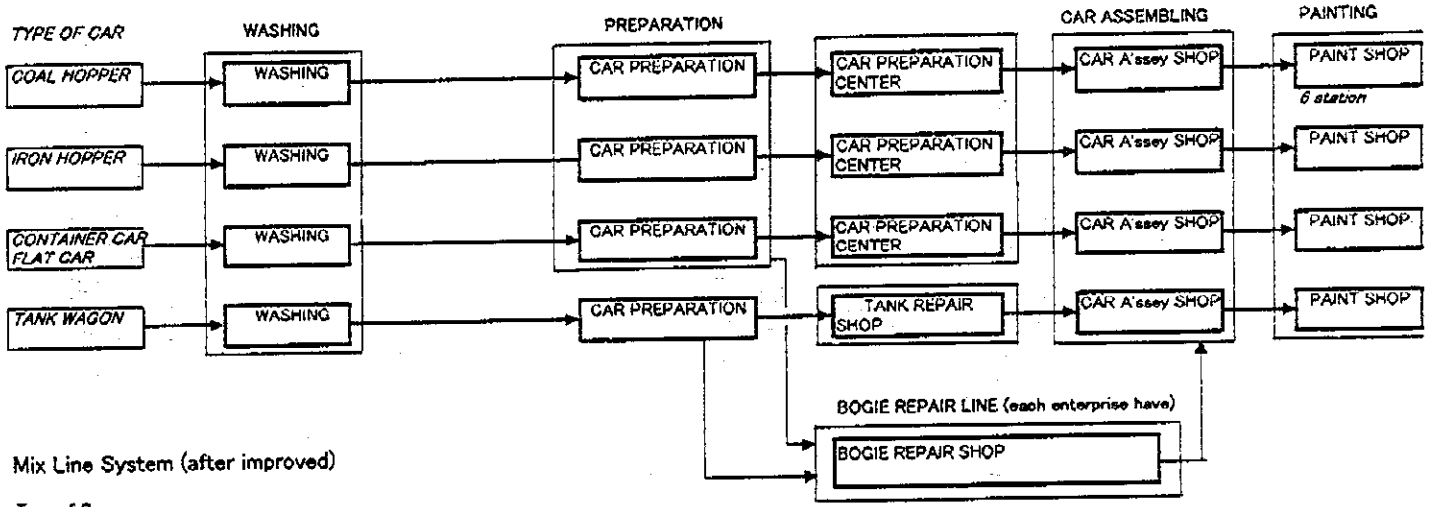
Step to mixed line organization

(1) classification of rapair work for each wagon car (at present time)

(2) grouping of work (shown bellow)

(3) re-organization of production line with IE technique.

grouping of work (at present time)



Mix Line System (after improved)

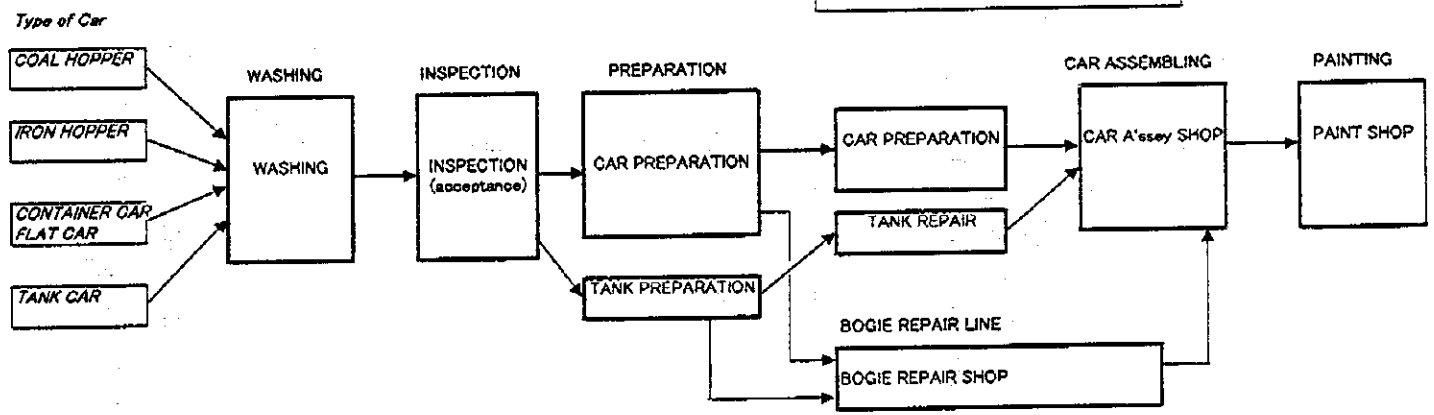


Fig. 6.5.3 Mixed Repair Line of Wagon at AWRZ

In addition to repair work, this Mixed Line is useful for new wagon fabrication, if metal working machines and some jigs (under frame, side frame, end frame etc.) are added in surplus space after restructuring of old lines. In this case, to upgrade the mixed repair line to mixed new wagon fabrication line, the investment cost will be lower than to construct an exclusive new wagon fabrication line.

KTZ is considering at the present time that each enterprise should undertake the whole of their repair work in their enterprise. But for the purpose of minimizing investment, the machinery works for wheel and axle repair should be concentrated at Ryaty AECRW in Almaty, AWRZ in Astana and EL, PC depots of KTZ from another repair shops in Kazakhstan.

6.5.4 Maintenance of Railway Rolling Stock

(1) The current situation of railway rolling stock maintenance is described in 3.7.4. Heavy repair of EL and DL is entrusted to foreign countries. All kinds of rolling stock maintenance, including heavy repair of EL, DL and EC, should be done in Kazakhstan. It is the most important to implement the following circular process for future development of rolling stock.

Rolling stock plan → Design → Manufacture → Commercial service →
Daily maintenance → Heavy repair → Rolling stock plan

Such circular process is effective for the reduction of new production and maintenance cost, and useful for the realization of better rolling stock to meet future social demands. Anyway, the cost of heavy repair in Kazakhstan for EL and DL will be reduced to less than 80% of the current cost using foreign countries.

(2) In order to conduct heavy repair of EL, DL and tank wagon in their own country, the KTZ have the following project while should be implemented.

a) EL

Atbasar EL Depot will be restructured so as to be able to undertake heavy repair of 300 sections of VL 80 type EL locomotives per year. The construction cost estimate is US$36 million , and a construction period of 3 years from 1999 to 2001 is scheduled.

b) DL

Shu DL Depot will be restructured so as to be able to conduct heavy repair of 300 sections of TE 10 type DL per year and 100 TEM2 type DL per year. The construction cost estimate is US$36 million, and the construction period of 3 years from 1999 to 2001 is scheduled.

c) Tank wagon

Atyrau FC Depot will be restructured so as to be able to conduct heavy repair of 500 tank wagons per year.

(3) Regarding the heavy repair of tank wagons, the execution plan of ZIKSTO in Petropavlovsk is under way as described in 3.7.4.

6.5.5 Localization of Spare Parts for Railway Rolling Stock

(1) The current situation of rolling stock spare parts is described in 3.7.5.

The Rysty-AECRW, repair company of PC, the AWRZ, repair company of FC, and the EL, DL, PC and FC depots of KTZ sometimes suffer from a shortage of spare parts. Although the spare parts could not be locally produced without license of the Russian Ministry of Railway, it is strongly recommended that the local production of spare parts should be implemented in order to solve the problems of shortage of spare parts and to save valuable foreign currency. AWRZ is keen to produce the spare parts for rolling stock. Besides, many companies such as PZTM in Petropavlovsk, Pavlodartractor, etc. have sufficient capability to produce them with their existing facilities. As for the production of spare parts for rolling stock made in the former Soviet Union, the concerned enterprises should be eager to acquire the license of the Russian Ministry of Railways and actively initiate the study and production of trial spare parts.

(2) The workshop of SBP has highly automated bearing production lines exclusively for railway rolling stock use.

In the outer race production line, specialized machines for producing the outer race are placed in processing order. In this line, one machine carries out one process and the product is sent to the next process in the order by means of a conveyer with automatic fitting and removing device.

Independent production lines are arranged for each part of the bearing. Such lines are very effective for mass production, but the efficiency of the lines is very low in case of

actual low demand. In order to increase the sales amount, SBP is now constructing 2 additional lines for tapered roller bearing, besides the existing 10 lines for cylindrical roller bearing. From the mechanical processing point of view, there is little difference between the cylindrical type and tapered type.

There is no much difference between a lathe used for cylindrical roller bearing and tapered roller bearings. If the production line in low use could be adapted to use the lathe for tapered roller bearings, the construction of new lines is not required.

If CNC (Computerized Numerical Control) lathe is placed in an actual production line, the line could product many kinds of bearings, besides cylindrical and tapered roller bearings for railway rolling stock use. For further development of the company, it is recommended that the company should acquire of ISO 9000 certification and start general bearing production, adding to the production of bearings for railway rolling stock use.

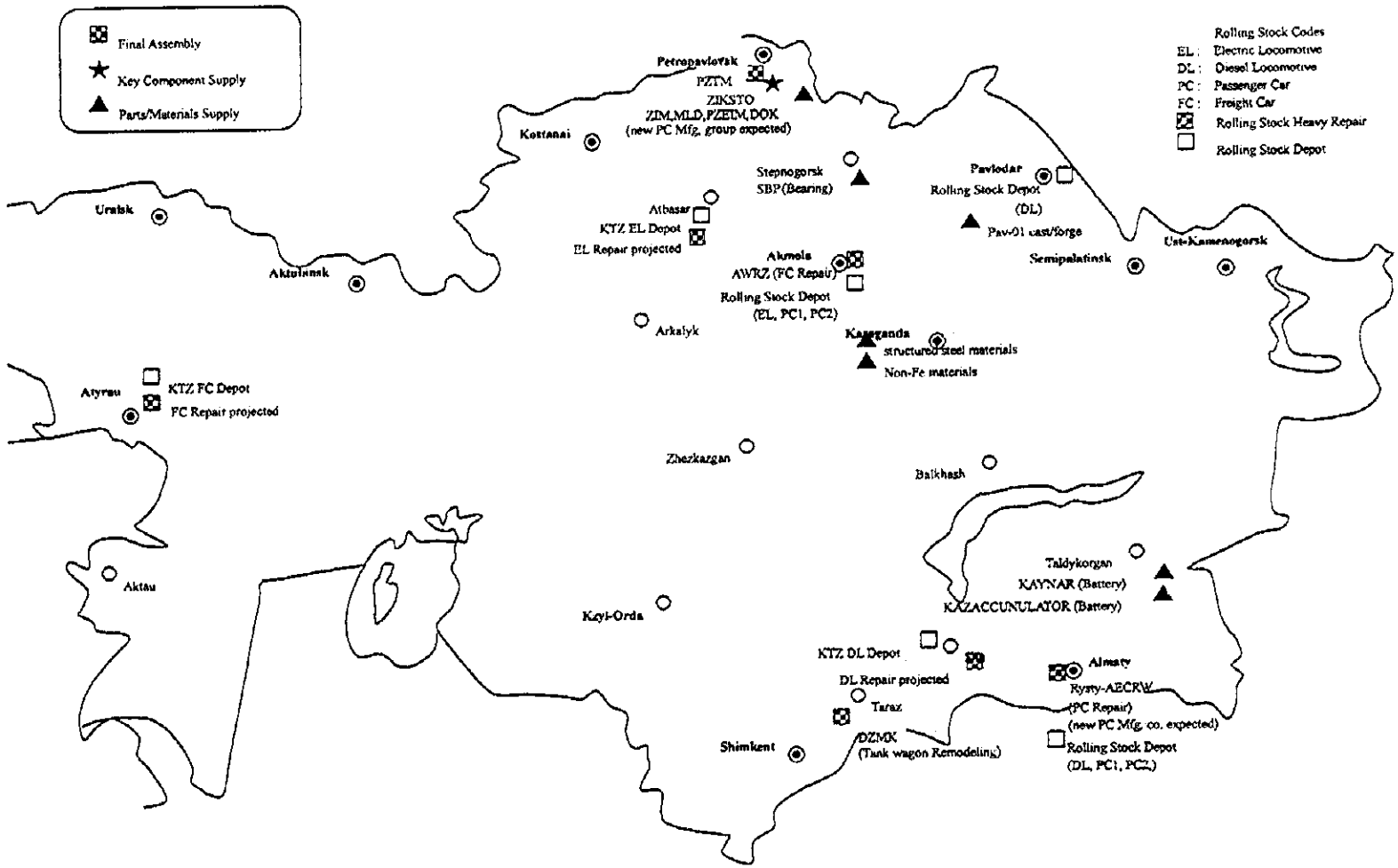


Fig. 6.5.4 Map for Railway Rolling Stock Enterprises

7. MANAGEMENT IMPROVEMENT PLAN FOR MODEL ENTERPRISES

In order to restore the business standing of companies and build efficient and effective production setups, each company should determine whether it should become a parts and components manufacturer or a final assembly manufacturer, before proceeding with the sale and scrapping of surplus equipment and revision of production lines.

Before the country achieved independence, companies in Kazakhstan, upon receiving orders from the Soviet central government, acquired raw materials and produced designated types and quantities of products for handing over to the central government. In the market economy environment, however, companies must take all responsibility for making decisions concerning product development, purchasing, production management, retailing, fund raising, plant investment, and so forth. Companies should build organizations and develop human resources that are capable of carrying out such functions.

In order to produce products that are competitive in terms of price, quality and performance, it is effective to form technical tie-ups with international corporate groups. At the same time, quality control systems should be built, equipment renewed and new technologies introduced.

Compilation of development strategies: Companies should abandon their existing integrated production setups and decide whether they should become parts and components manufacturers or final assembly manufacturers. It is appropriate that they first aim to become parts and components manufacturers. At the same time, they should select products and parts that they plan to develop and produce in the long term.

Rebuilding of production equipment and facilities: Based on development strategies, companies should revise their production lines by advancing the sale and scrapping of surplus equipment and if necessary purchasing equipment that is no longer required by other companies. Companies that plan to survive as parts and components manufacturers should build production lines that enable them to flexibly respond to orders from numerous companies.

Organizational reconstruction and improvement of management capacity: Companies should reconstruct their organizations to include departments in charge of research and development, purchasing, production, quality control, retailing and financial affairs, etc., and they should clearly define the functions and roles of each department. In addition to allotting appropriate staff and budgets to each department, companies should promote development of human resources. Based on inter-departmental cooperation, companies need to develop products that reflect user needs and carry out raw materials procurement and production that ensures customer satisfaction in terms of price and quality and secures profits. Companies should conduct aggressive retailing activities and establish post-sales service setups for customers. Such activities represent the first stage of quality control. Moreover, in order to secure tie-ups with international corporate groups in the medium to long term, it is essential that companies practice appropriate corporate control, compliance with laws and disclosure of information.

