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JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)
MINISTRY OF THE ECONOMY
THE REPUBLIC OF POLAND

THE STUDY
ON
RESTRUCTURING PLAN
OF
ENTERPRISES CONTROLLED BY THE STATE
IN
THE REPUBLIC OF POLAND

FINAL REPORT
SUMMARY

MARCH 1997

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TABLE OF CONTENTS

1	Introduction	1-1
1.1	Background of the Study	1-1
1.2	Purpose of the Study	1-1
1.3	Achievement of the Study	1-2
1.3.1	Company-wide reform of attitudes and awareness through the improvement Activities on the production lines	1-2
1.3.2	Formulation of Restructuring Plan and Mid- and Long-Term Plans	1-4
1.3.3	Technology Transfer Concerning Engine Design	1-6
1.3.4	Proposals to Polish State Enterprises and Industries in General and the Polish Government	1-7
1.4	Remaining Tasks	1-10
1.5	Structure of the Report	1-13
2	The Environment Surrounding the Model Company: Mielec Engines Co.	2-1
2.1	Economic Environment Surrounding Poland	2-1
2.2	Polish Automotive Industry and Market	2-3
2.2.1	Current Polish automotive industry overview	2-3
2.2.2	Polish automobile industry in the Central Europe	2-4
2.2.3	Foreign investors	2-7
2.2.4	Passenger cars	2-8
2.2.5	Truck and bus of medium and heavy duty	2-9
2.2.6	Diesel engines	2-12
2.3	Euro-Park Mielec	2-14
2.3.1	Euro-Park Mielec	2-14
2.3.2	PZL-Mielec Group	2-14
2.4	Environment around Mielec Engines Co.	2-15
3	Implementation of Plant Improvement Activities	3-1
3.1	Summary Description of the Plant	3-1
3.2	Production System and Production Control	3-3
3.3	Reform of the Production System by Improvement Circle Team Activities	3-3
3.3.1	Selection of Model Line and Formation of Circle Teams	3-3
3.3.2	Improvement Activities on the Engine Cylinder Head Machining Line	3-6
3.3.3	Improvements on the Engine Assembly Line	3-10
3.4	Productivity Seminar	3-15
3.5	Diagnosis of Situation Regarding Plant Management	3-21
3.6	Plant Improvement Activities after the 2nd Field Survey	3-22

4	Technology Transfer With Respect to Development of New Diesel Engine.....	4-1
4.1	Characteristics of the Technology Transfer	4-1
4.2	Background and Problems	4-1
4.3	Reform of Attitudes and Thinking of Mielec Engine's Development Department	4-3
4.4	Description of Technology Transfer (1): Special Technology	4-5
4.4.1	Teardown	4-6
4.4.2	Design Review	4-6
4.4.3	Seminars	4-8
4.4.4	Guidance With Respect to Casting Technology	4-9
4.5	Description of Technology Transfer (2): Management Technology	4-11
5	Formulation of a Restructuring Plan	5-1
5.1	Summary of Company Operation	5-1
5.1.1	Principal Management Indicators of Mielec Engines Co.	5-1
5.1.2	Features and problems of Mielec Engines Co.	5-3
5.2	Status of Restructuring of Mielec Engines Co. till now	5-4
5.3	Restructuring Plan as Proposed by the Study Team	5-6
5.3.1	Managerial problems of the company	5-6
5.3.2	Outline of restructuring plan	5-8
5.3.3	Prerequisite for the achievement of the plan	5-10
5.3.4	Characteristics of the approach in the present restructuring plan	5-11
5.3.5	Circumstances for propelling the restructuring plan	5-13
5.3.6	Implementation of the restructuring plan: Shaping up into an action plan.....	5-14
5.3.7	Preparation of rules of managerial techniques	5-15
5.4	A new Restructuring Plan with Mielec Engines Co.	5-17
5.5	Restructuring Status of State-owned Enterprises in Poland and Hungary	5-19
6	Corporate Strategy	6-1
6.1	Outline.....	6-1
6.2	Restructuring Strategies	6-3
6.3	Business Tie-up Strategy	6-4
6.4	Marketing Strategy.....	6-6
6.5	Product Strategy	6-9
6.5.1	Product strategy	6-9
6.5.2	R&D strategy for the Euro-3 engine	6-11
6.6	Business Strategy (Value chain strategy)	6-11

7	Recommendations to Polish State-owned Enterprises and Polish Government	7-1
7.1	Grand Plan and Strategy of Polish Automotive Industry in 2000'	7-1
7.1.1	Grand plan formulation in collaboration with industry and government	7-1
7.1.2	Establishment of industrial association and society of engineers	7-2
7.2	Strengthening Domestic Parts Industry	7-2
7.3	Export Policy	7-3
7.4	Technology and Science	7-4
7.5	Summary	7-6
8	Process of Mutual Understanding	8-1
8.1	Company Management Diagnosis and General	8-1
8.2	Line Improvement Activities	8-2
8.3	Communication	8-4
9	Conclusion	9-1

APPENDICES

A1	Poland Economic Data	A-1
A2	Outline of the PZL-Mielec Engines Co. Ltd.	A-3
A3	Management Indicators of Mielec Engines Co. Ltd.	A-7
A4	Mielec Area	A-8
A5	Plant Layout of Mielec Engines Co. Ltd.	A-9
A6	Organization Chart of Mielec Engines Co. Ltd.	A-10
A7	Organization Chart of WSK-PZL Mielec Co. Ltd.	A-11
A8	Mielec Family Companies	A-12
A9	Products of Mielec Engines Co. Ltd.	A-13
A10	SWT 11 Engine, MD 111 E Engine (Euro-2)	A-14
A11	Check List of the Company's Production Process and Quality Control	A-16
A12	Comparisan of Methods of Calculation of Profit / Loss Statement and Balance Sheet	A-17
A13	Product Development Process	A-18
A14	Seminar Material - Productive Maintenance (Productivity Seminar)	A-19
A15	Seminar Material - How to Solve and Tackle Restructuring (Countuparts traning) ..	A-31

INDEX

B10 life	4-6
Balance Sheet (BS)	5-4
Breakdown maintenance (BM)	3-8, 3-16
Cash flow	1-5
Concurrent engineering	4-10
Core competence	6-3
Cross-flow ports	4-7
Design Review	1-6, 4-6
Dilution tunnel	4-9
EURO-3	1-6, 4-2
Kaizen (improvement)	1-2
Key success factor (KSF)	1-4, 5-11
Ministry of Industry and Trade (Ministry of the Economy)	7-3
Pareto diagrams	3-11
PLN	3-2
Policy control	3-19
Preventive maintenance (PM)	3-8, 3-16
Product Portfolio Management (PPM)	6-6, 6-7
Productive Maintenance	3-15, 3-16
Productivity	5-1, 5-2
Profit/Loss Statement (P/L)	5-4
QC methods	1-3, 3-19
QC Story	3-10, 3-12
QC tools	3-12
QCD	3-3
Quality Function Deployment (QDF)	4-9
Reengineering (BPR)	6-3
Small improvement circle teams	1-2, 3-3
System parts	6-10
Tear down method	1-6, 4-5
TPM: Total Productive Maintenance	3-16
TQM	3-19, 6-3
Value chain strategy	6-11, 6-12
Value Added Productivity	5-1
3.4%	7-1
3S (see 5S)	3-8
4 valves	4-7
5M	3-3
5S	3-6, 3-17

1 Introduction

1.1 Background of the Study

At the 2nd East-West Industry and Trade Ministers Meeting, held in April 1993, Japan declared that for the sake of providing support for privatization of state enterprises of Eastern European countries it would undertake restructuring studies (enterprise diagnosis and preparation of restructuring plans) with respect to representative state enterprises of main sectors of industry as model enterprises. Furthermore, at the 3rd such meeting, held in May 1994, Japan promised support for preparation of comprehensive restructuring plans for model enterprises selected for promotion of enterprise reform. Under this circumstance, the Japan International Cooperation Agency(JICA) and the Ministry of Industry and Trade (the Ministry of the Economy as of after January 1997) and the PZL-Mielec Engines Co. (hereafter referred to as "Mielec Engines Co., or the Company") undertook the study on restructuring plan of enterprises controlled by the state in the Republic of Poland. The Minutes of the Study was signed in March 26,1996. The Japanese study team was formed in July 1996 to conduct this study.

1.2 Purpose of the Study

The purpose of the study is to provide suggestions for contributing to promotion of restructuring of a Polish state owned enterprises, Mielec Engines Co. which has been selected as the model enterprise directly covered by the study. The Polish Government is to take the necessary steps for applying the suggestions made concerning the model enterprise to state enterprises in general that are of a similar nature and that have the same kinds of problems. One of the reasons for selection of Mielec Engines Co. as the model enterprise is that the area in which it is located (the Mielec area) is a "structural recession" area with a high rate of unemployment that has resulted from reorganization, after collapse of the Soviet Union. The area was a sole center of Polish aeronautical industry which employed some 20,000 workers before the present reforms were initiated.

The Polish Government has designated that area as a special economic development zone and is making efforts for its vitalization.

1.3 Achievement of the Study

The study was focused on the following basic policies.

- (1) Improvement of the plant line, as a breakthrough for the restructuring plan. (Bottom-up innovation)
- (2) Technology transfer for the development of the new diesel engine, as a key factor for the restructuring plan. (Technological innovation for the Company's core product)
- (3) Instruction on the formulation of the mid- and long term business plans and joint formulation by newly organizing a committee. (Top-down innovation)
- (4) Proposing of restructuring plans for other state-owned enterprises and advising for the government based on the experience obtained from the study on the model company.