Construction of quality control systems: Improvement should start from tidying and housekeeping within plants and be expanded to total quality control (TQC). In the long term, in order to demonstrate to third parties that quality control systems are appropriate, companies should acquire ISO 9000 certification, which is the international standard for quality control systems.

Tie-ups with international corporate groups: In order to achieve rapid and low cost quality improvement and new product development, companies should seek to conclude tie-ups with international corporate groups which possess great technical and marketing capability. Before such tie-ups can be achieved, companies first need to dispose of surplus equipment and complete the establishment of their business management setups.

Introduction of new equipment and new technology: In order to produce reasonably priced products of the quality demanded by markets, it is necessary to replace existing specialized machines that are suited to mass producing limited product models, with multipurpose machining centers and NC lathes, etc. that are suitable for producing numerous models in small lots. Companies should introduce new equipment and raise their production technology levels. It is particularly necessary to carry out technological improvement in materials processing departments.

7.1 Outline of Companies and Improvement Issues by Sector

There are approximately 200 machinery manufacturers in Kazakhstan, however, only around 80 companies were visited and surveyed, and the assessment is an overall evaluation of those companies by the selected sector.

In compiling the model enterprises management improvement plan, an overall assessment of production management and quality control conditions, modernity of owned equipment, current state of surplus equipment and facilities, and product development capability, was conducted and issues for improvement were identified by sector. A five-stage assessment, in which an "A" ranking denotes parity with the standard of advanced industrial nations and an "E" ranking denotes the lowest standard, was conducted (see the Notes).

Distribution of equipment operation ratios by selected subsections in the machinery industry is shown in Fig. 7.1.1.

Table 7.1.1 Enterprise Contents and Improvement Issues by Sector

Sector	Number of Subject Factories			Production and Quality Control Standard	Current Equipment and Facilities		Product Development Technical Capability	Improvement Issues
	Total	Visited	Model		Modernity	Sufficiency		
Farm machinery	(120)	50	15 (8) (Note[3])	D	D	Surplus	D	• Introduction of QC • Introduction of small lot production technology • Strengthening of research and development • Enhancement of retailing and service system • Disposal of surplus equipment and facilities
Food processing machinery	(20)	9		D	D	—	D	• Demand study and promotion of research and development • Improvement of product quality and post-sale service
Mining machinery	(40)	15	6	D (1 enterprise C)	D	Surplus	D (1 enterprise C)	• Introduction of QC • Promotion of research and development and retailing • Disposal of surplus equipment and facilities
Railway rolling stock	(20)	9 +7 (Note[2])	6	C (1 enterprise B)	C		C (1 enterprise B)	• Improvement of management standards • Sophistication of processing technology • Development and plant construction for new rolling stock manufacture
Total	(200) (Note[1])	83 +7 (Note[2])	27					

Note 1: Figures are estimates, but a total of 201 machinery manufacturing companies is given in the State Program of the Machinery Complex Development in the Republic of Kazakhstan for 1998-2000.

Note 2: "+7" refers to the number of national railway depots.

Note 3: Eight companies also produce food processing machinery.

Note 4: Assessment ranks:

A: Same level as advanced industrial nations

B: Not up to the level of advanced industrial nations

C: Much improvement needed to reach the level of advanced industrial nations

D: Even more improvement needed to reach the level of advanced industrial nations

E: Achievement of industrialization is very difficult.

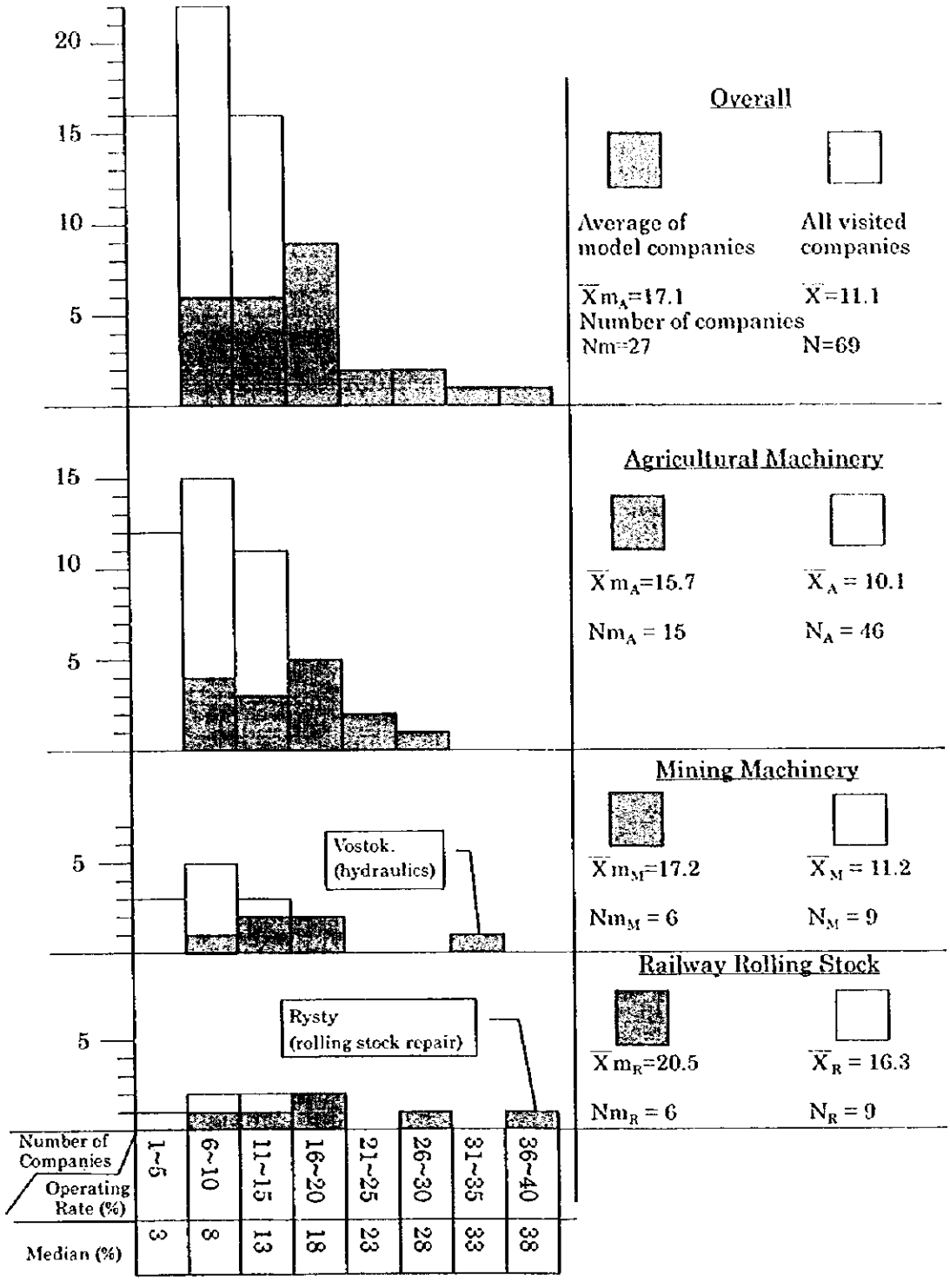


Fig. 7.1.1 Equipment Operating Rates in the Machinery Industry (observed during the enterprise visits)

7.2 Selected Model Enterprises

27 model enterprises of some 80 enterprises surveyed are selected from the viewpoint of industrial restructuring in the selected sectors.

7.2.1 Selection Criteria

The selection criteria of the model enterprises in the first field study is as follows on the premise of improvement or development of the enterprise.

(1) Role in Industrial restructuring

1. An enterprise which produce typical products in certain industry
2. An enterprise which is located in big economic regions
3. An enterprise which is specialized in the material production for manufactures

(2) Potential for Improvement of the enterprise

1. A potential market-oriented new substitute enterprise (based on existing facilities)
2. An enterprise which has capable management and sufficient technology
3. An enterprise which will be able to produce prominent products in near future including exporting products
4. An enterprise which has already observed as the investment project
5. An enterprise which has financial potentials

7.2.2 Enterprises Selected

The following model enterprises were selected, based on the above criteria through discussions with Kazakh side. Management improvement for these enterprises are proposed based on the case study of industrial restructuring. Outlines of the enterprises are shown in Appendix 1.

Agricultural Machinery

1)	Name of Enterprise:	AZTM
	Location:	Almaty
	Major Products:	Fe, non Fe metal products
	Sales Amount/month:	750 million Tenge
	No. of Employee:	(4500) 2005
	Reason for Selection:	Machinery components and parts
2)	Name of Enterprise:	Pavlodar Tractor
	Location:	Pavlodar
	Major Products:	tractor, crawler
	Sales Amount/month:	400 million tenge
	No. of Employee:	(22000) 8300
	Reason for Selection:	tractor cast and forge parts
3)	Name of Enterprise:	Die & Tool Division, Pavlodar Tractor
	Location:	Pavlodar
	Major Products:	Die & Tool
	Sales Amount/month:	n.a.
	No. of Employee:	800
	Reason for Selection:	Die & Tools
4)	Name of Enterprise:	Pavlodar Machine
	Location:	Pavlodar
	Major Products:	gantry and overhead crane
	Sales Amount/month:	n.a.
	No. of Employee:	420
	Reason for Selection:	machinery component, hydraulics, electronic parts
5)	Name of Enterprise:	October Lathe
	Location:	Pavlodar
	Major Products:	engineering with manufacturer
	Sales Amount/month:	6.3 million Tenge
	No. of Employee:	(1200) 100
	Reason for Selection:	process manufacturing, etc.
6)	Name of Enterprise:	PZTM
	Location:	Petropavlovsk
	Major Products:	spare parts, electric power and mine
	Sales Amount/month:	30 million Tengek
	No. of Employee:	(10000) 2000
	Reason for Selection:	mechanical parts, food process manufacturing
7)	Name of Enterprise:	ZIKSTO
	Location:	Petropavlovsk
	Major Products:	6t 2oxle trailer
	Sales Amount/month:	300 million Tenge
	No. of Employee:	(7000) 2500
	Reason for Selection:	machinery parts and farm implement

8) Name of Enterprise: Kirov
Location: Petropavlovsk
Major Products: electric parts, spare parts, farm machinery
Sales Amount/month: 14.2 million Tenge
No. of Employee: (6500) 700
Reason for Selection: machinery parts, electric parts

9) Name of Enterprise: Akomolaselmash
Location: Akmola
Major Products: farm implement
Sales Amount/month: 20.7 million Tenge
No. of Employee: (6500) 1000
Reason for Selection: implement, (tractor), JD combine localization

10) Name of Enterprise: Gas Apparatus
Location: Akmola
Major Products: gas stores and canisters
Sales Amount/month: 4 million Tenge
No. of Employee: (870) 148
Reason for Selection: grain storage, handling suitable

11) Name of Enterprise: Tselinenergomont
Location: Akmola
Major Products: electric power station equipment and maintenance
Sales Amount/month: 44 million Tenge.
No. of Employee: 800
Reason for Selection: fabrication (welding), machinery parts

12) Name of Enterprise: Eikos
Location: Almaty
Major Products: water purifier
Sales Amount/month: n.a.
No. of Employee: 140
Reason for Selection: food process machinery

13) Name of Enterprise: Pisheremmash
Location: Almaty
Major Products: Food processing machine (meat, milk)
Sales Amount/month: 3 million Tenge
No. of Employee: 150
Reason for Selection: Promotion of food processing machinery

14) Name of Enterprise: Diesel Engine Factory
Location: Kostanay
Major Products: Engine parts
Sales Amount/month: 1 million Tenge
No. of Employee: 600
Reason for Selection: Promotion of tractor engine producer

15) Name of Enterprise: Agroremmash
Location: Almaty
Major Products: Flour mill
Sales Amount/month: 2 million Tenge
No. of Employee: (200) 90
Reason for Selection: Promotion of food processing machinery

Mining Machinery

1)	Name of Enterprise:	Almaty Lathe Co.
	Location:	Almaty
	Major Products:	Lathe
	Sales Amount/month:	14 million Tenge
	No. of Employee:	100
	Reason for Selection:	No other lathe making enterprise except for this enterprise in this country and possibility to produce precise measurement tools
2)	Name of Enterprise:	AZTM (Almaty Heavy Machine Building Co.)
	Location:	Almaty
	Major Products:	Pipes, wires producing equipment: specialized castings
	Sales Amount/month:	975 million Tenge
	No. of Employee:	2,500
	Reason for Selection:	Market-oriented management
3)	Name of Enterprise:	Kargormash
	Location:	Karaganda
	Major Products:	Hydraulic facepost for coal mine
	Sales Amount/month:	80 million
	No. of Employee:	1,300
	Reason for Selection:	Special hydraulic technology
4)	Name of Enterprise:	KCMZ (Karaganda Casting & Machinery Building Plant)
	Location:	Karaganda
	Major Products:	Mining equipment and repair
	Sales Amount/month:	25 million Tenge
	No. of Employee:	750
	Reason for Selection:	Possibility to develop casing specialties to supply other enterprises in Karaganda
5)	Name of Enterprise:	Vostokmashzavod
	Location:	Ust-kamenogrsk
	Major Products:	Mining machines and tools
	Sales Amount/month:	120 million Tenge
	No. of Employee:	2,200
	Reason for Selection:	Market oriented management: Possibility to produce chemical or food processing plant
6)	Name of Enterprise:	Karaganda Parkhomenko Plant
	Location:	Karaganda
	Major Products:	Mining machinery, construction machinery and metallurgical machine
	Sales Amount/month:	10 million Tenge
	No. of Employee:	310
	Reason for Selection:	Possibility to produce pollution preventing equipment

Railway Rolling Stock

1)	Name of Enterprise:	Rysty-AECRW
	Location:	Almaty
	Major Products:	Passenger coach repair
	Sales Amount/month:	US$ 1.3 million
	No. of Employee:	2,000
	Reason for Selection:	Expected new passenger coach manufacturing
2)	Name of Enterprise:	Pavlodartractor
	Location:	Pavlodar
	Major Products:	Tractor
	Sales Amount/month:	10.4 million Tenge
	No. of Employee:	8,543
	Reason for Selection:	Expected Railway Rolling Stock spare parts manufacturing
3)	Name of Enterprise:	PZTM
	Location:	Petro-Pavlovsk
	Major Products:	Heavy machinery
	Sales Amount/month:	1.3 million Tenge
	No. of Employee:	2,876
	Reason for Selection:	Expected new passenger coach manufacturing
4)	Name of Enterprise:	Stepnogorsk Bearing plant (SBP)
	Location:	Stepnonagorsk
	Major Products:	Roller bearing
	Sales Amount/month:	18.3 million Tenge
	No. of Employee:	3.700
	Reason for Selection:	Important enterprise as designated by the government
5)	Name of Enterprise:	AWRZ
	Location:	Astana
	Major Products:	Freight wagon repair
	Sales Amount/month:	0.7 million Tenge
	No. of Employee:	820
	Reason for Selection:	Only one freight wagon repair company in Central Asian Railway
6)	Name of Enterprise:	DZMK (Dzhambul Metal Construction Workshop)
	Location:	Taraz
	Major Products:	Tank wagon repair, production
	Sales Amount/month:	300 million (1996), 180 million (1997), 600 million (1998) Tenge
	No. of Employee:	Engineer(100), Worker(370)
	Reason for Selection:	Production promotion is planned by KTZ

7.3 Basic Approach for Management Improvement of Model Enterprises

The following improvement plan for the model enterprise would be also applied for the other enterprises in the same sector

7.3.1 Drafting of Development Strategies

In the formulation and modification of strategic plans, the following subjects should be considered for periodic review.