Next four major achievements are summarized as follows:

1.3.1 Company-wide reform of attitudes and thinking through the improvement Activities on the production lines

Instead of relying solely on technical guidance and technology transfer, the people involved in the work on the lines have been able to carry out improvements themselves and achieve positive results through these activities.

Achievements are summarized as follows:

- (1) Two small improvement circle¹ teams were organized.
- (2) The study team instructed groups with Kaizen² (improvement), problem-solving and QC methods³ through OJT(On the Job Training).
- (3) Both two groups innovated the existing production systems.
- (4) The Preventive Maintenance was introduced for the first time for the Company..
- (5) The groups achieved immediate improvements of productivity by reducing the shortage of in-process inventory parts at the final assembly line and lowering the rate of machinery trouble by 50%.

¹ The original term for this kind of team is names the QC Circle. It is a small group to perform voluntarily quality control activities within the same workshop. This small group carries on continuously as a part of company-wide quality control activities, self-development and mutual-development, control and development within the workshop, utilizing quality control techniques with all the members participating.

² There are two method of the productivity improvement ; the technical innovation and Kaizen. The technical innovation is carried out by introducing new technologies and new facility investment which is planned, studied and implemented by engineering specialist. The degree of improvement is great but it is conducted not often.

Kaizen on the other hand is implemented by continuous improvement by circle teams of several kind, namely purely plant workers or engineering specialist. The cost of Kaizen is much lesser than the innovation and its output is great due to its continuation.

³ There are 7 tools for TQM. (Parato Diagram, Cause-and-Effect Diagram, Histogram, Control Chart, Check Sheet, Scatter diagram and Management by Classification)

(6) Output of the improvement activities were presented at the *Productivity Seminar*.

Among production lines with problems to be solved which were found as a result of the plant auditing, the engine machining and assembly lines were selected as model lines.

The improvement activities started with simple themes. However, a very basic change in the production method, i.e. reduction of the number of engines on the production line by 50%, was made on the basis of the enthusiastic support of all those involved. Since the plant people had never thought of that before, it took a great deal of courage and resolution for them to undertake it. Furthermore, it was demonstrated that productivity can be substantially raised by introduction of maintenance activities that hitherto had not been considered. It was found that the method can be applied to other state enterprises of different manufacturing industries in Poland.

The leaders of the team who organized such improvement activities have made it very clear that they are firmly resolved not to go back to the old ways of doing things.

The top managers and all employees appreciate that the activities triggered reform in attitudes and thinking throughout the company. In that way the study team and the people at Mielec Engines Co. have been able to make a major break through in the task of restructuring the enterprise.

At the outstart of the study, the team was not at all confident that the people on the lines would themselves form circle teams and undertake improvement activities on the basis of our suggestions. It took three weeks until such activities on the lines were formally accepted by the Company. At first, the labor unions had their doubts about the study team's restructuring plans, but once they came to understand the aim of such restructuring, they assumed a cooperative attitude. It is almost certain that, the activities could not materialized without understanding and cooperation of the labour unions.

The positive results of the team activities were announced at the productivity seminar which was chaired by the company president and held at Mielec Engines Co. on December 3 1996. Unlike the usual case in seminars, the recipients of guidance instead of those providing the guidance played the main role. Many guests were invited to the seminar, including representatives of the Ministry of Industry and Trade, the Japanese Embassy, related universities, the parent company and the press. Both the audience, i.e. company employees, and the guests were very much impressed.

The major significance of the above-mentioned activities can be said to lie in the following two points:

- (1) The first step toward enhancement of the international competitiveness of state enterprises in the present market economy is improvement of the quality of present products and productivity regarding them. The activities in question are based on that basic consideration.

- (2) Reform of the attitude and thinking of employees has been accomplished as a result of their experiencing the positive effects of such improvements. The team will present proposals for continuation of making of improvements so as to lead to development of a company-wide movement of "self-restructuring."

1.3.2 Formulation of a Restructuring Plan and Mid- and Long-Term Plans

Proposal presentation of a restructuring plan was the main theme of the study and was meant to lead to reform and improvements concerning top management in response to improvement activities on the plant lines, and therefore the present study is characterized by the following three points:

(1) Formulation of mid- and long-term plans (3-year plans and 5-year plans)

For the following reasons, the study team considered that the mid- and long-term plans should be formulated as the basis for management of the company:

- ① The mid- and long- term plans are basic necessities for the strategic business planning.
- ② Such plans help the Company adapts to changes of environmental factors.
- ③ Such plans provide future visions and goals for the company.
- ④ Such plans may enhance new product development.
- ⑤ Such plans add greater challenge to the Company's financial strategy.

The study team presented the Company a plan which up to now has had only annual plans, with a concrete draft plan, affected the stance of the Company for their positive participation in the formulation of the restructuring plan. At the final stage of the Study, the Company formulated a draft plan of its own.

(2) Features of the proposed planning method

The presented restructuring plan aims at a market priority strategy. Furthermore, the studies and diagnosis concerning restructuring are from an external environment viewpoint which is tailored to Polish environment as opposed to general company diagnoses, in which the viewpoint is an internal viewpoint.

The method is that of obtaining the "key success factor" (KSF)⁴, i.e. the possibility of winning in market competition from the external environment, the market competitiveness of the company's products, the company's adaptation capacity, etc. and setting the allocation of company resources and the departmental goals within the company and formulating the action plans for implementation of such KSF.

⁴ KSF is the factor which are most critical for a particular product and / or services in the market. KSF may relate to product function and cost according to the stage of life cycle of products.

(3) Financial Planning

The premise for financial planning is that of using cash flow⁵ as an assessment measure, introducing borrowing, which has been avoided up to now, and undertaking became clear that they had not had mid- and long-term plans before not for abstract reasons but simply because they did not have the specific necessary techniques and know-how. active leading In the present case the company's own proposal, consisting primarily of immediate joining of the Mielec special economic zone scheme and allocation of the funds results from the various tax exemptions obtained thereby, has emerged, and the company is making a switchover to an active financial policy.

The Company is expected to be approved to join the Area by maintaining six months 15% increase of revenue in 1996 fiscal year over the revenue in 1995.

The study team presented three scenarios in terms of simulation data, and a restructuring committee was established, resulting in lively discussion on the basis of which Mielec Engines Co. has selected Scenario 1, the most active alternative of the three, as the basis for its own restructuring plan. And the Company has explicitly indicated that it will set goals for the different departments within the company on the basis thereof.

The study team undertook risk analysis and investment effectiveness evaluation concerning Scenario 1 of the three scenarios proposed by it for presentation to the company and is of the opinion that in view of the considerable flexibility and possibilities of the goals of Scenario 1 there is high probability of achievement of the plan by the year 2001.

Still to be undertaken, however, are a study of the feasibility of achieving the goals and construction of a management system. Five state enterprises in the motor vehicle field in Poland and Hungary were visited for case studies to be used as a basis for objective evaluation of the above-mentioned restructuring plan. Many of those enterprises have undertaken restructuring on the basis of their own resources and efforts and therefore served as references for the study team's proposal on the basis of which it has been possible to verify its validity.

The restructuring planning techniques will be presented at the business management seminar which is planned to be held on March 3 1997 so as make it possible for other state owned enterprises in Poland to benefit from such experience.

In summary, following outputs are obtained:

- ① The Company started the restructuring committee meeting to study the mid- and long term plan of their own.
- ② The study team transferred a planning methodology to meet Company' needs.

⁵ Cash flow is defined as the following formula.
Cash flow = net profit + depreciation - dividend and profit bonus for employees

- ③ The Company turned to take the challenging financial strategy.
- ④ Some problem areas in marketing, product, planning, investment planning and cost control etc. are clarified for improvement

1.3.3 Technology Transfer Concerning Engine Design

In this study emphasis has been placed on technology transfer concerning specialized design technology. The study team has placed development of a new engine for meeting the EURO-3⁶, new European exhaust gas standards, as the main theme of the restructuring plan. At the time of the second field study, Mielec Engines Co.'s top management and the development department assumed an active posture regarding development of such a new engine.

In response to that, the study team undertook detailed transfer of technology and know-how regarding structure, design standards, testing standards, etc. through on-the-job training.

The following were undertaken for that purpose:

- (1) Design measures were studied by dismantling competitor engines by the tear-down method⁷ for comparison with the company's parts and the design review⁸ method.
- (2) Technology transfer concerning cases of engine design by Japan's main diesel engine manufacturers, the technology for meeting future exhaust gas standards, the latest technology papers published in leading countries, etc. was undertaken in the form of seminars and design reviews.
- (3) The study team twice invited Professor Zabrocki of the Krakow Institute of Technology, one of the leading figures of Poland's Internal Combustion Engine Society, to the company, and visits were also made to that university for the purpose of receiving guidance from him and the staff. The company has already had a close relationship with that university for many years in the context of which it has received guidance from it and is working hard for continuation of promotion of such cooperation between industry and the academic world. In addition, it has also requested cooperation of Professor Lejda of the Rzeszow Institute of Technology.

Ordinarily such technology transfer regarding specialized technology is accomplished by enlisting the services of several renowned research consulting companies in Europe, but, nevertheless, the

⁶ European engine exhaust gas emission control regulations under proposal which is expected to be effective in 1999 or 2000. Since they require stringent reduction of NOx and PM, they affect engine designs significantly.

⁷ It is a tool of the Value Analysis. Products of its own and of competitor's are disassembled to compare and analyze design features in pursuit of finding design change proposals for cost reduction.

⁸ It is a method of the system engineering to review a package of design drawings, technical specifications and other documentations of the product by expertise of different and relevant fields as invited at the design review meeting. Design review are conducted several times at different stage of the product development processes.

technology transfer accomplished by the study team has received high evaluation by the additional side as having been of great help in practical terms.