- Should the enterprise in question concentrate on manufacturing final products or supplying component parts?
- Should the enterprise in question maintain its independence or seek a foreign partner?
- What kind of products is it desirable to become competitive in?
- Are existing equipment, facilities and organizations worth reconstructing, or should they be discarded?

When business owners examine the problem points discussed in the following sections with a view to promoting enterprise improvement, they should also give consideration to the following problems. Many revisions are required on both the software and hardware sides. In other words:

- Software revisions (revision of the management system and business approach)
- Hardware revisions (revision of physical assets and plant layout)

As the extent of required changes becomes clearer the answer to this question should be reviewed. It is certainly one of the key questions asked by any potential foreign investor. The judgment of most foreign investors to date is that restructuring of existing enterprises is not worthwhile; they would rather start to build a completely new enterprise with new management structure and team and new production facilities. Certainly a domestic investor might rationally come to a different conclusion. His options for introducing new technologies might be more limited and more expensive, and financing will certainly be more expensive. Never the less the judgment showed by the international market cannot be totally ignored.

7.3.2 Basic Approach for Management Improvement

The following diagram illustrates the links that exist between priority issues faced by companies and basic subjects for management improvement.

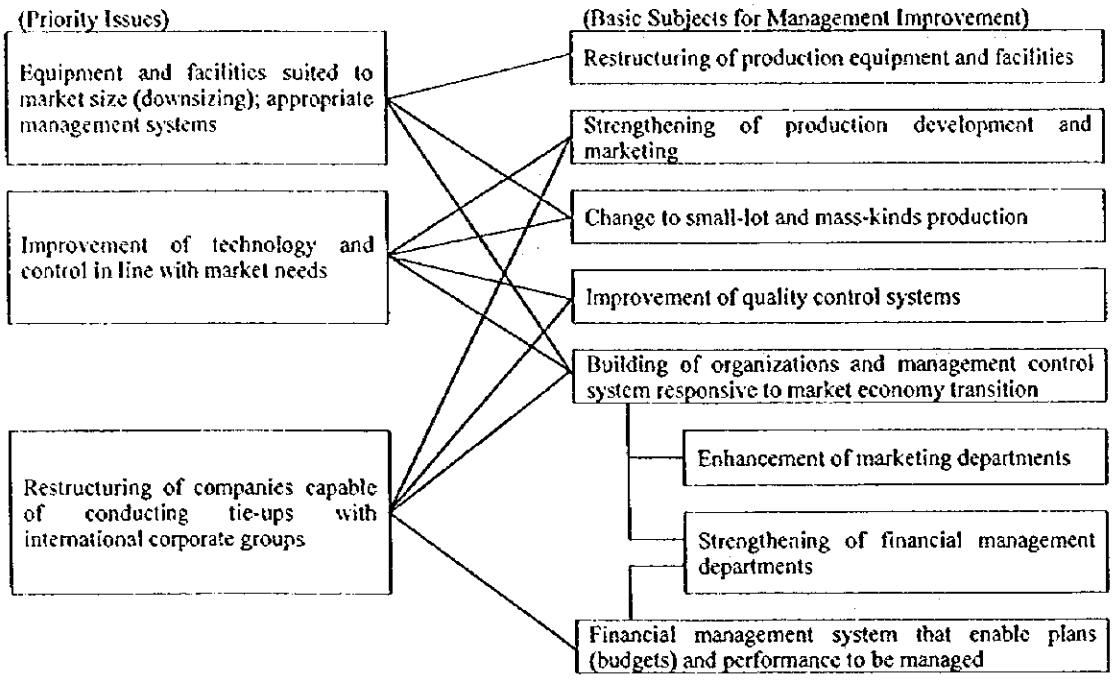


Fig. 7.3.1 Linkage Between Key Issues and Basic Subjects for Management

7.3.3 Management Improvement by Model Enterprise

The basic subjects for management improvement mentioned above are described individually in the following sections. Table 7.3.1 compiles the subjects for improvement that have been deemed to be important for each model enterprise based on the findings of the company visit surveys.

In determining the importance of improvements, consideration was given not only to the current conditions of the companies, but also to the future roles of companies (responsibility for key product development and production, etc.) within the industrial restructuring plan.

Table 7.3.1 Management Improvement Subjects by Model Enterprise

No. (Note1)	Model Enterprise Name	Basic Subjects for Management Improvement						Remarks (main roles in industrial restructuring)
		Downsizing of production equipment/facilities	Strengthening of marketing functions	Strengthening of product development	Introduction of small lot production system	Improvement of quality control	Strengthening of financial management	
A 1)	AZTM	※	※	※	※			Special material precision parts
2)	Pavlodar Tractor	※	※	※	※		※	Medium tractor improvement
3)	Die&Tool Division, P.T.	※	※	※			※	Food processing plant equipment
4)	Pavlodar Machine	※			※	※	※	Parts manufacture and repair
5)	October Lathe	※	※	※			※	Food processing plant equipment
6)	PZTM	※		※		※	※	Parts manufacture
7)	ZIKSTO Petropavlovsk	※	※	※		※	※	Medium and large tractor development
8)	Kierov	※		※	※	※	※	Electronic parts and work machine parts
9)	Akmolaselmash	※	※	※		※	※	Crawler combine harvester development
10)	Gas Apparatus	※	※	※			※	Storage equipment manufacture
11)	Tselinenergomont			※	※			Farm machinery parts manufacture and repair
12)	Eikos		※	※	※			Food processing machine development
13)	Pisheremmash		※	※	※			Food processing machine development
14)	Diesel Engine Factory	※	※	※		※	※	Engine series standardization
15)	Agroremmash		※	※	※			Food processing machine and work machine development
M 1)	Almaty Lathe	※	※	※	※		※	Gear box development
2)	AZTM	※	※	※	※		※	Large precision parts manufacture
3)	Karaganda gormash	※	※	※			※	Hydraulic equipment expansion
4)	KAMZ	※	※			※	※	Parts manufacture
5)	Vostokmashzavod	※	※	※		※	※	Wheel loader development
6)	Karaganda Parhomenko	※	※	※	※		※	Coal washer machine and parts manufacture
R 1)	Rysty-AECRW			※	※	※		Repair and manufacture of passenger car
2)	Pavlodartractor	※	※		※	※	※	Rolling stock parts manufacture
3)	PZTM	※		※	※	※	※	Passenger car manufacture
4)	Stepnogorsk P. J.	※	※	※			※	Rolling stock and general use bearings manufacture
5)	AWRZ				※	※		Freight car repairs
6)	DZMK					※		Tank wagon manufacture

Note 1 (No. column):
A: Farm machinery manufacturing M: Mining machinery manufacturing R: Railway rolling stock manufacturing

Note 2 (Importance of improvement subjects)
*: Important ※: Very important

7.4 Restructuring Procedure of Production Equipment and Facilities

The procedure for reviewing and restructuring the existing production equipment and facilities is indicated below.

(1) Formulation of Product Strategies

Concerning the key products and key components and parts that are handled by each manufacturing company, a medium to long term product strategy shall be formulated.

a) Final Assembly Companies
The target companies must have past experience of mass producing and assembling final products. With respect to components and parts, plans for dividing operations and purchasing externally shall be considered.

b) Components and Parts Manufacturing Companies
Companies that do not satisfy the criteria described in a) shall first give consideration to the production of components and parts.

(2) Preparation of Production Equipment and Facilities Plans

Plans for installing the production equipment and facilities necessary for the manufacturing processes to be handled by each company shall be prepared. As a precondition for calculating the production capacity of the required equipment and facilities, it must be possible to achieve the target production volume with an equipment operating rate of 70%.

(3) Preparation for Streamlining of Production Equipment and Facilities

Manufacturing companies that have made the management decision to engage in the manufacture of key products and key components and parts shall next prepare for the streamlining of production equipment and facilities.

1) Gathering of Information on the Current Conditions of Production Equipment and Facilities

With respect to processing equipment, equipment lists shall be revised and the manufacture dates, specifications, uses, operating conditions, any problems and book values, etc. of equipment shall be surveyed and recorded. Equipment shall then be ranked according to its potential for future utilization.

The current state of processing equipment shall be surveyed taking account of the following table.

Table 7.4.1 Current Conditions of Processing Equipment

Model (including date of manufacture)	Machine Specifications	Applicable Range	Required Specifications	Operation	Maintenance Cost	Performance Evaluation (precision, productivity, reliability)	Book Value	Judgment (use or disposal by selling or scrapping)

Other facilities shall be also surveyed and ranked in the same manner.

2) Selection of Surplus Equipment and Facilities

Based on the information obtained above, each company owner shall quickly determine whether equipment and facilities should be utilized or disposed by selling or scrapping upon considering their importance in the medium to long term strategy and current operating conditions.

The utilization or disposal (selling or scrapping) of processing equipment shall be determined in the following procedure.

(Basic Approach)

- Equipment shall be minimized in order to reduce costs incurred in holding on to surplus equipment.
- Machine operating rates and processing efficiency shall be raised through using general purpose machine equipment.
- With respect to low productivity processes, based on the assumption that process machine equipment will either be sold or scrapped, the parts produced by these processes shall be ordered externally.

(Conditions for Equipment Utilization)

1. The equipment satisfies the required specifications of target products.
2. Productivity is high.
3. Operating rates are high.
4. Consideration shall be given to maintenance costs and repair frequency.

(Equipment Conditions for Scrapping)

1. The equipment is deteriorated and does not satisfy required specifications.
2. Breakdowns are frequent and maintenance is expensive.

(Equipment Conditions for Selling)

1. The equipment is surplus to requirements in the Current and future production plan.
2. Productivity and operating rates are low.

3) Relocation and Transfer

For the sake of asset management and securing efficiency on production lines, surplus equipment shall be moved and orderly stored in separate areas away from the production lines. Moreover, when moving and installing useful equipment, floor improvement must be carried out.

(4) Disposal by Selling or Scrapping

Before scrapping equipment, ample consideration shall first be given to the possibility of selling.

It is necessary to promote information exchange and selling activity within the industry based on the exchange of information relating to machinery specifications and current conditions of maintenance. In this case, it would be effective for machinery makers such as Almaty Lathe Co., etc., which already have experience of selling used machinery overseas through industrial associations, to take the initiative in forming committees and promoting the sale of equipment throughout the whole industry. As for the collection of information relating to demand, it would be appropriate to make use of the Machinery Industrial Center.

7.5 Strengthening of Marketing and Products Development

While some enterprises have made significant progress in re-orienting their activities towards the market, many have made little progress. Some managers are still sitting in their office waiting for orders or instructions to produce goods. These managers seem to believe that the term "market demand" is simply a new word to replace the soviet "norms" that used to determine the supply of machinery to users.

Understanding of market principles needs to be improved in the following areas

7.5.1 Examination of Market Trends

Most enterprises still tend to view themselves as suppliers to a particular end-user sector, such as agriculture, mining, construction, railways etc. in line with their historic affiliation to a Ministry of the old USSR. This strict vertical segregation is artificial and is only found in the Former Soviet Union. In all other countries machinery enterprises try to supply customers in many different end markets. They try to develop a range of related products for a variety of customers in different sectors. This approach has been taken for two reasons:

- by developing related products they are able to obtain extra value from much of their product development activity
- by diversifying their markets they reduce their exposure to a downturn in any particular market.

Kazakh enterprises need to review their main products and design skills and redefine their markets in terms of technologies, rather than end users.

7.5.2 Strengthening of Marketing Functions

No machinery manufacturers have yet managed to establish strong marketing and distribution functions. Companies need to invest more resources than ever in order to develop their marketing departments and distribution departments. The largest marketing department observed among the interviewed companies was composed of five staff out of a total work force of 2,200 employees. The ratio of marketing expenditure to sales among the surveyed companies was less than 1% of the equivalent figure among companies in the West.

The internal reform of companies is required. In the current situation of financial crisis, almost all companies regard marketing and distribution as necessary evils accounting for one of the many indirect expenses they must bear. However, without efficient marketing departments, it will be impossible for companies to survive in the long term. Marketing departments need to not only identify and create markets for existing products, they must also identify potential markets for new products. Companies should allocate sufficient budgets to marketing and count them as a single cost item.

A marketing department conducts the following kind of work:

- Collection and analysis of market information
- Sales planning
- Sales promotion and advertising
- Repair and servicing
- Parts supply, etc.

The marketing cost for the final assembler is rather larger than the parts supplier in general.

7.5.3 Importance of Product Development

The marketing departments and engineering departments of companies must work closely in the development of new products. The selection and development of new products should be well balanced. Moreover, companies must respond to market needs while at the same time giving consideration to their current technology and manufacturing capacity. Thus, it is important to study whether the product will be independently developed by itself or jointly with the other company.

As stated in "4.5.2 Strategy for Gaining Access to International Market", the shortcut to securing the products competitiveness in the international market is to make technical tie-ups with international corporate groups. The procedures and guideline for those alignments are stated in Appendix-2: Guideline for Technical Alignment.

7.5.4 Pricing Strategy in the Market

Many enterprises still see price as a figure that they set by adding a profit margin to their costs, and then complain if the price is too high to attract buyers. This approach to price is really a hangover from the Soviet system. Price must be seen as a target set by the market that an enterprise must meet; or else it must get out of this market.

As part of their market research programs enterprises must start trying to determine the price that the market is prepared to pay for new and existing products. This sets a target that product developers and production engineers have to meet.

Pricing of existing products must be more flexible and take account of willingness to pay. Currently most markets are very price sensitive. Often enterprises are getting themselves in to a vicious circle, as rising prices reduce demand. This in turn increases average costs pushing prices higher again. This cycle has to be broken. In some circumstances prices charged to some customers, (the most price sensitive customers) may need to be set below average costs but above variable costs, to increase volumes and bring down average costs. Most enterprises are in urgent need of assistance to introduce more flexible pricing approaches and increase total sales.

7.6 Change to Small Lot and Multiple-Kinds Production

Currently production enterprises such as Pavlodar Tractor hold huge quantities of machine tools each dedicated to performing a single task. As a result the production system can only work economically on very long production runs and updating of specifications is extremely difficult. The concept of "continuous improvement" which is now central to quality improvement in virtually all Japanese production systems would be extremely hard to implement in such a production system.

7.6.1 Transition to Small Lot Production

To manage the expansion of the market and improve the competitiveness of the products, countermeasure against production cost reduction is necessary by introducing small lot production system, especially to review machining and sheet metal/press process which are able to cope with small lot production system. The change of production system needs large amount of fund with the support of technology and money. Due to the inflexibility of the former production system, drop of production volume pushed up production cost per unit, hence the raise of sales price. From this point, the adoption of small lot production system is necessary

Targets for this are as follows:

- Enable companies to extricate themselves from their existing cumbersome, large-scale production systems.

- Build production systems that have high operating rates and can flexibly respond to current production scale and product diversification.
- Reduce production lead times from design through to delivery in response to needs.
- Through introducing small lot production management systems, reduce inventory size, shorten delivery times and cut costs.

In existing production systems, machine processing is predominantly carried out using special purpose machine lines, and sheet metal pressing is performed using single function tool presses (cutting, bending, drawing). Such production systems are highly expensive, inefficient and unproductive for producing small lots, which are now required as a result of the declining scale of markets. Flexible production systems that can handle small lot production and design changes, etc. are required.

7.6.2 Utilization of Outsourcing

In the Japanese system, many parts of the production process are contracted out to specialist independent companies. There are two reasons for this:

- specialist companies can concentrate on the development of special skills
- specialist companies can often reduce overheads for basic production operations.

There is an urgent need to develop specialist companies who can improve the technologies in areas such as casting. (These may be formed out of segments of existing major enterprises such as AZTM, Vostokmashzavod and Karaganda Casting and Mechanical Plant). Technology in this area is twenty to thirty years out of date; until this is updated it will be practically impossible to meet current quality expectations of consumers.

Until better cost control systems are installed in existing enterprises it will not be clear how urgent is the need for the development of specialist companies carrying out basic pressing and machining operations for larger enterprises. In Japan large companies face high overheads and thus contract out many operations to smaller specialist firms who can achieve lower overhead costs per unit of production. The companies producing

final goods continue to carry out those operations where there is a high value added, but contract out the simpler operations where the value added is low.

The extent of outside contracting that is appropriate in Kazakhstan will depend on the cost structures of Kazakh enterprises, and may be somewhat different from Japan, but certainly more outsourcing will be required than is current practice. Outsourcing as a cost reduction technique will not be effective until an effective business culture is created in Kazakhstan so that the transaction costs between the prime manufacturer and the components suppliers are minimized.

Outsourcing will be a staged process, but the basic concept is illustrated in Fig. 7.6.1.

To construct the business connection among assemblers, parts and component manufacturers, and subcontractors which are in charge of processing, free and frequent exchange of the information among them is very important. The conceptual figure of division of labor is shown as Fig. 7.6.2. To accelerate the information exchange activities, the machinery industrial association, and the machinery industry information center should be utilized as mediators.

The development of the components industry will also require more standardization, so that components, sub-assemblies and assemblies are more interchangeable. While there is an extensive set of GOST standards, often there are no standards applying at the component level. Component manufacturers and final product assemblers should adopt international standards as quickly as possible

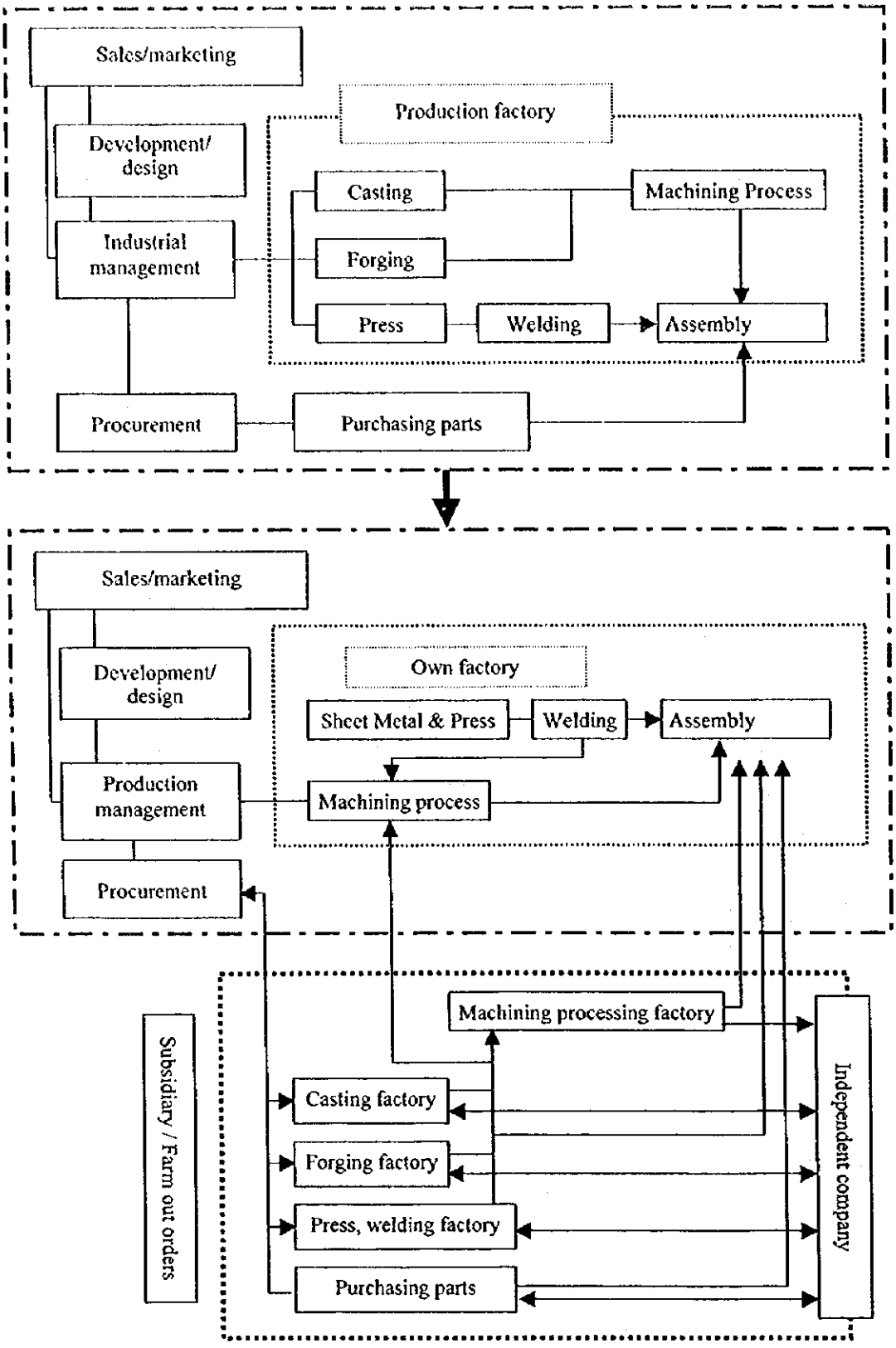


Fig. 7.6.1 Condition After Changes of Manufacturing System

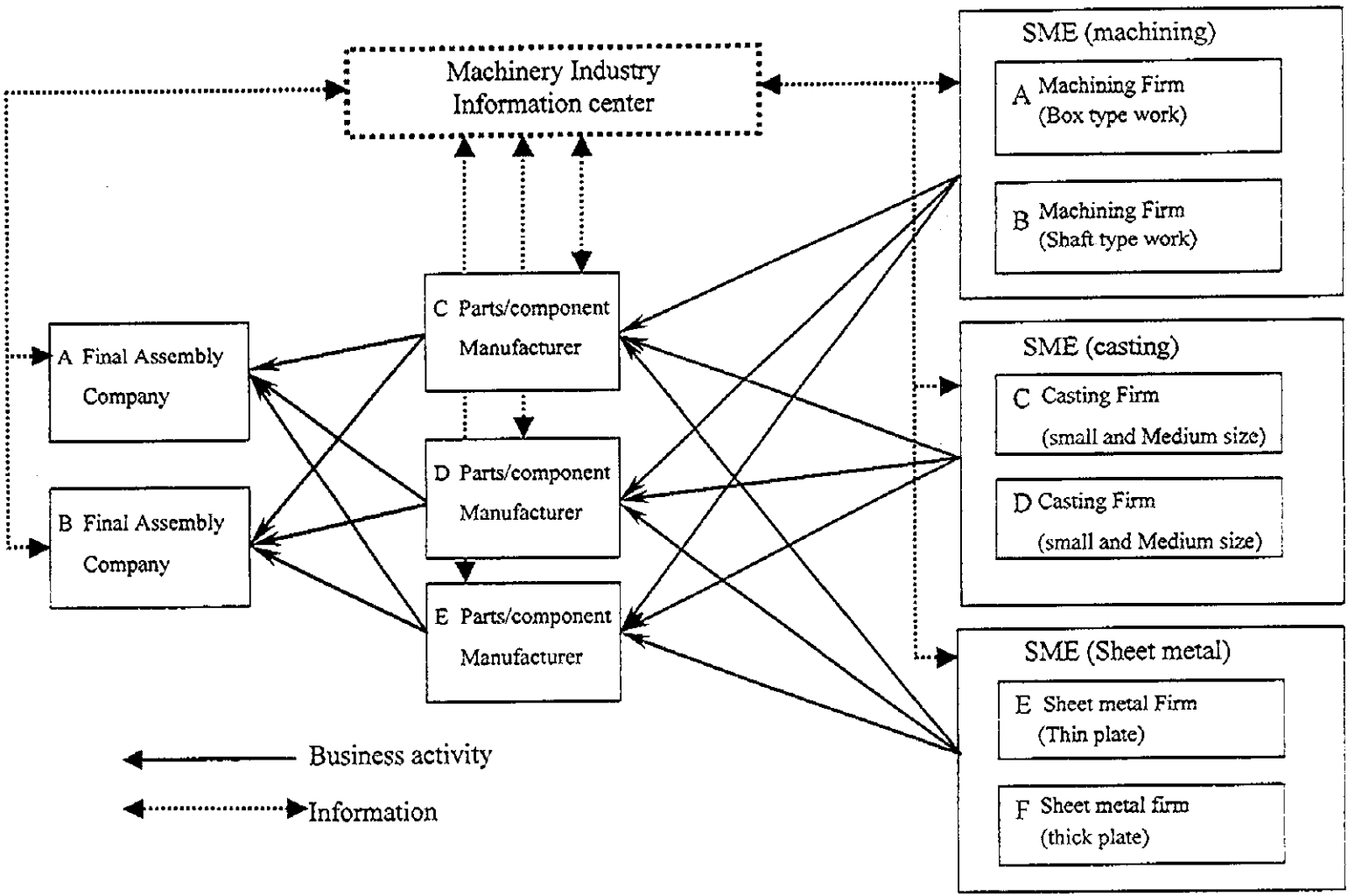


Fig. 7.6.2 Conceptual figure of division of labor

7.6.3 Transition to Multipurpose Machinery

Almost all the machinery currently owned by production plants has no general applicability at all. It is thus necessary to establish the following kind of production system through introducing multipurpose machinery.

- System where a single item of multipurpose machinery has the same production capacity as 20 or more existing single function machines.
- System that enable products to be easily upgraded and new products to be produced with a minimum of plant investment.

(1) Machine Processing

Production in machine processing has fallen to below 10% of the equipment capacity and many processing machines are single function machines with little general applicability. As a result of the equipment surpluses and low productivity, etc. that are created by these conditions, manufacturing costs are inflated and quality is reduced. In future it will be necessary to make production systems more flexible by mainly introducing machining centers (MC) and NC lathes.

According to the circumstances, it seems difficult for the enterprises to raise investment by themselves. Financial support from the government is aspired. The relation of production unit number and suitable production facilities is shown as Fig. 7.6.3.

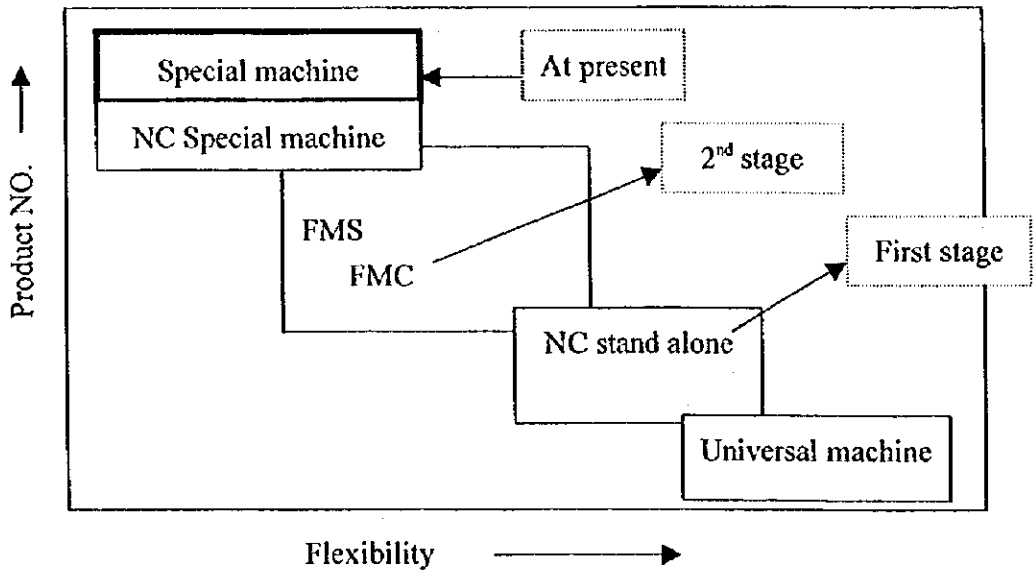


Fig. 7.6.3 Machine Tool System

Table 7.6.1 Comparison of Machining System

	Flexibility		Production work	Necessary process
Machining center	Machining of many kinds of parts can take place consecutively simply by invoking a new numerical control program	Machining can be performed on all axes. Without manual intervention machining of many faces of details can be performed.	For complex components, components where tolerances are critical and small lot production systems	Preparation of NC program
Numerical Controlled lathe	Machining of many kinds of parts can take place consecutively simply by invoking a new numerical control program	Without manual intervention can produce many kinds of components that an be described in polar co-ordinates	For various kinds of components where tolerances are critical and small lot production systems	Preparation of NC program
Special machine	Machining of single component		It is suitable for mass production	

(2) Sheet metal and press

Current systems are totally inappropriate for current production levels. These systems contain many lines each dedicated to a specific component. Each line includes presses for trimming and drawing without changing dies. This system cannot be adapted to small lot production. When used for producing small lots these systems result in excessive die depreciation and very low productivity for the presses.

1) Presses

As a first stage, the press management systems should be improved to reduce the time necessary to exchange dies, and the number of presses should be reduced to match the workload under the new press management system. To improve flexibility and utilization of press machines cutting and processing systems which do not use special dies should be introduced.