Improvement of development management technology is another important task that the company is faced with, and much is expected of its present efforts for acquisition of ISO 9001 certification. However, its development department has been late in starting the necessary work for that purpose, and therefore the study team has made proposals for making institutional improvements for the purpose of solving the problems that have caused such delay.

1. 3. 4 Proposals to Polish State Enterprises and Industries in General and the Polish Government

Another special feature of the study is its comprehensive scope of view. Three approaches have been in formulating proposals.

① Macroscopic study

A study team's specialist, primarily in Warsaw, undertook activities to study centering on macroeconomics, privatization, industrial policy, the motor vehicle industry sector, regional industrial development and economic conditions in the Mielec zone, etc.

② Microscopic study

In addition, the study team analyzed various information based on Mielec Engines Co.'s experience in promotion of restructuring and information collected in visits to government agencies, other enterprises, banks, and universities and on the basis thereof, made proposals applicable to Polish state enterprises in general and to Polish government agencies. To broaden its perspectives, the study team also visited other European international aid organizations in UK, Germany, EU, and Hungary.

③ Domestic study

Japanese experience in industrial policies such as enhancement of facility investment, R&D, export, and special functions of government are studied and compared with corresponding features in Poland to formulate recommendations.

As a result, proposals are focused on the following:

(1) For state-owned enterprises

- ① Restructuring efforts to improve and innovate the corporate management, marketing, technological competitiveness of product, productivity, and manufacturing engineering.
- ② For mulcting mid-and long-term plan and future unison
- ③ Minimum but continued investment for modernization of products and production facilities.
- ④ Utilization of existing benefit provided by the government

- ⑤ Not relying on any kind of artificial price mechanism. (For example, devaluation of the Polish currency exchange rate for exporting)

(2) For government

① Exhibit of leadership at the national level

It is recommended that government undertakes and promotes programs to enhance vitalization of corporate management and entrepreneurship.

Establishment of a national-level award such as the President's award, or the Baldrige Award in the US is recommended. The Baldrige award was promoted by a Public Law which mentions foreign competition as the major rationale. No other business prize or development in managing theory can match its impact. There are similar in Brazil and Japan.

② Formulation of the grand plan and its strategy for the industry sectors, using this proposal for the automotive industry as an example,

The recommendation is applied forwards the promotion of the whole industry rather than direct support for individual companies.

Proposed issues for government review are :

- a. The structure of automotive industry, in particular enhancing automotive parts and engine industries.
- b. Infrastructures such as highway construction⁶ and urban traffic.
- c. Transportation and distribution of goods
- d. Energy
- e. Environment assessment
- f. Globalization, overseas marketing and trade

The strategic positioning and the role of Polish automotive industry in Central Europe and its Eastern market including CIS, is the most crucial issue.

In this regard, the study team has asked the Polish government to collect and analyze more information and statistical data to facilitate the formulation of future plans by Polish enterprises as well as foreign investors.

⁶ In five-year financial period, i.e. from 1995 till the end of 1999, Poland is to receive a total of over ECU 1bn from this fund for infrastructure improvements. The first tranche of this loan, expected for 1996, is for ECU 650m, and will be allocated for transport infrastructure (including construction of the A-4 motorway).

The team considers that for the study as a whole, the goals set forth in the inception report have been satisfactorily attained as per the above description, the following having been the factors that made it possible:

- (1) The active posture and leadership of the president of the model enterprise.
 - Throughout the period of the study he, as the counterpart of the study team leader, set aside about two hours every other day for interviews with him.
 - He did not fail to attend any of the main reporting sessions and committee meetings for the purposes of the study and give instructions to the company employees at them.
 - At the main conferences and particularly at the sessions of the steering committee in the Ministry of Industry and Trade, too, he committed the company to implement all of the study team's proposals and afterward did in fact do so.
 - He furnished information concerning the company's management plans and financial situation that can be considered to be classified as confidential.
- (2) Cooperation by all of the company's staff.
 - In spite of the fact that they were busy with their regular duties, the counterparts of the seven members of the study team and all of the other employees at all levels of the company, which has a total staff of about seven hundred, received the study team and provided full cooperation with it.
 - The study team was fully satisfied with all of the conveniences furnished it by the company, including office facilities, transportation, communications, meals, etc.
- (3) Cooperation by the company's labor unions.

At first the labor unions were very wary in view of the fact that the purpose of the study was restructuring, but as the study progressed, they received assurance that the purpose of restructuring was not labor intensification or reduction of personnel strength but rather vitalization based on respect of the people on the line as human beings and fully cooperated with the study.

Although the company has two different labor unions, it is one of the companies in Poland with the best labor-management relations, and that, too, was an extremely favorable condition for the study.
- (4) Cooperation by the steering committee and the Japanese Embassy
 - Participation from Warsaw in the productivity seminar at Mielec by the chairman of the steering committee of the present project and by the representatives of the Japanese embassy and their words of encouragement on that occasion helped to boost the morale of the company president and employees.
 - The steering committee provided the study team with full cooperation in its survey visits to

government offices and other state enterprises and banks, etc.

(5) The restructuring activities of the company itself.

The fact that the study team has not had to start from scratch but rather has been able to follow upon the restructuring efforts of the company itself since it was established in 1993 by breakup of the original enterprise.

(6) Setting of goals regarding restructuring.

The goals have been set not so much in terms of raising of productivity as in terms of strengthening of corporate competitiveness as the determining factor for survival in a market economy, and they are to be achieved not by downsizing but rather with retention of the present employees on the basis of the future goal of doubling turnover.

That is why the labor unions have been able to cooperate. Furthermore, although raising of productivity has not been the direct goal, in actual fact the improvements made on the production lines have served the purpose of rationalization with respect to productivity.

(7) Placing greatest importance on the actual production lines.

The idea of placing greatest importance on the actual production lines and respecting the human dignity of workers that is such an important part of the "culture" of Japan's production industry has been a big factor in the favorable reception of the study team by everyone at the company. It was also necessary, however, for the study team to understand and respect the strong degree of European individualism, rationalism and personal pride of Polish managers.

1.4 Remaining Tasks

(1) State of Progress

Table 1.4.1 summarizes the progress made with respect to the above three items in the two parts of the present study in Poland, which lasted 40 days and 30 days, respectively, in PDCA (Plan, Do, Check, Action) terms. Implementation (Do) of the improvements on the production lines has been completed, and such improvements are now in the "Check" stage, but the other two items are still in the "Plan" stage.

In principle, ongoing promotion of the project has been left in the hands of Mielec Engines Co. itself to be furthered on the basis of its own efforts.

If the present plans for acquisition of ISO 9001 certification are steadily implemented, that will serve as solid grounds for addressing the above-mentioned task. However, in general corporate tie-ups and other similar forms are necessary for effective acquisition of management know-how and control know-how, short-term technology transfer being of only limited effectiveness. Although the company what has been accomplished so far, suitable follow-up is also essential in order for the

present study to bear real fruit. That being the case, the Polish side has expressed the desire for follow-up after the present study winds up with the Draft Final Report presentation in February and reflection in the Final Report as a result thereof.

Technology transfer with respect to the tasks "policy control," "Quality Functional Deployment" and "product planning and development process" has been accomplished by productivity and marketing seminars and other means, but there is a limit to the effectiveness of guidance in the form of seminars, it being necessary "to do and show" and "to have do and show" when it comes to concrete practical tasks. Policy control is the essence of Japanese-style TQM, but even in Japan in actual practice it takes 1-2 years for full implementation.

	State of progress				Remaining tasks
	P	D	C	A	
Improvements on the production lines	○	○	△	X	<ul style="list-style-type: none"> -Promotion of maintenance activities -Implementation of policy control -Horizontal development
Restructuring planning	○	△	X	X	<ul style="list-style-type: none"> -Total demand survey for sales projection -Improvement of accuracy of calculation of necessary plant and equipment investment -Construction and implementation of product development process -Establishment of permanent promotion system -Complete implementation of ISO 9001 requirements
Product development	○	△	X	X	<ul style="list-style-type: none"> -Carrying out of design reviews -Preparation of development study document -Implementation of Quality Functional Deployment -Implementation of concurrent engineering -Strengthening of research and development system

Table 1-4-1

Since adequate market data and analysis thereof are particularly necessary for implementation of restructuring plans, the stage of verification by the company itself has not yet been reached. That being the case, breakdown into implementation plans has also not yet been completed. Such things

are now to be carried forward by Mielec Engines Co. by its own efforts. For that purpose proposals will be made for early reflection of the ISO 9001 system in the company's practical work and development of the necessary management and control arrangements.

(2) Strategic Business Planning for Mielec Engines Co.

The objective of the restructuring plan for the Company is to reform its corporate culture and reinforce its competence to become a major supplier of the diesel engines in the Central market by its own effort. However, in order to attain this goal and privatization, simple practice of the restructuring plan is not sufficient enough. The strategic corporate planning which consists of the marketing, product planning and strategic alliance must be studied even at the moment. The study team has discussed some topics of this subject with top management, yet no specific proposals have been raised from the team. In particular, the time has come to start to study the strategic alliance or potential investors,

After the restructuring committee was organized, the company executive staffs seem to be active for studying this theme.

1.5 Structure of the Report

The present summary of the report has been compiled not simply as a summary thereof but also with a view to making the experience of Mielec Engines Co. as the model enterprise in this study useful as far as possible to other state enterprises in Poland.

Next chapters of this summary report consist of "macro" and "micro" observation of the environment in which Mielec Engines Co. finds itself and the chapters after that present highlights of what has been set forth above in the present chapter, centering on the study team's proposal items.

Chapter 2 brings forward issues of this study by reviewing environmental factors surrounding the model company.

Chapter 3 deals with the state of implementation of plant improvement activities, and Chapter 5 the restructuring plans which has been proposed to Mielec Engines Co. is explained as the main theme of the present study. They are considered in comparison with other state enterprises. Recommendations for the Company's business strategies are set forth in Chapter 6. In Chapter 7 proposals are made to Poland's industry and the Polish Government, with the focus on the motor vehicle industry as an typical industrial sector that Mielec Engines Co. belongs to. Chapter 8 has been compiled for reference purposes. It analyzes and presents the study team's experience as regards how it went about its work, how it communicated and other aspects of its work process in technical guidance and technology transfer in Poland, a country with a different culture, different customs and a different way of thinking than Japan, in order to be able to accomplish the output of the

study as described in the preceding chapters.

The information collected in the surveys of present conditions is given in the appendices as reference material.

The readers can find technical terms in the Index and footnotes.

2 The Environment Surrounding the Model Company: Mielec Engines Co.

2.1 Economic Environment Surrounding Poland

Poland is the first economy in post-communist Europe to have surpassed the level of GDP reached at the time of the fall of the communism in 1989. Poland is placed at the head of the recovery process, ahead of the Czech Republic, Slovakia and Hungary.

According to a recent study, Polish companies hold best fours among top best earning companies in central Europe. (Fig. 2-1-1, 2-1-2)

Poland has entered into the OECD, while entry into the membership of European Unions in 2002 is in progress.



Fig. 2-1-1 Poland

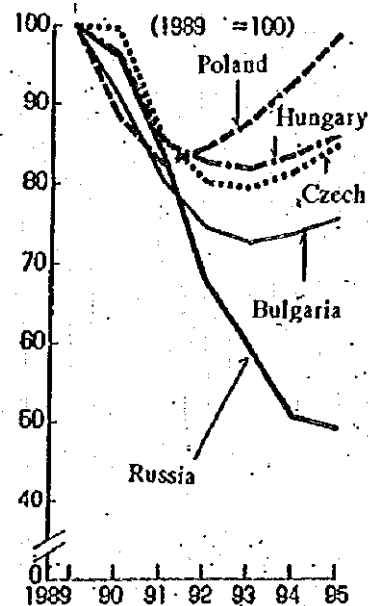


Fig. 2-1-2 GDP Trend

Macroeconomic trend in Poland will bring GDP growth in 1996. The economic vision for 2000 is prospected to be favorable as shown in Fig.2-1-3.

The GDSP growth rates have maintained positive figures of 7.0 % in 1995 and forecasted to be 6.0% in 1996. It is prospected that it will be able to maintain 5.0 - 5.4% growth for the remaining years of

the 20th century. Whether Polish economy might maintain the good growth or not depends on factors of export growth, the reform of the industrial structure, the privatization of state-owned enterprises and continuous introduction of foreign direct investment. However, it can be assessed that the Polish economy has the potential of realizing the GDP growth of more than 5% until the turn of the century and expand its size of economy 28%-30% bigger than the present one.

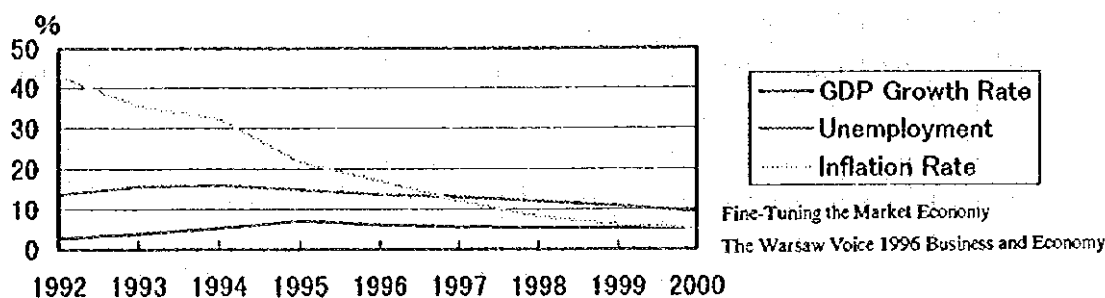


Fig. 2-1-3 Macroeconomics Index

Since the beginning of 1996, the deficit in Poland's foreign trade has been growing steadily, a tendency which is arousing concern.

The fact that imports exceed export is not in itself a reason for concern. This attests to the continuing positive business climate in Poland, which is stimulating demand for imported products, especially supply and investment goods. From the point of view of development prospects this can be considered a positive phenomenon. However, what should be arouse concern is the steady decline in the rate of growth exports.

It is estimated that the rate of growth of imports in the whole of 1996 will reach 20-22% and that of exports 18-10%. However, despite the slowdown, the rate of growth or export is still high and typical of the best development countries. The liberalization of trade within the World Trade Organization as well as Poland's relations with the European Union and the Central European Free Trade organization (CEFTA) have helped prevent the decline in the rate of growth of Polish exports from becoming too rapid.

According to the data by Polish Agency for Foreign Investment, the foreign direct investment in Poland amounted to US\$4 2.1 billion in 1995 and it has already reached to the figure in the first half of 1996, as compared to US\$ 4.3 billion over the whole 1988-94 period. This is the reflection of the recent intensification of merger and acquisition by European and American large enterprises.

The privatization of state-owned enterprises will be further proceeded through the National Investment Fund's Program (Mass Privatization Program) in addition to the systems of privatization through Capital Privatization and Direct Privatization. The combination of these privatization methods will prepare the way for the privatization of big state-owned enterprises and those of financial sector and, by the year 2001, the private sector will amount 80-85% of GDP which is now about 60%.

As an example, Daewoo purchased 13% stock shares of Andoria from the 13th NIF (Yamaichi UK) in December 1996.

2. 2 Polish Automotive Industry and Market

2. 2. 1 Current Polish automotive industry overview

The Polish automotive industry, like other advanced automotive industry in the world has its own three basic industry structure, the basic R&D, assembling and parts industries of the self-sufficiency and self-completion. This industry feature is rather different from Asian NIES countries. However the problem is the lack of the world class technology, lower productivity and old production facilities.

Poland has the full-set automotive industry as follows:

- (1) Motor car industry
- (2) Truck industry
- (3) Tractor industry
- (4) Automotive engine industry
- (5) Automotive mechanical units and components industry
- (6) Automotive electrical-electronics units and components industry
- (7) Automotive plastic-rubber equipment and upholstery industry
- (8) Automotive overhaul industry

The industry structure looks as follows.

Polish automotive sector	
— State enterprises	50
— Individual state treasury companies	12
— Private companies	58
— Polish	41
— Foreign	6
— Joint venture	11

Number of employees in the industry are 96 thousand.

Today Poland has 340 components makers , 260 of them are devoted to the auto industry.

Number of registered automobiles in Poland are:

Passenger cars	6,760,000
Vans	685,000
Lorries(Trucks)	550,000
Buses	85,800

According to GUS statistical data, passenger car production was 338,000 units in 1995, which represents a 34.5% increase over the year before. The figure for 1996 up to September is 329,000 units, for a 19.2% increase over the same period of the previous year.

In Poland, its automotive domestic demand has been prospected to be doubled according to several studies. Fig.2-2-4 shows the past and projected output of cars in Poland reported in recent Wall Street Journal.

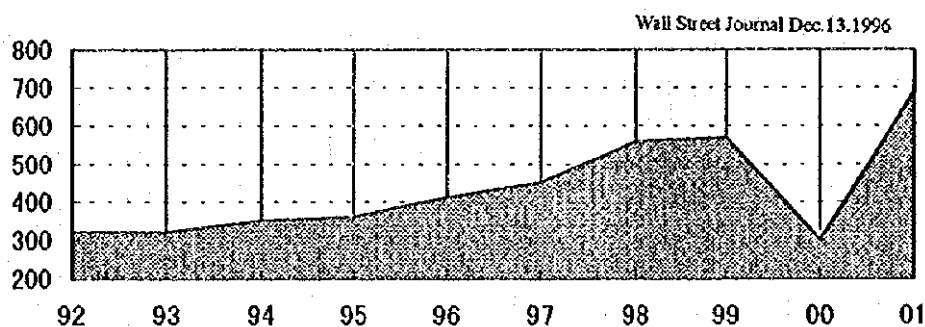


Fig. 2-2-1 Past and projected output of cars (x1000)

2. 2. 2 Polish automobile industry in the Central Europe

Next Fig 2-2-2, 2-2-3 are good indications that the Poland is leading in the automotive industry in the Central Europe at present.