2) Cutting and Trimming

Cutting processes such as turret punch press, laser cutting machine, plasma cutting machine and gas cutting machine do not need special dies, and can produce many different kinds of parts. To improve the drawing process, it is necessary to improve the design of parts and replace conventional presses with presses with numerical control press brake. These are more flexible and can be used economically in small lot production systems. These improvements can improve the product design as well as reduce production costs. (refer to Table 7.6.2 and Fig. 7.6.4)

Table 7.6.2 Sheet Metal Process

	Die		Program	Steel thickness	Comments
Press	Individual die for each product	Change die	Not necessary		Many presses and many dies required
Turret punch Press	Universal punch die	Automatic	necessary	Max 3.2mm	
N.C. Laser machine	Not necessary	Not necessary	necessary	Max 10mm	
N.C. Plasma Cutting machine.	Not necessary	Not necessary	necessary	Middle	
N.C. Gas Cutting machine.	Not necessary	Not necessary	necessary	Thick	
N.C. Press brake	Universal punch die	Automatic	necessary	Middle	

	At present	
Cutting process	Thin	Press
	Middle	Press
	Thick	Press

Recommended production system			
	Thin	Middle	Thick
Turret punch Press	Δ		
N.C. Laser machine	O		
N.C. Plasma Cutting mach.	O	O	O
N.C. Gas Cutting mach.		O	O

Drawing process	Thin	Press	
	Middle	Press	
	Thick	Press	

Press (bending)j	Δ	O	O
N.C. Press brake	O	O	

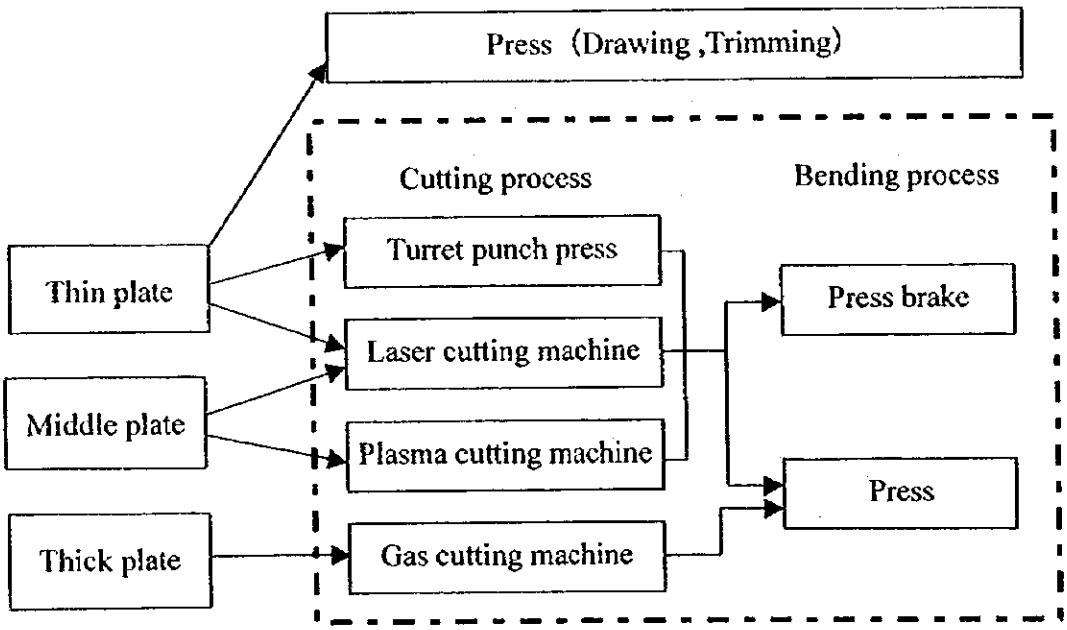


Fig. 7.6.4 Reform of a Sheet Metal Press Process

(3) Introduction of CAD/CAM (computer-aided design/computer-aided manufacturing)

The productivity of NC controlled machines is greatly improved by the adoption of CAD/CAM systems. In the first stage the NC programs are prepared by CAM computer software. Finally the whole process from design to the NC program preparation can be integrated with a full CAD/CAM computer system.

Table 7.6.3 Introduction of CAD/CAM

Process		Result
Design	Introduction of CAD	Preparation of NC program by a computer-aided design data application
Machining	Adoption of Machining Centers and NC lathe	
Sheet metal/ press	Various NC cutting machine	Efficient production of program by CAD data → NC program
	NC press brake bending processing	

7.7 Improvement of Quality Control Systems

Before most Kazakhstan enterprise can recover domestic markets and enter foreign markets product quality has to improved, and be seen to be improved.

7.7.1 Subjects of Immediate Needs

Production plants are operating at only 10-20% capacity and conditions of plant management and equipment maintenance are deteriorating. Nonconforming products are disposed together with cutting waste, etc. and plant interiors are disorderly. In these circumstances, it is thought that quality control cannot be sufficiently observed. The situation is also unsatisfactory concerning the recording and storage of inspection data and statistical processing.

It is necessary to rebuild quality control system, starting with thorough implementation of the "five S's" (Japanese expression referring to tidying, housekeeping, cleaning, cleanliness and discipline), recording and storage of inspection data and use of statistical processing techniques.

Reducing nonconformity rates is absolutely essential for the realization of small lot production. The future objective of companies should be to use the seven tools of quality control (Pareto diagrams, check sheets, histograms, graphs, scatter diagrams,

cause and effect diagrams, and control charts) in acquiring ISO certification so that they are able to target international markets.

The philosophy of company-wide quality control should also be introduced to encourage all organizations to approach their work with the right attitude. Company-wide quality control requires participation by all company employees and also cooperation between staff working in production processes. Operators should have a positive group consciousness that ensures they play an active role in overall system improvements. Moreover, in order for company-wide quality control to be successful, company managers themselves need to adopt a quality-oriented way of thinking and it is important that quality control staff possessing authority and executive powers should be assigned.

7.7.2 Total Quality Control

Railway standard rather strictly regulates the quality control of railway rolling stock manufacturers for its importance of safety. The outline of Total Quality Control is described here with the example of railway rolling stock manufacturer. However, the concept is common for all enterprises.

On the other hand for the rolling stock industry in Kazakhstan, there are already established railway standards for maintenance, inspection, overhaul, etc., including limit standards, methodologies and intervals. However, it seems that these standards are not practiced sufficiently. It is therefore necessary to develop a quality control program realistic and suitable for Kazakstan's railway system considering the existing rules, standards and practices and the concepts of TQC as well for a better and safer railway operations. In such a development, the Kazakhstan Railway (KTZ) and the industry enterprises should jointly participate.

In the above viewpoint, the basic considerations will be essential:

(1) Quality control to be jointly performed by the railway and industry

1) Maintenance of quality records of rolling stock and major components

For each rolling stock, when it is newly built, quality records should be taken and maintained, including serial number, completion or delivery date, supplier, test and inspection results, etc.

2) Maintenance of quality related history of each rolling stock

Including operation records, operated distance, accident and trouble, history of repair and overhaul, etc.

3) Review of quality standards (inspection standards)

Review the existing standards and make them more practical, including wear limit, fatigue limit, item, interval and procedure for each of inspections, repair and overhaul.

4) Review and confirmation of share of work scope between railway and industry

The railway and rolling stock industry should have discussions of how to share the work scope and responsibilities about quality related records, including how to exchange the information.

(2) Quality control to be performed by the industry

As mentioned above, the quality control covers the entire enterprise activities, including design, engineering, production preparations, parts and material procurement, subcontracting, production, inspection, sales, services after sales, accounting, personnel administration and education, etc.

Therefore, it is indispensable that every member of an enterprise, including president, directors, managers and all employees, must participate in the activities in his capacity. As a general reference, we would suggest to review and improve the quality control systems by referring to the attached Fig. 7.7.1 Total Quality Control ("TQC") system.

1) Quality Policy

The "quality policy" of an enterprise should be established and known to all the employers and employees (cf. Fig 7.7.2). The policy should indicate a way or concept to realize the enterprise's basic business principle, and should be changed or modified periodically (every year, for example) depending on the achievement results. It would be necessary to have a staff office to monitor and assess the activities performed under the policy.

2) Methodology and Participation

Based on the quality policy, everyone in the enterprise should make up his/her target and methodology to achieve it. To make up a target, everyone should reconsider his/her expected role in the organization to improve it (cf. Fig. 7.7.3).

3) Education and Training

Opportunities or classes to educate about the quality policy and the methodology to realize it should be made for each level of organization members. Quality policy staff office should make and carry out an education and training program.

4) Maintenance of Quality Records

Certain quality records should be maintained to verify the methodologies and to assess the achievement of the quality targets. Record maintaining periods should be classified by such various ways of thinking as the contents, importance, agreement with customer, legal regulations, expected lifetime of products or components, frequency of repeat use, etc.

For example, the records of the new parts and components of rolling stock should be maintained at least until the rolling stock's first heavy overhaul (KP-1).