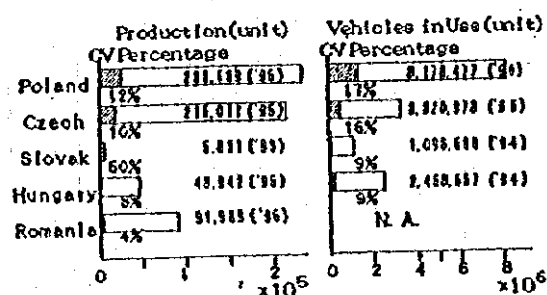


Fig. 2-2-2: Auto statistics in Central & Eastern Europe

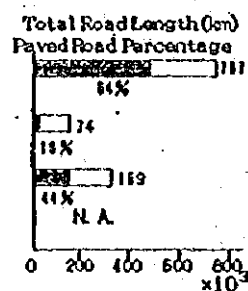
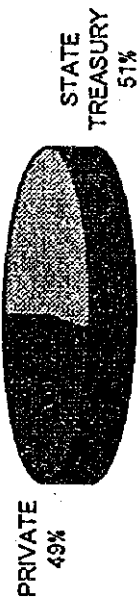


Fig. 2-2-3: Comparison of road conditions

AUTOMOTIVE INDUSTRY IN POLAND

Fig.2-2-4 OWNERSHIP STRUCTURE (A)



OWNERSHIP STRUCTURE (B)

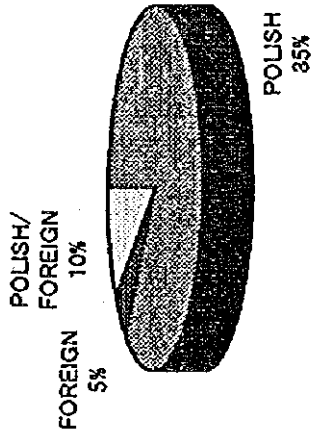


Fig.2-2-5 EMPLOYMENT

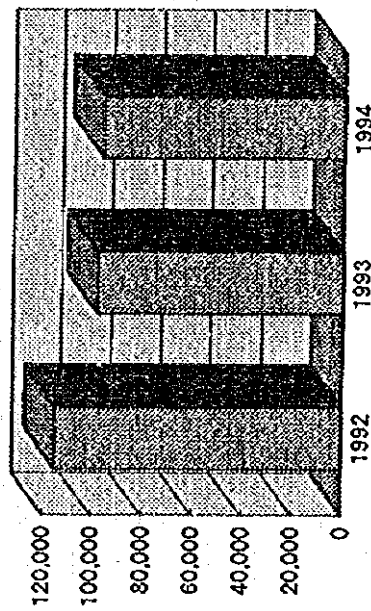
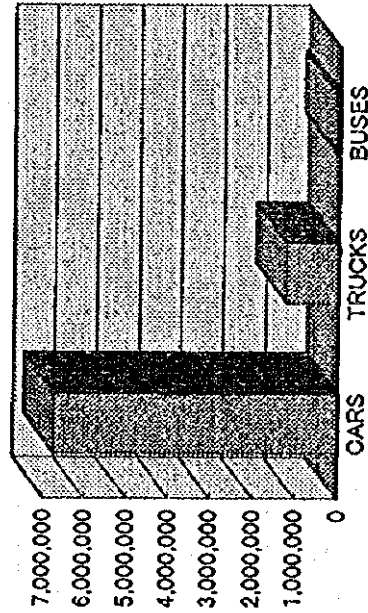


Fig.2-2-6

MOTOR VEHICLES CURRENTLY OPERATING IN POLAND



Source: Polish Agency for Foreign Investment, 1996

Since current Poland is in the process of joining the EC in 2002, Poland is directing to the Western Europe's market which is matured and saturated. Yet Poland could be a supplier of entry level cars and automotive parts to the Western Europe. However, the future potential market would be found in the Polish domestic market, the Central Europe and the CIS(Commonwealth of the Independent States) which could be the last automotive markets where future high growth rate is expected as other markets like China and India. (Table 2-2-1, 2-2-2)

Fig. 2-2-4, 2-2-5, 2-2-6 show major data on the Polish automotive industry.

(UNIT:1,000)

	1993	1994	1995	1996	Average Growth 1993~1996
World	33,015	34,803	36,467	38,521	16.7
Central Europe (includes CIS)	1,186	1,316	1,472	1,630	37.4
Czechoslovakia	133	159	191	238	79
North America	9,550	10,136	10,134	10,423	9.14
Asia ,Ocean	3,015	3,390	3,753	4,052	34.4
Central/South America	1,843	1,861	1,930	2,053	11.4
East Europe	11,324	11,656	12,459	13,369	18
Germany	3,063	3,001	3,128	3,310	8

Source : DRI/Mac growhill, World Automotive forecast 1993

Table 2-2-1 World auto sales past and projected

(UNIT:\$1,000)

	1993	1994	1995	1996	1997	1998	1999	2000	Average Growth 1993~2000
Czechoslova	133	159	191	238	289	315	355	375	182%
Bulgaria	15	25	41	53	63	79	90	98	—
Hungary	50	68	101	17	15	165	175	191	282%
Poland	224	237	264	294	329	375	421	455	103%
Rumania	40	50	63	69	87	94	101	108	170%
Yugoslavia	104	157	202	219	232	237	242	250	140%
Sub total	566	696	862	1,000	1,155	1,265	1,384	1,477	160%
CIS	620	620	610	630	650	660	700	720	16%
Grand Total	1,186	1,316	1,472	1,630	1,805	1,925	2,084	2,197	85%

Source : DRI

Table 2-2-2 Central European auto sales past and projected volume

In recent days, Poland is said to be a greatest automotive production center in the whole Europe. It could draw production from Western Europe. This idea is based on a recent increase in foreign direct investment for the Polish automotive industry. In addition Poland can supply well durable and high quality products to meet market sales in the West European countries with lower cost than EU products and with the comparable cost with Asian and Latin American products.

2.2.3 Foreign investors

During past year, Fiat and rivals from the U.S. and Asia have announced they will invest over \$ 3 billion in Polish car production by the end of the decade. Over \$750 million more has gone into vehicle-component manufacturing. Fiat Auto Poland, the top car-maker in Poland, produces only some parts and subassemblies and its major work goes to external auto-parts makers. FAP is trying to strengthen its contractors including Teksid Poland(aluminum and iron castings), Gilardini Poland (exhaust systems and mirrors) and Magnetti Marelli Poland and also encouraging other contracted domestic auto-parts makers for joint venture with foreign parts makers.

This year, the Fiat's Tychy plant factory will produce 200,000 super compact Cinquecento "city cars," 75% of which will be exported to Western Europe. The cooperation with Fiat started in 1921 and it is a good example of a long term cooperation between Poland and a foreign partner.

Waewoo plans to introduce modernized technologies into main factories in Lubullin, Warszawsa and Andoria and other 13 auto parts factories. It is estimated that Daewoo will take Fiat's first place in future.

Fig 2-2-7 shows major foreign investor's plants.

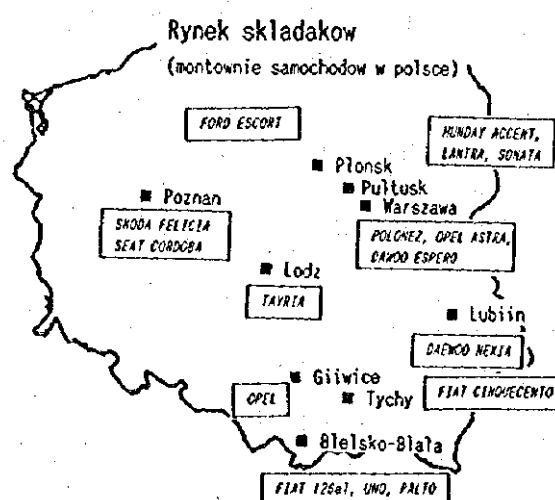


Fig. 2-2-7 Foreign Investor's Plants

2.2.4 Passenger cars

According to the estimates provided by the Research Bureau of the Sejm, by the year 2000 the total registered passenger cars will be 10 million and by the year 2010 - 15 million.

The Central Statistical Office states that the average number of residents per automobile is 5.7. In Japan the figure is 3.5, yet the Polish figure is higher in the rest of many countries.

Table 2-2-3 shows major car manufacturers. Research carried out by the Penter Market and Opinion Research Institute shows that over half of Polish families have an automobiles, and 2% of them have two. This rather high propagation is due to imported used cars.

Name of makers	Unit	Share (%)
Fiat (Dmestic)	106,547	40.3
FSO Polonez (Dmestic)	68,993	26.1
Fiat (Import + CKD)	27,541	10.4
Opel (Import +SKD)	12,460	4.7
Ford (Import +SKD)	8,046	3.0
Renault (Import)	8,018	3.0
Peugeot (Import +SKD)	4,001	1.5
Skoda (Import + SKD)	3,855	1.5
VW/Audi (Import)	3,789	1.4
Daewoo (Import)	3,593	1.4
Others	17,036	1.4
Total	263,879	100.0

Table 2-2-3: Top10 Markers of Car Sales in Poland (1995)

2.2.5 Truck and bus of medium and heavy duty

Since Zasada group holds stocks of Jelcz and Autosan, 100% of Polish truck and bus companies are invested by foreign companies.

Table 2-2-4 show Polish truck bus companies. One industrial vehicle company is added because it is a customer of the Mielec Engines Co.

Company	Products	Installed engines	Mielec's share	Competitors
Star SA	Small, medium capacity trucks, Special military cross country vehicles	Scania		
Jelcz Automotive Works	Trucks, Tractors, Buses	MAN, Detroit Diesel, M Benz	35%	Styr, Star
Scania-Kapena	SAAB trucks, Low-deck bus, coaches	Scania, SAAB		
Autosan	Coaches, City buses, Low-deck buses	M Benz	15%	Andoria, Renault, Cummins
Volvo-Poland	Truck-tractors, coaches	Volvo		
The Factory of City Transport	City buses	DAF		
Huta Stalowa Wola	Industrial Vehicles			Cummins, Caterpillar

Table 2-2-4

Table 2-2-5 shows sales volume of Mielec engines for domestic truck and bus makers.

Fig. 2-2-8 indicates the bus production in Poland.