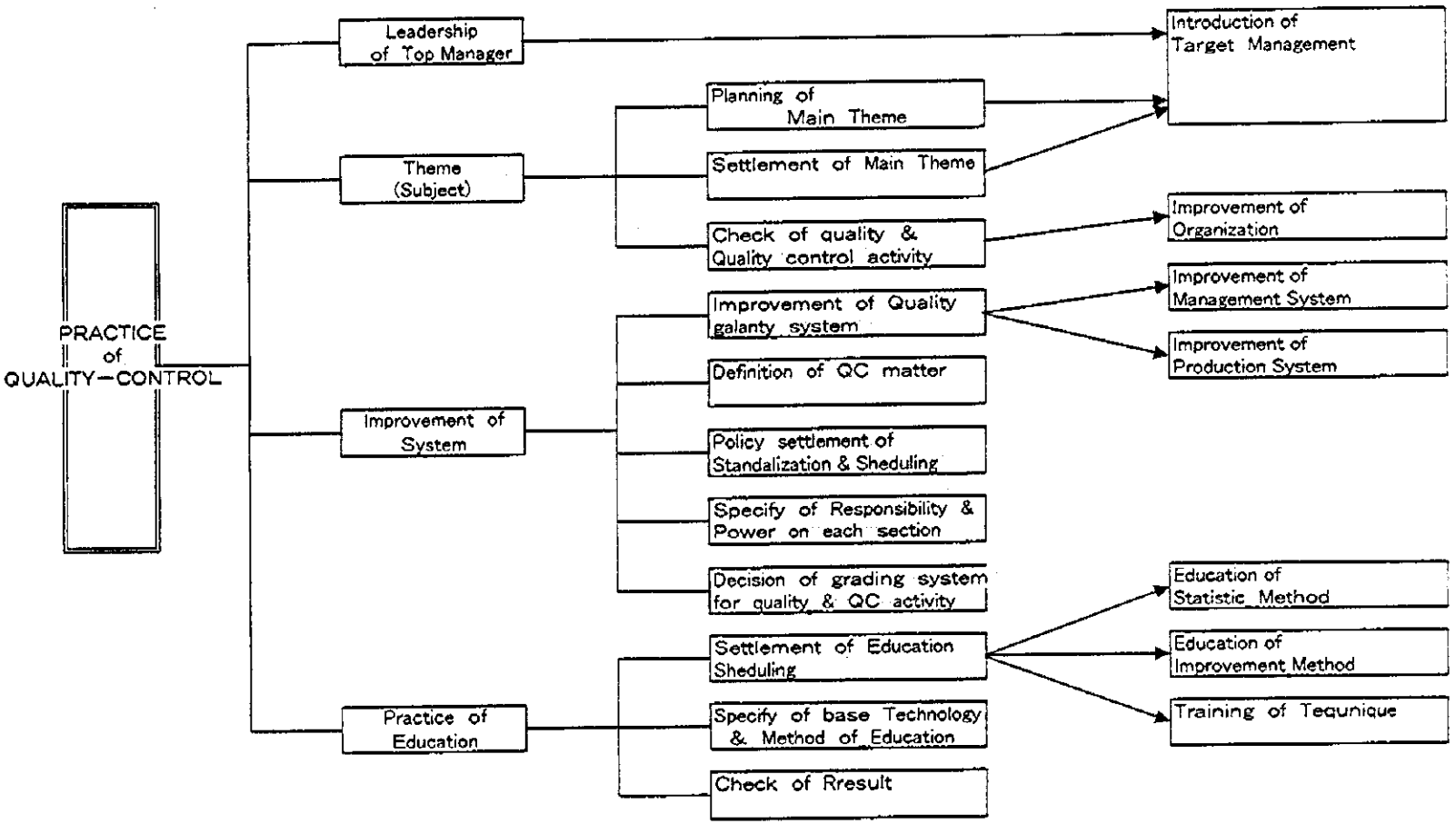


Fig. 7.7.1 Total Quality Control

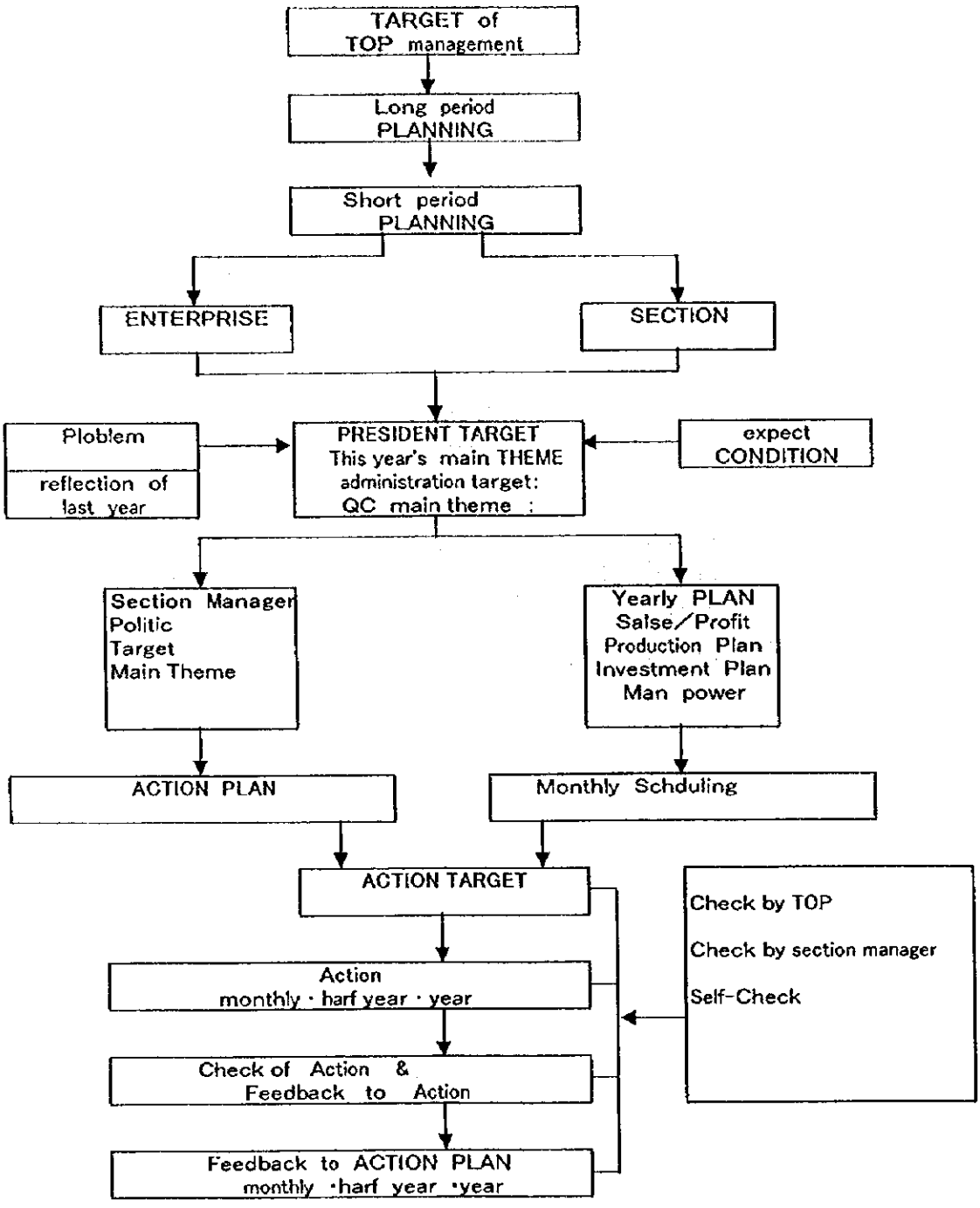


Fig. 7.7.2 Flow of Target Management

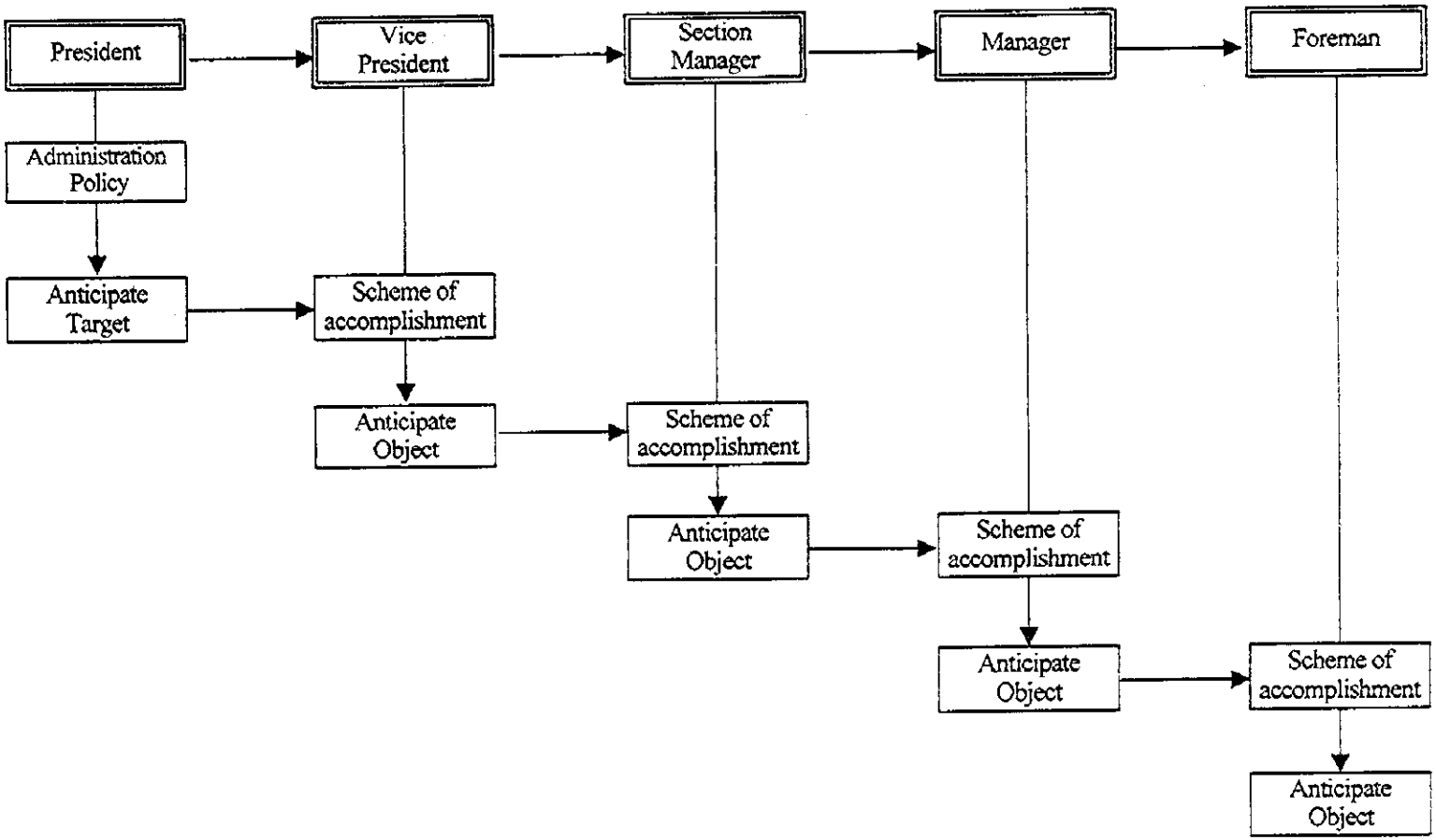


Fig. 7.7.3 Target-Scheme relation Chart of each section

7.8 Improvement of Management Control

Management is a major weakness throughout the machinery sector, indeed throughout the whole industrial sector. There is an urgent need both to reform management structures and the improve the skills of the executives in those structures.

Under the former system objectives were set by the overall planning system. Enterprises operated within very closely defined boundaries, and indeed were only responsible for detailed production planning. They did not need, indeed were strictly forbidden to take strategic decisions. As a result management structures developed which were highly compartmentalized involving only vertical reporting with very little lateral interaction.

The market economy calls for a totally different approach. Enterprises now must make strategic decisions; indeed the market is built on the premise that producers are much better informed of specific market requirements and must take responsibility both for strategic as well as detailed production decisions.

It is vitally important that prescriptive planning by Government should stop and that the responsibility of enterprises to respond to market needs, not Government set targets, is clearly understood by all parties.

7.8.1 Management Training

Almost all business owners and upper management staff are aware of the need (and also want) to receive training in management methods under market economy conditions. They should actively take part in training activities and programs that are provided through government support.

Management has to enforce their leadership in securing the work volume, financial management, restructuring of production facilities, product/engineering development, and quality control. To carry out those issues, it is necessary to catch up the market trend and improve management system and strengthen the capability of strategy planning accordingly. For the better management training program, upper management and staff should not only participate the training program, but also take part in the provision of training programs.

7.8.2 Financial Planning

It is necessary to take great care in financial planning. Introduction of a business plan is the first step that has been taken by a few companies, but it is necessary to expand these activities much more. At this stage of the business plan, it is necessary to analyze cost effectiveness (profit and loss) within the company, and the next step is to gauge manufacturing costs for each manufactured product and part and compile cost improvement plans.

In order to give priority to book profits, inappropriate methods of accounting treatment should be avoided and treatment should be conducted in strict accordance with company accounting principles. Moreover, when conducting financial analysis, it is necessary to avoid concentrating solely on profits as indicated on income statements, but to also analyze cash flow.

7.8.3 Organization

For companies in Kazakhstan, organization development that involves enhancement of the following four functions in particular is an issue that requires immediate attention.

1. Organizational development and clarification of divisions of responsibility in order to strengthen marketing functions. In particular, it is important that companies possess departments for collecting and analyzing market information.
2. Enhancement of production technology departments in order to rebuild production equipment and facilities and promote small lot production in accordance with changes in the market environment.
3. Establishment of departments for promoting the introduction of company-wide quality control.
4. Strengthening of accounts and financial affairs departments in light of the harsh nature of the current financial environment.

Company organization should basically be kept simple and suited to the scale of each company. However, concerning functions that become necessary in accordance with expansion of company operations and revisions of policy, companies must build organizations and clarify divisions of responsibility in order to realize the desired results. For the sake of company development, organizations should also grow.

Figure 7.8.1 shows an example of the organization changes that ensued following expansion of operations at a leading Japanese machinery manufacturer.

Even in the early days of this company when the scale of its operations was small and it didn't conduct its own retailing, an organization clearly showing the role of planning, accounts, production technology, purchasing, design engineering and other indirect departments surrounding the manufacturing department already existed.

In the second phase of organization development, in order to strengthen its management setup, the company established a quality control department to act as the center for promoting company-wide quality control. Moreover, as the role of accounting became more important in line with increased sales and higher costs, the company strengthened its accounting department. It also entrusted market information collection and analysis functions to the quality control department.

In the third phase of development, the company added and strengthened a retailing function to its organization. Following this, by strengthening its marketing functions and developing new products and sectors in line with market trends, the company grew into a manufacturing and retailing enterprise capable of holding a worldwide share in its product range.

Generally speaking, companies in the machinery manufacturing industry in Kazakhstan do not have clearly demarcated organizations like the one described above and they do not possess the business management setups that are required in a market economy environment.

Rather than adhering to fixed organizations, it would be effective for companies to promote short term improvements through, for example, flexibly organizing project teams in response to emergency and important problems. Such project teams play an important role in strengthening lateral links between organizations.

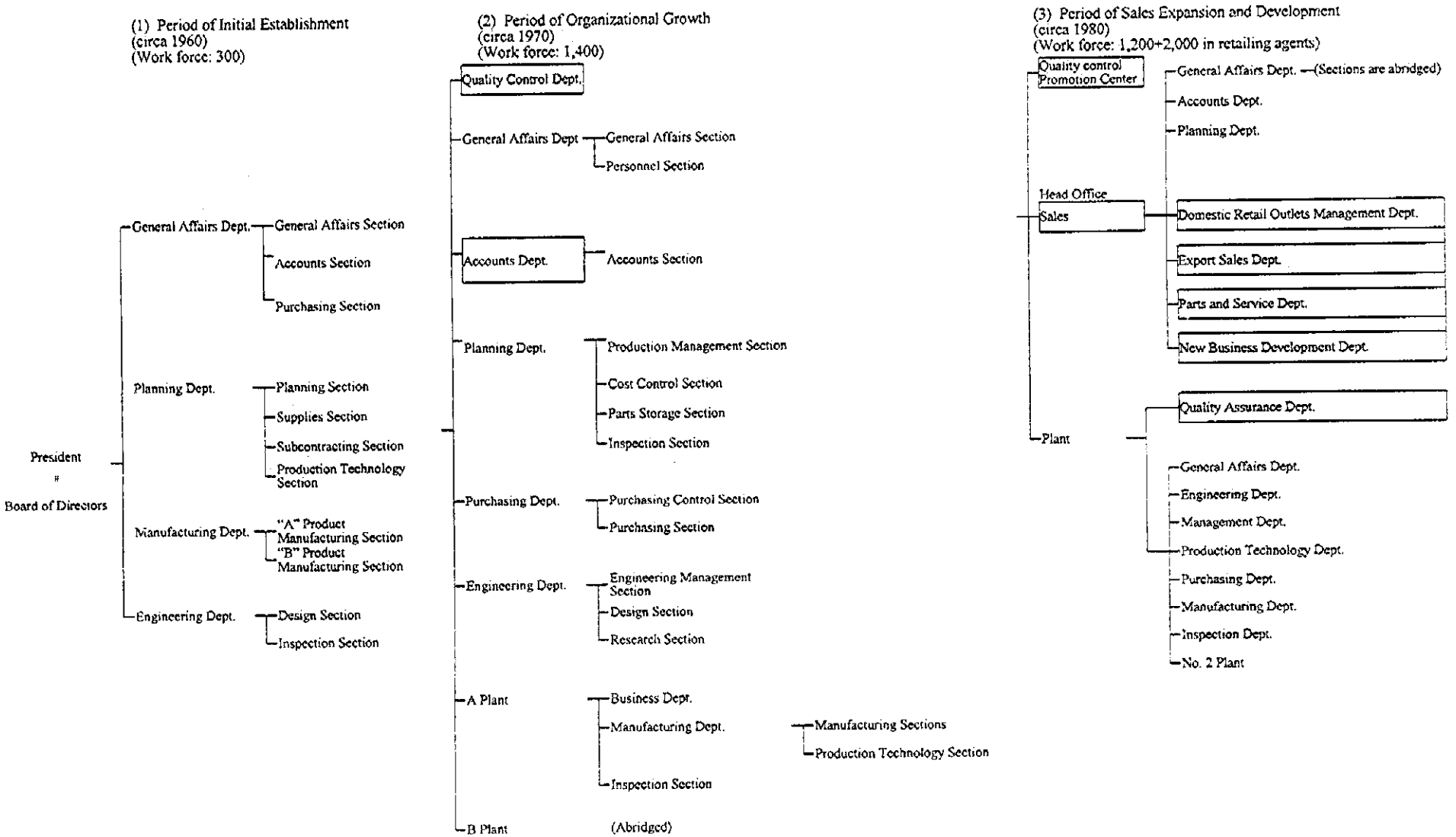


Fig. 7.8.1 Organization Growth in Line with Expansion of Operations (case of a Japanese machinery maker)

7.9 Improvement of Materials Processing Section

It is a question of great importance to understand the actual condition of material industry for the development of machinery industry, as that basis. Now, the field study has been mainly conducted in agriculture and mining sectors in Kazakhstan. The working ratio of these factories are 20%, and many factory are suspended operations. It was a few factory that the material process section are operated.

Table 7.9.1 show the summary of findings on Material Process section from questionnaire survey regarding production capacity, technical level, and etc. The improvement plan for the material processing sector is proposed hereunder based on the result of questionnaire survey and interview survey.

(1) Casting Section

In the material process section, technical level of AZTM is comparatively high, it is expected the development in the future. Especially, foundry shop produce the alloyed steel ingot for the forging shop, because of special alloyed steels are not domestic production for the forging materials in Kazakhstan. Therefore, they have the production technique that to make easy the high grade materials of high alloyed steel, etc.. Next, in VOSTOKMASHZAVOD, foundry shop is specialized for high manganese steel, and hold the complete equipment, and then regular castings section is rationalized by the disposal of decrepit equipment, and to reduce the scale of the factory.

On the general castings, CASTING & MACHINERY BUILDING have corresponded the technique for demand in Kazakhstan on steel and iron castings. EXCAVATOR is specialized for the production technique of steel casting and copper alloy. The other, AKMOLASELMASH is proud of that they have the production technique of malleable cast iron and they are the only enterprise in Kazakhstan. But it is the past material in the world, at now, they must change to the spheroidal graphite cast iron. In this way some steel castings are changed to the spheroidal graphite cast iron.