Fig. 2-2-9 shows truck & tractor sales in Poland

	Customer	1993	1994	1995	1996
Engine	Jeloz	619	695	737	559
	Sanok	72	59	112	95
	Fadroma Wroo	71	67	92	12
	Stalowa Wola	213	218	178	134
	Inni odbiorcy	504	257	145	164
	Total	1479	1296	1264	964
Bus	Sanok	72	59	112	95
	Jeloz	217	223	239	162
	Total	289	282	351	257
HD Truck	Jeloz	80	263	382	397
Geneset	Large(WS)			30	
	Small(Deutz)			3	
	Total			33	

Table-2-2-5: Sales Volume of Mielec Engines Co.'s Products

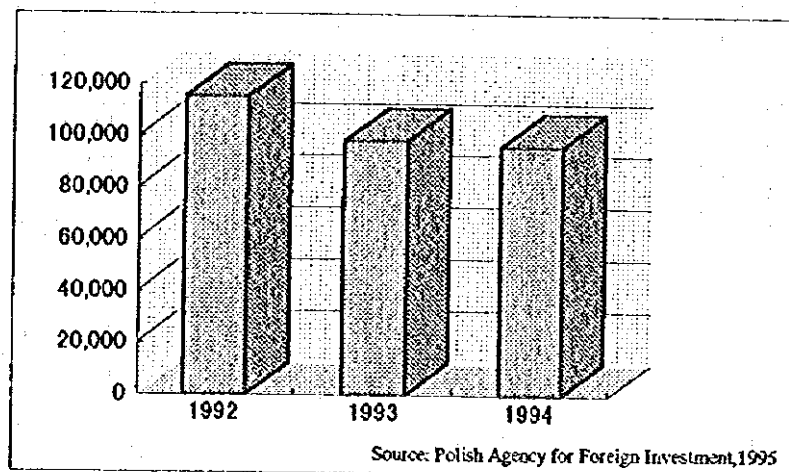
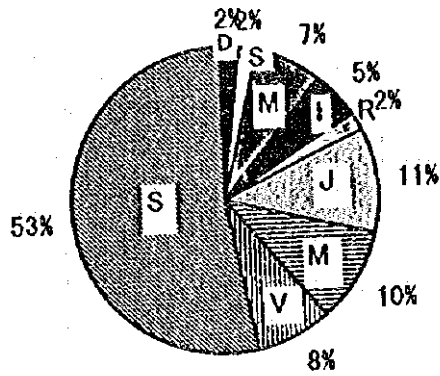


Fig. 2-2-8: Bus Production Poland

In the forthcoming five years, an additional 50,000 trucks (lorries), (7,000) buses will be needed. (From the report of PAIZ 1994)

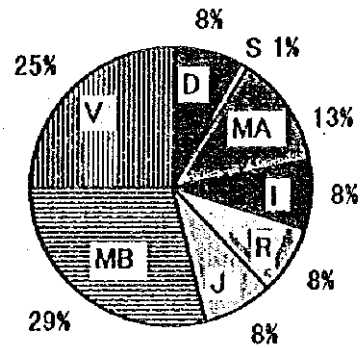
Truck Sales

1994

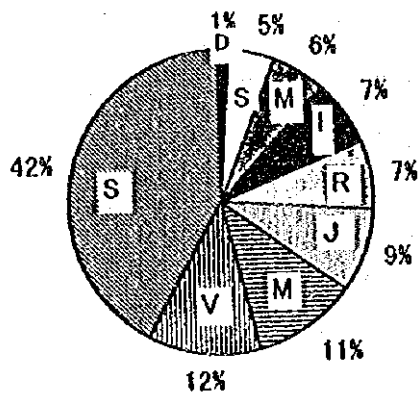


Tractor Sales

1994



1995



1995

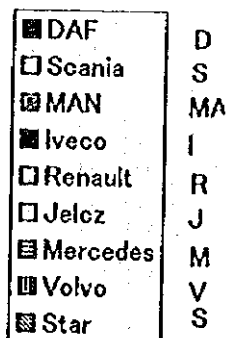
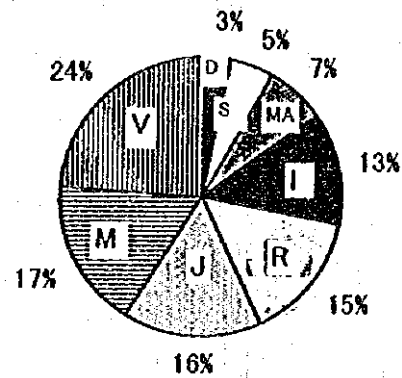


Fig. 2-2-9

Courtesy of Mieloc Engines Co.

2. 2. 6 Diesel engines

Diesel engine production is in growing and Europe and Asian shares are higher than rest of region. (Fig.2-2-10) As far as the automotive and industrial engine production are concerned, it is mostly concentrated to the West Europe and Japan. (Fig. 2-2-11)

Among these volume, share in heavy duty diesel engines is small. Yet engines of around 10 liter are principal size among heavy duty class,

Also the world diesel engine manufacturers are limited in numbers. They are:

Japan: Suzuki, Hino, Mitsubishi, Nissan Diesel

Europe: Mercedes Benz, Deutz, Man, IVECO, Volvo, Scania, Leyland base; Mielec, DAF

US: Cummins, Catapiller, Detroit Diesel

China:

Other Industrial diesel engine manufacturers: Komatsu, Yammer, Perkins

Problems of diesel engine industry are:

Global over production capacity

Sales saturation in advanced industrial countries (Fig. 2-2-12)

Challenge to environment regulation countermeasures, High cost R&D

Most of heavy duty truck manufacturers equip engines of their own made.

There are no diesel engine manufacturers which exclusively make truck/bus engines.

In the US and in the Europe, trucks are assembled with different make of engines, power trains and axles according to customer's choice. This kind is not exists in Japan.

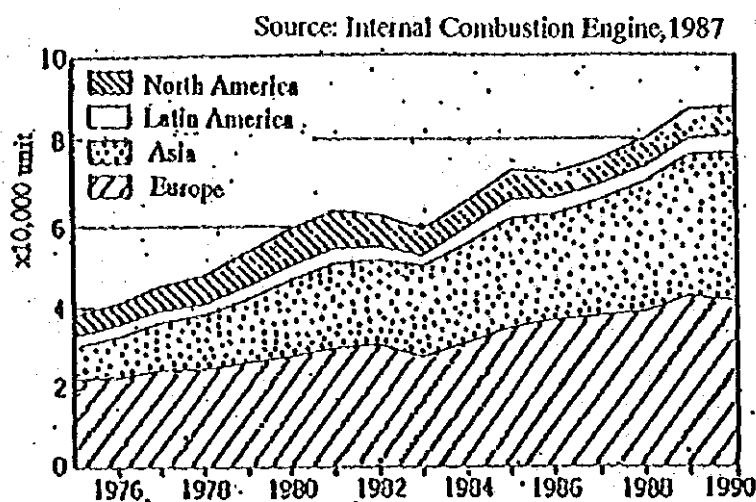


Fig. 2-2-10 World Diesel Engine Production

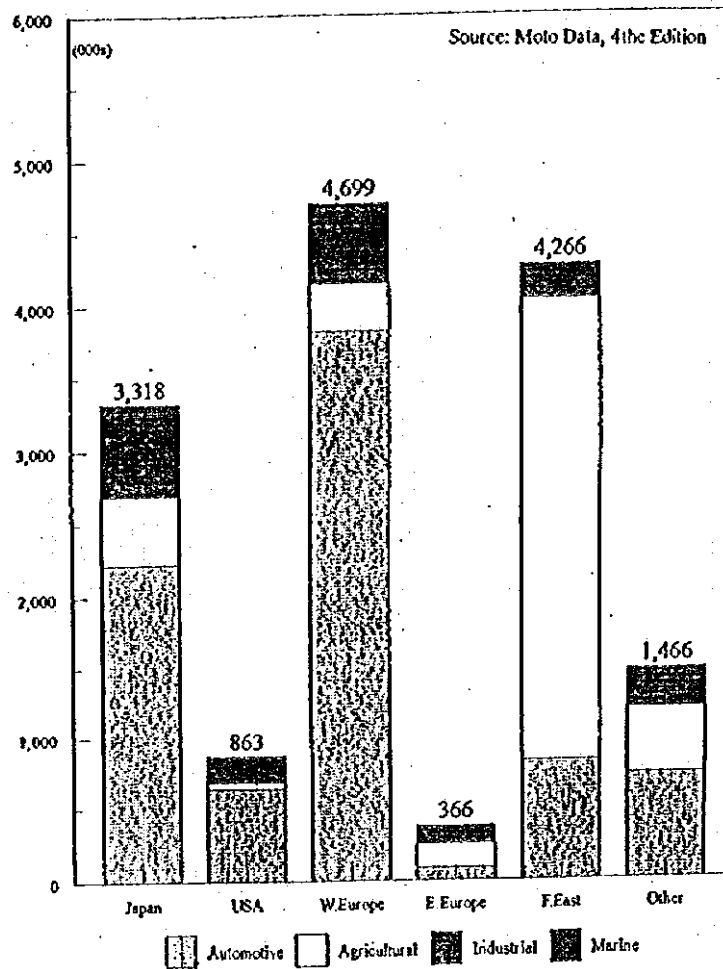


Fig. 2-2-11 1994 Diesel Engine Production by Application

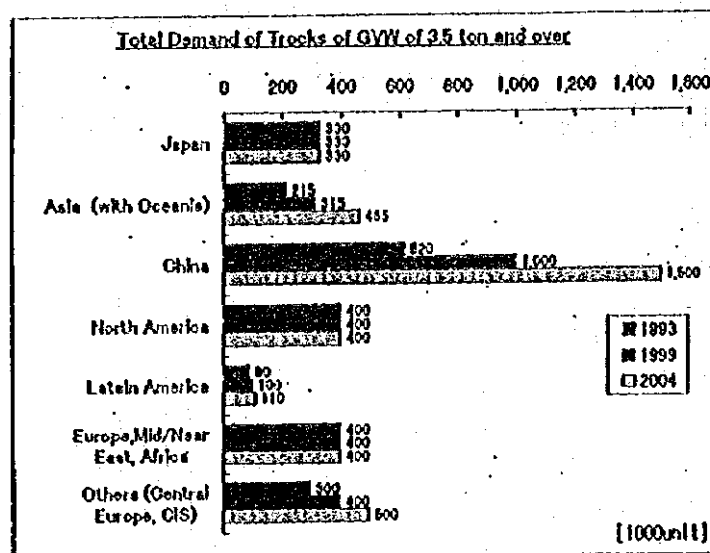


Fig. 2-2-12

2.3 Euro-Park Mielec

2.3.1 Euro-Park Mielec

Euro-Park Mielec started its operation in early 1996. By the end of September 1996, twelve economic entities were granted permits to conduct activities in the zone. It is expected that by the end of 1997 investors will create 8000 work places. This number is likely to increase 1,3000 by the year 2000. On the basis of permits granted so far, the value of investments launched in the zone is estimated at over PLN 80 million. The first two investors listed in August 1996 will reach some 56M. Currently there are eight enterprises operating in the Euro-Park Mielec Special Economic Zone.