The other, there are PISTON COMPANY for engine parts, IRISTY for brake shoe of rolling stock, PZTM point to the precision casting, etc., as the specialized enterprise for its products.

At first, molding process is green sand mold and dry sand mold mainly in each foundry shop, but some foundry shop use the sodium silicate bonded sand. Core mold is used

oil sand and dry sand mold, advanced foundry shop use the shell mold. Now, there are developed many molding process as show Fig. 7.9.1 in the world, they have individuality in each process. We select the process to check with home products by kind of casting metal, casting size, number of lot, required dimensional accuracy, etc.. It is a matter of course that molding cost, environment of workshop, difficulty of waste treating, difficulty of sand reclamation, etc. are an object of process selection.

Green sand molding process in Kazakhstan is mainly jolt squeeze molding now. It will be enough for less production, but in the future, molding process for mass production needs go to the high pressure molding, the high speed molding and the impact molding, corresponding casting quality, quantity of products, dimensional accuracy, etc..

Molding process for large castings is mainly dry sand mold. Sodium silicate bonded $2CaO\ SiO_2$ sand to use some foundry shop is useful for steel casting molding sand, but molding process for iron castings needs change to the organic sand process because of casting quality and dimensional accuracy in the future. Further, the sand preparation system is ill equipped at each company, so that they make many rejected casting. It is necessary that to introduce the fitted sand preparation equipments correspond to sand process.

Next, on melting process, we supposed the refining technique is not yet established except some foundry shop. The refining of molten steel is needs to keep the casting quality. And we supposed that many foundry shop take to the chemical analysis of molten steel after casting the products. It is important to check the quality of molten metal before pouring, so it is necessary that to introduce the analytic machinery as quantomater and to analyze quickly.

At now, kind of produced materials are cast iron, malleable cast iron, steel casting. Malleable cast iron is changed to spheroidal graphite cast iron (Ductile Cast Iron = DCI) in the world, so that it needs to introduce the production technique in the future. In the manufacturing of this material, quality of molten metal is important, especially existence of sulphur check the spheroidizing of graphite, so in case of cupola melting, it needs the desulphurizing to remove sulphur melted into metal from coke.

The other, in case of low frequency induction furnace melting, it is possible to control the chemical composition by arrangement of raw materials, to control the melting

temperature, high temperature melting, and to take the spheroidizing treatment as it is, so that it is easy to produce the DCI.

Spheroidizing procedure of molten metal is developed many kind of process, as show in Fig. 7.9.2 Ladle addition method and (b) Sandwich Process are easy process. This material have increased much recently, because of it is possible to produce the high strength casting as a steel by heat treatment.

To manufacture as an experiment on this material, it is introduced easy at the foundry shop to hold the low frequency induction furnace. For example, AZTM, VOSTOKMASHZAVOD, KARAGANDA CASTING & MACHINERY are introduced easy as a model enterprises.

(2) Forging Section

In forging section, there are produced mainly the plain carbon steel forgings, except some alloyed steel forgings. Forging method is operated by free and die forging, but they used die forging mainly in the visited enterprises. We suppose that the demand for die forging increases more in the future, it will be needs to introduce the production technique of die forging.

In this case, die manufacturing technique is very important. Each visited enterprise hold the pattern shop, some of them, AZTM, VOSTOKMASHZAVOD, and PAVLODAR TRACKTOR, PZTM, are good die manufacturing section. These pattern shop will be needs to grow well.

So far as we visit to some factory, we suppose that there are common equipment and even technique, but only AZTM produce the forgings by the homemade alloyed steel ingot, it is expected that they can produce the suitable materials for products. And also, TSELINGDROMASH produce the alloyed steel forgings.

We suppose that the engine parts are made into light weight, so that it will be needs to introduce the production technique of die forging for nonferrous alloys, to make the supply system for parts industry.

(3) Press Forming Section

In press forming section, there are provided the suitable equipment for each enterprise's products. ZIKSTO hold huge press machine as 700 units. We suppose that they were provided the equipment for every shape modification of products, and then these condition were completed. This is unusual condition.

At each enterprises, we suppose that there are common equipment, but there are held large press machine, PAVLODAR TRACTOR, AKMOLASELMASH, BUS ASSEMBLY, ZIKSTO, etc.. As a special instance, CASTING & MACHINERY BUILDING produced roof forming for building materials by rolling mill. This is forming by domestic thin steel plate, but there were arisen many wrinkles by the directionality and ductility because of that the steel plate is inferior in quality. In this way there are remained many problem to improve the formability in the domestic materials.

(4) Welding Section.

On the welding for the assembling, generally there are operated by CO_2 gas shield manual and automatic welding, the result of welding bead is no good. So it is necessarily that to study more the welding technique. In VOSTOKMASHZAVOD manufacturing pressure vessel of export products, they are introduced the submerged arc welding for stainless steel thick plate, and good quality on the result of welding bead. In this way, it is possible accepted welding in international market, each enterprise have to learn this.

(5) Surface Treatment Section

On the abrasive wear, there are introduced the overlaying, powder sintering, etc., especially TSELINENERGOMONT is revivifying treatment by the overlaying for the crank shaft of engine and the rotor of generator apply the developed original plasma spraying process. This thermal spraying technique is useful process, it is applicable a number of machine parts, as cylinder head, cylinder liner, piston, valve for of diesel engine, and roll for every kind of machine, etc., so we expect more expansion.

(6) Heat Treatment Section

Each enterprises hold the plural heat treating furnace, and operate the heat treatment of annealing, normalizing, tempering, quenching, etc., according to the necessity. Special surface hardening are operated on cementation and nitriding treatment at AZTM,

PARKHOMENKO, PAVLODAR TRACTOR, MACHINE TOOL CONSTRUCTING, ETC.

General heat treatment for formal steel needs in the future, but we suppose that the heat treatment for surface hardening is required for every kind of machine parts, with the development of parts and component industry.

It is difficult to classify the surface treatment, but the surface modification technique of metal surface to use the plasma, the laser and the other thermal energy, it will be needs to study by the technical information of advanced countries.

The above is outline of improvement of manufacturing technique in material process section, Table 7.9.2 show the proposal of improvement. In this manner, AZTM, VOSTOKMASHZAVOD, KARAGANDA CASTING & MACHINERY, EXCAVATOR, AKMOLASELMASH, PUSTON FACTORY, PARKHOMENKO, IRISTY, PZTM, TSELINGENERGOMASH, etc. will be needs to develop in the future.

(7) Steel

The other hand, materials for machine shop is almost imported from Russia and so on, and the domestic steel of present use are only carbon steel. By the way, the steel products made by Karaganda Steel Works are hot rolled sheet of 2~12 mm thickness, cold rolled sheet of 0.5~2 mm thickness, 5~60 mmø bar, and so on. The thick plate, thin plate, shape steel, alloy steel, and non-ferrous alloy are imported from Russia and so on, by barter trade.

Examining the formed products of domestic materials, there are many defects by poor steel making technique. We suppose that they do not take the exact melting and refining on steel making, but it is not clear that we could not check the melting process.

There are developed many refining process as Fig. 7.9.3, in the world. They have corresponded to the individual characteristic for uses and purpose, you must take to select the process by the melting capacity, material quality, etc.. You must take at least deoxidation and degassing of molten steel.

Table 7.9.1 Summary of Findings on Materials Process at Enterprise Visit (1/2)

	Enterprise name	AZTM	VOST	KC&M	EXCA	AKSL	PIST	IRIS	PARK	PAVL	PZTM	MTCL	BUS	ZAPS	ZIKS	SMAL	TSEL
MATERIALS CAPACITY	Cast Iron	70	1	36	-	35	30	72	7	900		3	15	-		20	
	Malleable	-	-	-	-	25	-	-	-	-	-	-	-	-	-	-	-
	Cast Steel	30	40	41	160				7	636	8		25	-	80	2	2
	Allow Steel	8	180							480			15	150			4
	Aluminum			1			10	0.1		3	5	1		-	5		
	Copper Alloy	0.5	60		120												
MODEL	Wood Pattern	◎	◎	○	○	○	○	○	○	◎	◎	○		○		○	
	Metal Mold	◎	◎	-	○	-	○	○	-	◎	◎	○		-		-	
SAND PROCESS	Green Sand	○	○	○		○	○	○	○	○	○		○	○			
	Dry Sand	○		○													
	CO_2 Proc.	○	○	○	○					○		○					
	Oil Sand		○		○	○			○	○				○			
	Shell Mold	-	-	-	-		○	-	-		-	-	-			○	
EQUIPMENT	Jolt-squeeze	2L	1L	○	○	2L	1L	1L	1L	10L		2L	8U				
	Sand Slinger	2U	-	-	-	-	-	-	-	○	-	-	-			-	
	Hand Ramming	○	○	○	○		-	○	○		○	○	-				
	Die Casting	-	-	○	-	-		1U	-			-	-				
	Low pressure	-	-		-	-	10U	-	-		Lost Wax	-	-				
	Centrifugal Cast	6U	-	-	-	-	-	-	-	-							
	Full Mold Pro.	--	-	-	-	-	-	-	-	-	○	-	-	-	-	--	-
MELTING	Cupola	5t/2		3/1		5/3	7/1	5/3	2/1	10/2 20/4		3 /4		-	3/1		
	L.F. Furnace	10/2	1/1 8/1	2.5/			6/3			10/2				-			
	H.F. Furnace		.2/2	.4/2 1.5/ 3/1		.2/1					.2/1			-	.2/1		
	Arc Furnace		6/2		5/4		2/1		.5/1	6/13		5/3	1.5/	3/3			
Crucible Furnace				Detroit				1U				○		-			
FETTLING	Sand Brast	○	○	○	○	○	○	○	○	○		○	○	○		○	
	DECORER	-	○	○	-	-	-	-	-	-	-	-	-	-	-	-	-
	Heat Treat	○	○	○	○	○	○	○	○	○		○	○	○	○		○
Technical Level		◎	◎	○	○	○	○	○	○	Δ	Δ	Δ	-	○	-	-	-
Special Mention		Melting Tech	H-Mn Cast Main	Steel Cast Main Product		Mal-lea-ble	Engin e Part	Brake shoe	Small Part	Red-uction	New Tech nol.	Machi ne Tool	Roll Stock Part	Spare Part	Steel Cast	Engin e Parts	

Note: * Number of Materials & Capacity Column: x 100 tn/year
* Model Column: ◎; Great. ○: Possess Equipment
* Sand Process & Fettling Column ○: Introduce of Possess Equipment
* Equipment Column: L; Line, U: Unit
* Melting Furnace Column: ton/unit
* Technical Level Column: ◎: Great ○: Average. Δ: Poor. - : Unknown

Table 7.9.1 Summary of Findings on Materials Process at Enterprise Visit (2/2)

Enterprise name		AZTM	VOST	KC&M	EXCA	AKSL	IRIS	PARK	PAVL	PZTM	MTCL	BUS	KYZY	ZIKS	POWE	ENER	AGRO	TSEL
CAP	Carbon Steel	35	11	8	6	11		22	120			15	0.3				-	9
	Alloyed Steel	35	-	-	-	-	-	-	-			-	-				-	4
KIND	Free Forging	O	O	O	O	O	O	O	O	O	-	O	O	O	O		-	O
	Die Forging	O	O	O	O	O	-	O	O	O	O	O	O	O	O		-	-
EQUIP	Air Hammer	3t8U	-	-	1t3U	3/1St	O	1t6U	3t	O	100t	-	21t	-	O 5t		-	-
	Mechanical Pr.	315t 10U	315t	250t 14U	250t 2U	250t	160t 4U	100t 4U	4000t	O	315t	800t	100t	O	400t		-	O
	Hydraulic Pr.	250t 2U	1250	160t 2U	3t 1U	400t	-	-	-	-	150t	160t	800t	2500	25t		-	-
	Furnace	O	O	O	O	O	O	O	O	O	45t	O	60t	O	O		-	O
Technical Level		◎	O	O	O	O	O	O	O	O	O	O	-	O	-	O	-	O
Forging Section Special Mention		Own Make Ingot	Large Forg-ing					Own Make Part	Large Forg-ing				Non Sur-vey		Non Sur-vey		Non Sur-vey	
EQUIP	Mechanical Pr.	315t 8U	400t	O	250t 2U	800t		250t 19U	1000t	O	400t	800t	160t	O 700U	30t		120t 102U	O
	Hydraulic Pr.	315t 3U	-	O	-	250t		-	-	O	150t	160t	60t	O	-		100t 10U	O
	Roll Bender	O	O	2U	O	O		O	O					O		O		
	Forming Roll		-	3U	-	-		-	-	-	-	-	-	-	-	-	-	-
Welding Process			SAW	CO_2	CO_2	CO_2	Hand	CO_2		CO_2		CO_2		CO_2	CO_2			
Technical Level			◎	O	O	O	O	O		O		O		O				
Hard Facing		-	-	-	O	O	O	-	-	-	--	-				O		
Powder Sintering		-	-	-	-	O	-	-	-	-	-	-	-	-	-	Plusma	-	-
Cementation Hard		O	-	-	-	-	-	O	-	-	O	-	-	-	-	-	-	-
Nitriding Harden		O	-	-	-	-	-	O	-	-	-	-	-	-	-	-	-	-
Heat Treatment		O	O	O	O	O	O	O	11U	O		O	O	O	O	O	O	
Technical Level		◎	◎	O	O	O	O	O	O	O	O	-	O	-	O	O	-	O
Pressing Section Special Mention		High Lev. Tech	High Lev. Tech	Prod ucts Form		High Lev. Tech	Roll Stock Part						Non Sur-vey		Non Sur vey	High Lev. Tech	Non Sur vey	

Note: * Capacity Column: x 100 ton/year
* Equipment Column: t: ton, U: Unit
* SAW: Submerged arc Welding
* CO_2: CO_2 gas metal arc welding
* O : Introduce or Process Equipment
* Technical Level Column: ◎: Great. O: Average. Δ: Poor. - :Unknown

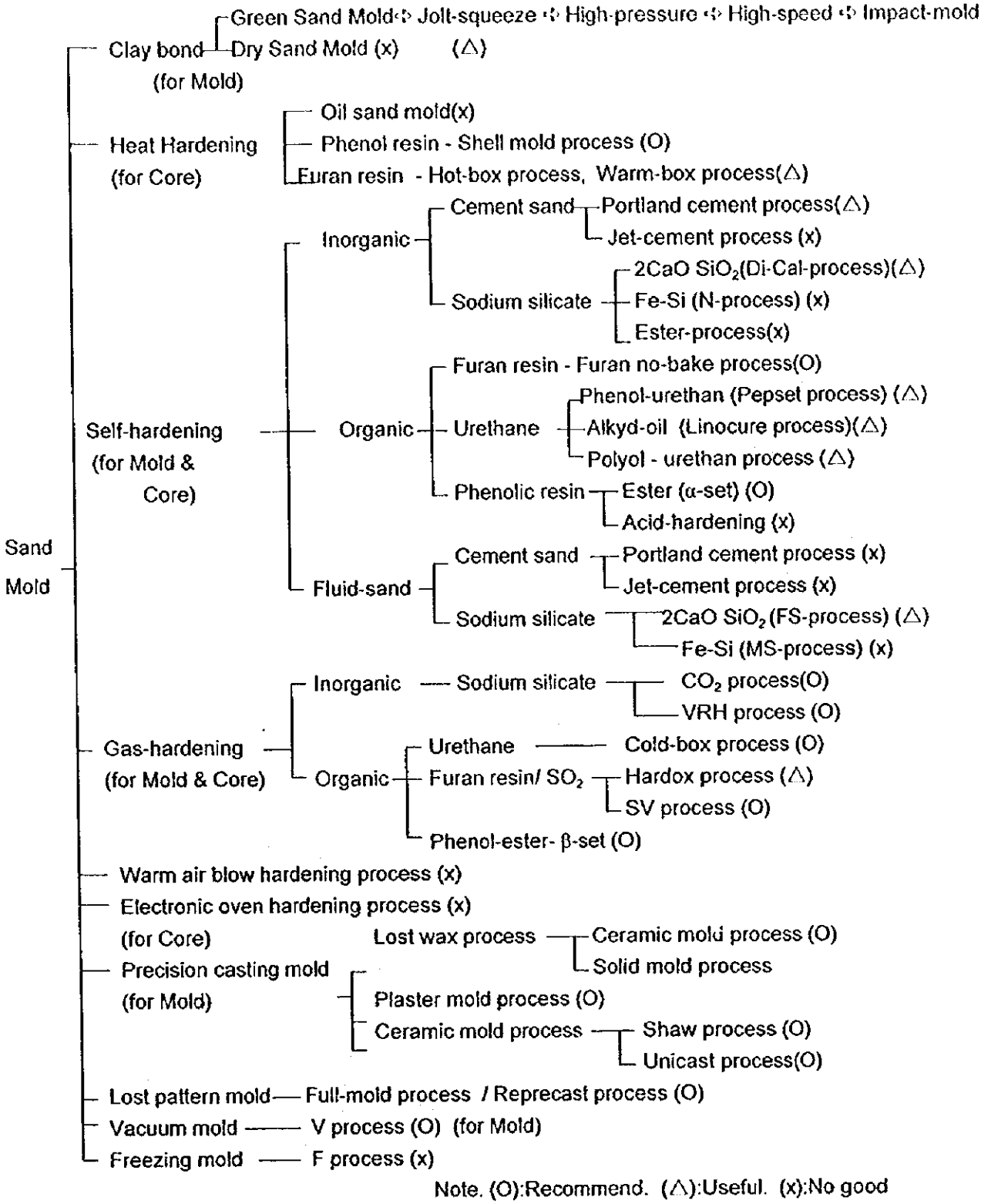
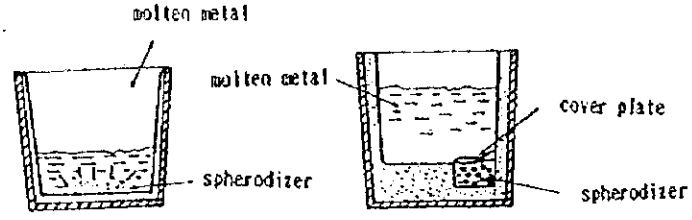
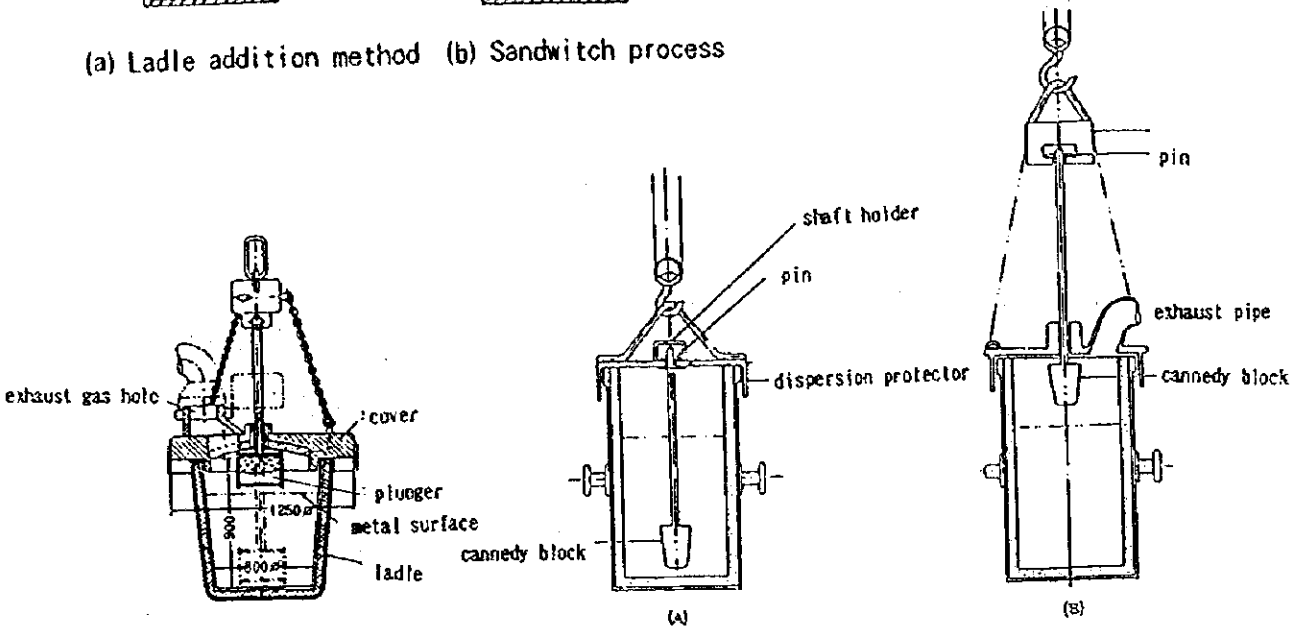


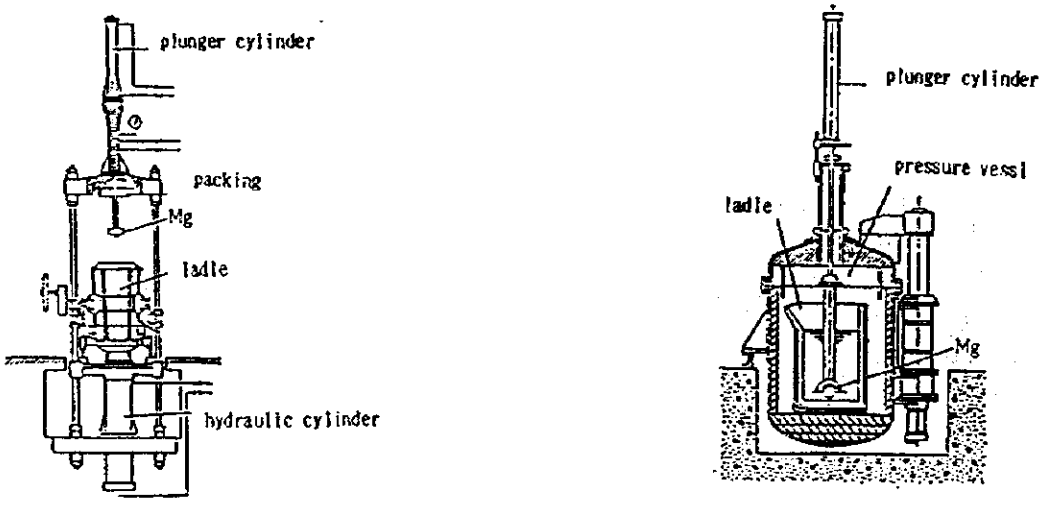
Fig. 7.9.1 Classification of Molding process



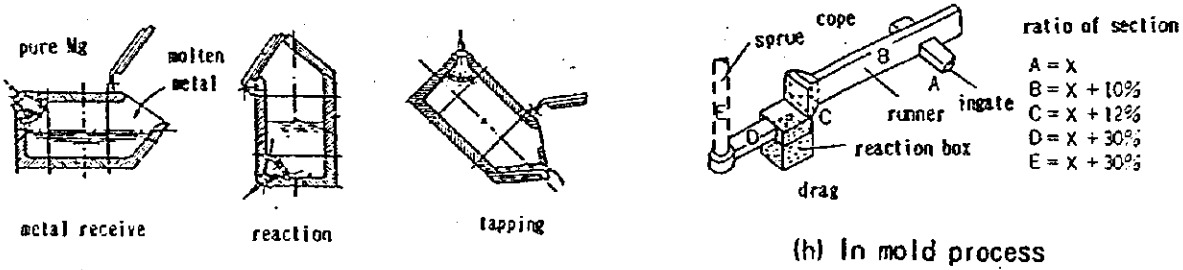
(a) Ladle addition method (b) Sandwitch process



(c) Plunger process (d) Cannedy process



(e) Pressure adding process (f) Pressure vessel process



(g) Converter process (h) In mold process

Fig. 7.9.2 Spheroidizing Procedures

Table 7.9.2 Recommended Improvements for Materials Processing Section

Department	Recommended Direction		Specific Contents
Casting department	Molding	1. Enhancement of sand treatment equipment 2. Molding process selection 3. Forming and molding rationalization 4. Large-scale molding rationalization	1. Enhance basic sand treatment equipment in order to reduce casting non conformities. 2. Select the alloy type and size of castings, number of lots, required dimensional precision, molding cost, work environment, and ease or difficulty of waste treatment and sand recycling, etc. according to the company's own products. 3. Upgrade to high pressure molding, high speed molding and impact molding in accordance with the quality, production volume and dimensional precision, etc. of castings. 4. Treat cast iron items with resin sand according to casting quality and dimensional precision, etc.
	Melting	1. Securing of casting quality 2. Chemical analysis of solution	1. Refining of cast steel solution is necessary. 2. It is important to confirm solution quality before casting. 3. Introduce machine analysis by quantometer, etc. to speed up analysis.
	Material quality	1. High level strengthening of castings	1. Master ductile iron manufacturing technology.. 2. Methods of solution spheroidizing Low frequency induction furnace melting - Sandwich method 3. AZTM, Vostokmash and Karaganda Casting and Machinery, etc. should consider introduction first.
Forging department		Improvement and expansion of die forging technology	1. Establish alloy steel die forging technology. 2. Develop die manufacturing technology. 3. Master non-ferric metals die forging technology.
Sheet metal department		General applicability of machine equipment	Standardize methods of attaching dies.
Welding department		Technical improvement	1. Conduct technical research.
Surface treatment and heat treatment section		Promotion of the practical application of new technologies	1. Expand applications to various machine parts. 2. Utilize plasma, lasers and other forms of heat energy. 3. Promote research into metal surface reforming technology.

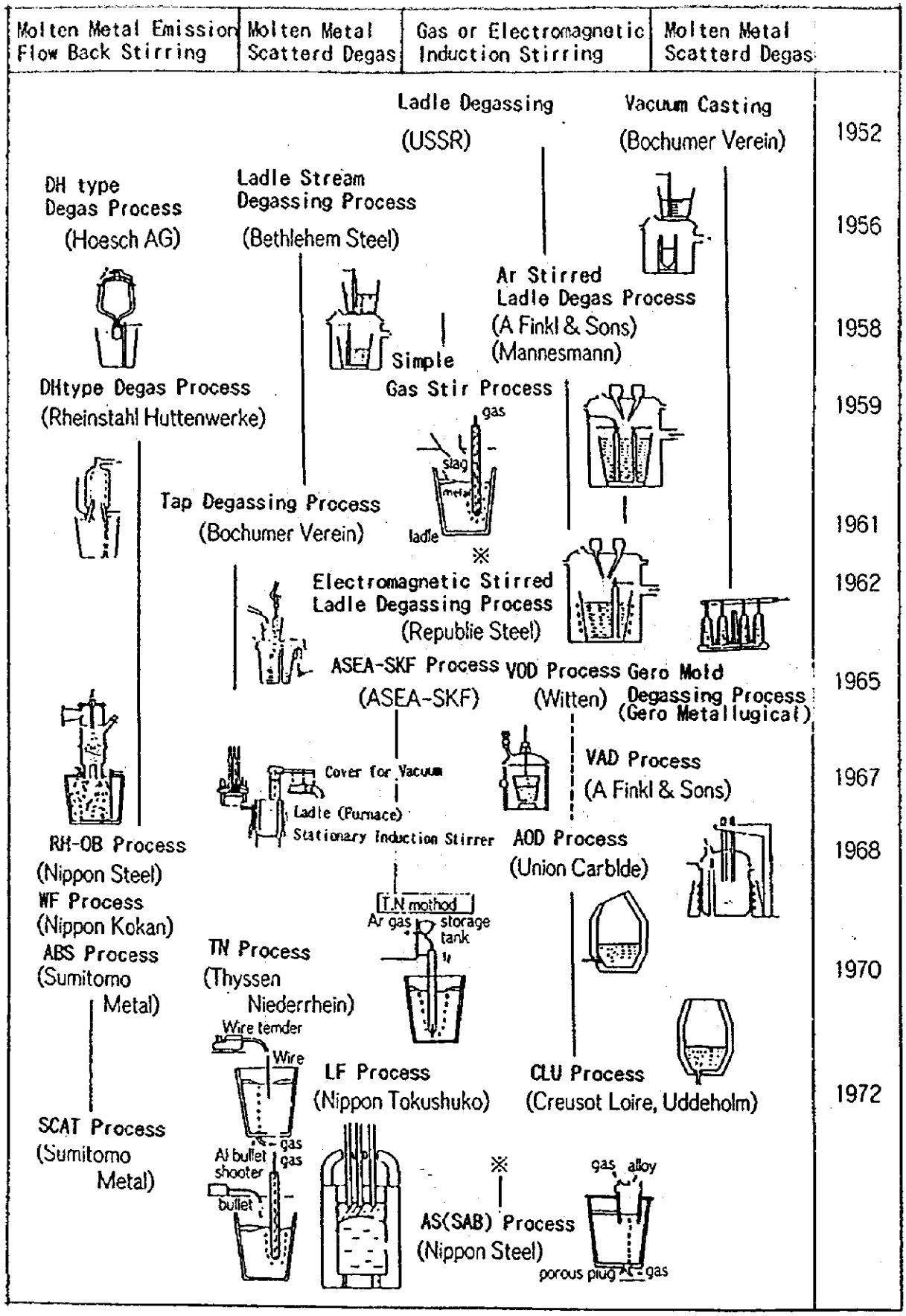


Fig. 7.9.3 Refining Process