At the moment there are other two zones; the Katowice and the Suwalki Special Economic Zones. 6 or 7 successive special economic zones have been drafted.

Mielec Engines Co. will get tax exemption benefit by joining the Euro-Park. The plan will be discussed in Chapter 5 as an important condition for the restructuring plan.

2.3.2 PZL-Mielec Group

The WSK PZL-Mielec Co. the transportation equipment company is the parent company from which the PZL-Mielec Engines Co. was separated in April 1994.

WSK PZL-Mielec started the first production of military aircrafts in 1939. Since then more than 110,000 aircrafts of different kinds have been produced. After the collapse of the USSR, this giant once employed 20,000 people was disintegrated into small specialized companies.

The Mielec group is proud of its skilled labor resources, accumulated high technologies, a good employer/labor relation and the aircraft industry.

However, there were some negative legacies from the parent company as over-capacity production facilities and shrank export market as a result of a fall of COMECON.

Following its own restructuring effort, the Company brought about remarkable results. No doubt disintegration of the WSK PZL-Mielec to small companies survived the original huge group to respond quickly to the collapse of the COMECON system. The drawback of this disintegration seems to make the business unit rather small scale. Business management indicators show that PZL-Mielec Company's financing operation is sound and stable, but its business scale per employee is rather small which causes low productivity. Even comparing with 29 Polish automotive parts manufacturers, the Company ranked at lower position in term of the amount of sales. (Based on the 1993 date)

The subsidiary companies of the joint stock holding company, Transport Equipment Corporation PZL-Mielec, are classified into two groups, namely 14 companies of more than 50 % share holding and 11 of less than 50 % (As of 12/31/1995). Some companies are successful but not all of them. The Company belongs to the second group of less ownership by the parents company, but 0.25 % of its fixed asset must be paid for the holding company annually. For Mielec Engines Co. it is not

negligible. At the end of September 1996, one of the stock holders, the WSK PZL-Mielec planned to transfer 8.8 % share to the bank DKB in Lublin thus the bank holds 48.8 % share. This could be a step toward the privatization of the Company.

Even though there are some companies related to the automotive industry in the group like an Injection pump manufacturer, any distinguished advantage for the Company obtained from the group is not known to the study team.

Appendix 7, 8 show a structure and activities of the WSK PZL-Mielec group.

2.4 Environment Around Mielec Engines Co.

The expected high growth of the Polish automotive industry will be a favorable factor for the Mielec Engines. However, there are several difficult problems to be solved

(1) Entry of foreign competitors

Membership for Poland in the EU may allow stronger competitors from the West to the Polish market.

There are too many competitors to the Mielec Engines Co. Liaz of Czeck, Man of Germany and DAF of Holland have plans to assemble their trucks in Poland.

It must be noted that there exist in Poland is no 100 % Polish breed automakers except for Mielec Engines Co. There are only two automotive diesel manufacturers in Poland;

Mielec Engines Co. and Andoria. However, Daewoo has purchased andoria's stock and will be the 75% shareholder in future.

(2) Market competitiveness of its business and products

Even though the Company's products such as the 11 liter diesel engine has had advantages in low cost and quick delivery to customers, probably within several years, the Company will lose these merits. Despite of the newly developed Euro-2 engine which will be put in the market this year, the Company's competitor's product performance, quality and product variance will exceed the Company's products. Reducing import tariff or complete exemption in 2002 will decrease the price advantage of the Company.

(3) Lowered export price competitiveness

Due to Polish currency exchange rate, profitability of export business is decreased. This tendency will be intensified when Poland joins the EU.

(4) Euro-3 emission control requirement

Euro-3 engine development is a heavy financial burden for the Company. Also R&D capability is serious problem to be solved.

(5) Concentrated stock holder

In September 1996, Bank of Lublin increased its stock share in the Mielec Engines Co. up to 48.8%.

(6) Domestic restructuring of the automotive industry

Zasada group is investing to the domestic bus and truck manufacturers. However the Zasada group is the best customers of the Company as well as a potential investor.

Jelcz as a start ,purchased 100% of the Mielec engines but the share is declining; in 1993, 81% and in October 1996, 68%. Even though, there are several advantages for the Mielec engines, Zasada is replacing them by Mercedes Benz engines.

(7) The domestic automotive parts industry is also exposed to severe competition from foreign companies.

The production technology and productivity in the domestic automotive part industry are in behind of the world standards. Thus the Company purchased major engine components from Western European companies. The Mielec injection pump manufacturer which is a family company of the Mielec Engines Co. is no exception.

3 Implementation of Plant Improvement Activities

3.1 Summary Description of the Plant

Mielec EMIengine's plant is located on vast grounds shared with another group of its parent company, WSK-iec. Mielec Engine's part of those grounds has a total area of 69,425 m². 34,785 m² of which is accounted for by the projected area of buildings and other structures. That is a surplus of facilities considering the fact that presently Mielec Engine's Co.'s plant has a monthly production scale of only a hundred some engines. The breakdown of such facilities is 37% for production, 6% for warehouses and storerooms, 7% for management offices and 49% for various accessory facilities (see Appendix A4, A5).

The plant once produced 12,000 engines a year and has 425 pieces of machining equipment. A lot of it is of Soviet or Polish make, but since the engines are based on technology transfer from Leyland, specialized machinery of British make has been installed for cylinder blocks, etc. Anyway, all of the equipment is at least 25 years old and obsolescent. Recently they have started to introduce some NC machinery and machining center machinery, but they are still in the learning stage with it. The engine general assembly line is a very long some 60 meters, and 27-30 engines are on it in spite of the fact that the daily production quantity is only approximately 8 engines. In other words, the in-process quantity is 3.5 days' production. The engines move along the line at the very slow pace of 7 cm a minute. Since both the machining lines and the assembly line of the plant are continuing to be used without restructuring in spite of the fact that the plant's scale of production has been reduced to one-tenth of what it once was, productivity is extremely low.

The plant organization is shown in Appendix A6 concerning the organization of the entire company. Of the company's total staff of 739 employees, 253, or 34%, are directly involved in production. If those indirectly involved in production are included, the personnel strength of the production department comes to 428 (58%).

Table 3.1.1 Personnel Breakdown (as of Jan. 31, 1996)

Management staff	82
Production personnel	253
Production support staff	199
Technology and other indirect departments	205
Total	739

The number of employees directly involved in production is small, one person being responsible for several items of machining equipment, but they have a high level of skill.

There are two labor unions with different superstructures, i.e. one under the Electrical and Machinery Industry Labor Union Federation, with roots in the former Communist regime, and one under "Solidarnosc" (Solidarity). According to the survey carried out in early September 1996, together they had a membership rate of 50.1% of the company's employees. Most of the members of the "Solidarnosc" labor union were workers on the production lines and that most of those of the other labor union were office workers. In any case, the company's labor relations are good, and it has not experienced any strikes from inception of the company which was established in April 1993.

The plant's main products are 11-liter diesel engines and generator sets as an applied product. It also makes other industrial application products and a small scale generating set and ambulances, repairs and makes service parts for engines as well as doing machining work on commission. The breakdown of its turnover is as follows:

Table 3.1.1 Breakdown of Turnover (%), 1995
Total turnover: 391,778 PLN¹ (approx. 1,600 million yen)

Item	Number of units sold	% of turnover
Engines	1,344	59.6
Engine repairs	326	6.9
High-output generating sets	27	3.7
Medium- and light-output generating sets	3	0.2
Engine parts, services		21.5

The 11-liter engines are of the old type (SW680) and the improved type (SWT11), and 7 models of them differing as whether they are vertical or horizontal and whether or not they have a turbo charger along the same line. A new "ecological engine", the MD111E, for which EURO-2 certification has been obtained, is scheduled to be mass produced starting in 1997.

¹ New Zloty

3.2 Production System and Production Control

The production method is production by orders, and continuous production is being carried out. There is only one working shift, and it also works every other Saturday. The standard delivery time for the engines is two weeks, but if requested by the client, they also have a special "express" delivery time of 3 days. Machining and assembly take one day, performance testing another day, and painting the third day. The express delivery time is based on their sales differentiation strategy as a means of competing with Mercedes Benz and other foreign products with longer delivery times.

95% of the engines produced by the Company are purchased by five companies, the two bus manufacturers Jelcz, of the Zasada group, and Autosan accounting for 81% (66% and 15%, respectively). The sales department plans the annual production for the next year in August of each year taking into consideration the actual production figures for the year before. It informs the casting manufacturer for the large parts and the departments concerned in the Company as the basis for production and parts procurement.

In monthly production planning the working production planning section decides on the quantities for the following month one week before the end of each month and instructs the production lines to that effect. Furthermore, it gives instructions concerning the production volume for 3 days after the month that the plan concerns starts. That way of doing things out to preclude excessive in-process quantities, but in reality things are not done like that.

3.3 Reform of the Production System by Improvement Circle Team Activities

3.3.1 Selection of Model Line and Formation of Circle Teams

(1) Process From Selection of Model Line to the Activities

① Criteria of Model Line Selection

Model lines were selected to maximize output (product QCD², safety and morale at work) and minimize the plant input ("5M")³ so as to be able to enhance product strength in order to survive in market economy competition, the study team's restructuring goal.

② Model Line Improvement Items

- * Minimization of production cost: reduction of defects, raising of yield rate, reduction of in-process volume

² Quality, Cost, Delivery

³ Man, Machine, Material, Money, Method

- * Minimization of production time: reduction of machining, transfer and waiting time
- * Effective use of production equipment and reduction of trouble with it: "3S", daily checks and implementation of preventive maintenance
- * Making the work place more attractive and bright: reduction of shavings, keeping tools, etc. in good order and posters
- * Making the work place safer and more friendly: installation of safety screens, removal of dirt and stains on floors and wearing of helmets

The model line improvement goals are reduction of cost and machining and assembly time by 50% in comparison with the present actual figures. With reduction of machining and assembly time, operators will have more free time and will be able to participate in improvement circles, i.e. smaller groups for improvement activities.

③ Detailed Survey of Present Conditions of Model Lines

- (1) Interview survey covering overall methods, personnel assignment, content of work responsibilities, etc.
- (2) Machining time and assembly time actual figures and standard times; if no data is available, implementation of time studies
- (3) Actual figures regarding in-process volume, MHI (Man Hour) and frequency of trouble per machinery unit and actual figures on maintenance
- (4) Confirmation of content of work of operators and maintenance personnel
- (5) Cost study regarding purchased items, items for which outside orders are place and present products

④ Procedure for Model Line Improvements

- (1) Selection of model lines and setting of study items and diagnosis methods
- (2) Deciding within the company and explaining them to those working on them so as to get them to agree to them
- (3) Deciding on the members who will work on the model lines and appointment of leaders
- (4) Simple explanations and training for study, diagnosis and improvement
- (5) Personnel reassignments and deciding on persons in charge, items to be implemented, etc.

Two model lines were selected: the engine cylinder head machining line and the engine assembly line.
That process is indicated in Fig. 3-2-1 below.

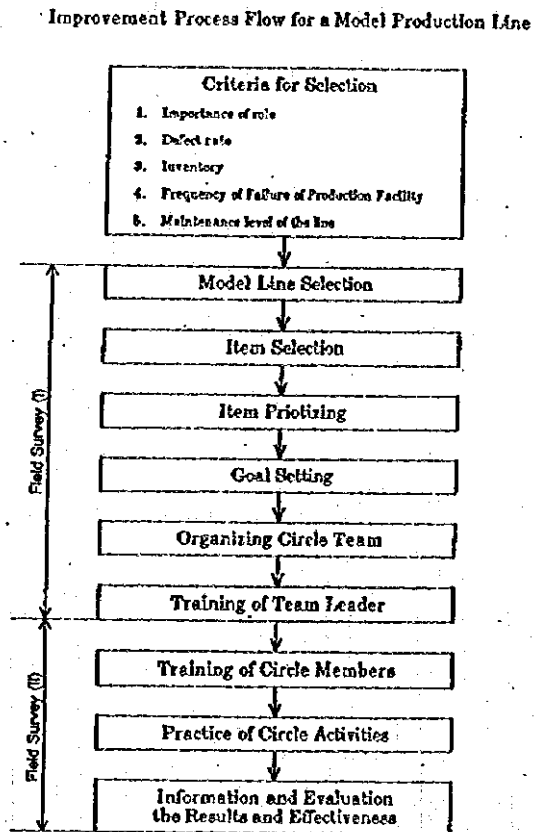


Fig. 3-2-1

In the context of restructuring of Mielec Engines Co. the study team's initial plans called for mastery of improvements in small group activities on the plant production lines on the basis of on-the-job training. The selected themes were simple and immediate production-line problems, and it was intended to limit the improvement goals to QCD⁴ for present products as the immediate task for the sake of making it possible for the company to get out of the difficult situation that it finds itself in.

At the same time, the study team was very anxious about whether or not it would be possible to introduce improvements through small circle activities, a system born and raised in Japan, if the people concerned belonged to the European cultural sphere and had been a part of the Communist bloc until only 7 years ago. However, the start that was made was smoother than expected thanks to the enthusiastic way they received the study team and its ideas. But in the end that was achieved through persevering efforts to understand one another through discussion. The circle teams were formed, and their goals were set. Furthermore, "5S"⁴ and other simple urgent proposals were put forth by the study team. The first part of the study ended shortly thereafter, but when the study team returned to the plant for the second part of the study, they had done all of the "homework" that had been left them with.

It is specially noteworthy that they had already resolved to change the production method and were already implementing the changes. That is something that neither the study team nor Mielec Engines Co. had even thought of initially. Such implementation was due to the courageous decision made by the improvement team leaders, the "managers" on the production line, after many talks with the study team after long brain-racking and heart-searching. The process that led to that decision will be described in Chapter 8.

3.3.2 Improvement Activities on the Engine Cylinder Head Machining Line

(1) Team Composition

Leader: Mr. R. Lato (assistant chief, parts machining section).

Total members 6: work foreman, production technology man, repairman, procurement man and production planning man.

Please see Photo 3-3-1

⁴ Keeping everything neat, in order, clean, maintaining personal cleanliness and work discipline (Seiri, Seiton, Seisou, Seiketsu and Shitsuke in Japanese)

(2) Activity Goals

- (a) 50% reduction of in-process volume of cylinder blocks: 60 units/day
⇒ 30 units/day
- (b) 25% reduction of equipment downtime: 40 h/month ⇒ 30 h/month
- (c) 5% reduction of total machining time

(3) Problems

This machining line which consists of three "sublines": A, B and C completes the cylinder block from the input casting. As indicated in Fig. 3-3-1 sixty cylinder heads are on the line at a time even though the plant has to produce only 8 engines a day, (Please see photo 3-3-2, 3-3-3)

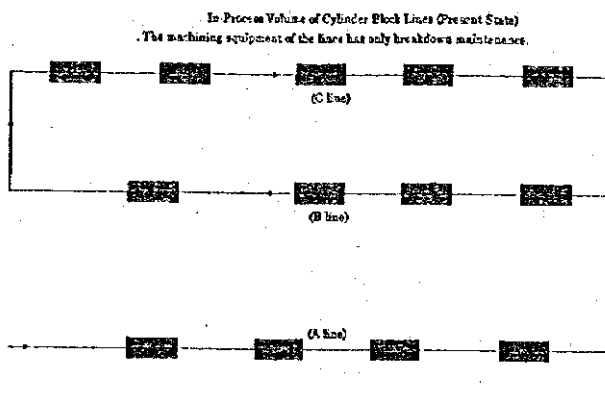


Fig. 3-3-1(A) Cylinder Block Line before Improvement

On each A, B, and C line, 20 engine blocks are subjected for machining. 4 blocks indicates 20 engines.

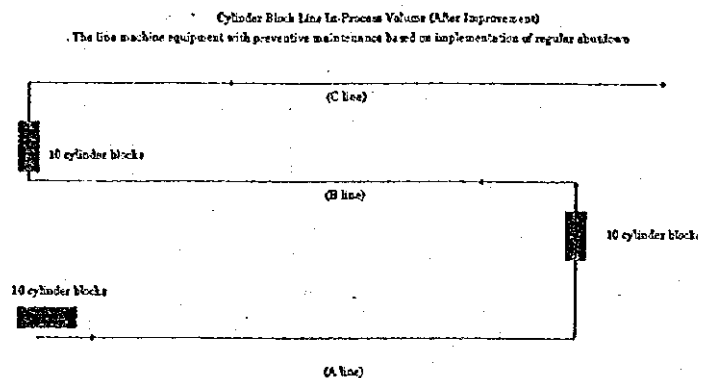


Fig. 3-3-1(B) Cylinder Block Line after Improvement

One block indicates 10 units.

In its analysis of the problems of the production lines, circle team members identified two major factors behind occurrence of such an excessive in-process inventory.

① High rate of equipment downtime

The data that has been kept since 1995 on the monthly equipment downtime rate shows an average down time of 40.8 hours, number of incidents of 18 and an average rate of down time of 22.1%. Because of this high down time, operators of the lines tend to have excessive safety stock by worrying about delay in delivery.

② High Finished Product Defect Rate

The defect rate of the cylinder head castings, which are purchased from the outside, is very high: 10-30%. This extraordinary high defect rate caused large inventory.

(4) Positive Results of the Activities

1) 50% reduction of in-process volume

Time observation was undertaken with respect to the three "sublines", A, B and C, and determination was made of the time that it takes to machine 10 units within daily operating time. The measured times were as follows: A: 6.5 h. B: 6.0 h. C: 7.5 h. Accordingly the system was changed to production of 10 units each on those three sublines. As a result the in-process volume was reduced from 60 units to 30 units.

2) Reduction of equipment downtime by 25%

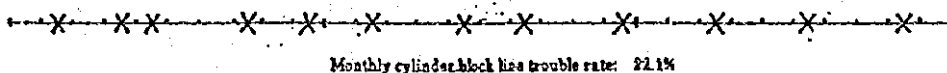
As shown in Fig.3-3-2, once every two days any machines have failures and stops for about 3.5 hours. Such a status causes frustration for the production people and moreover, it makes the in-process inventory further more because the continuous line production system. Therefore, regular shutdown days was established on every Saturday from November 23. As a result, there was no equipment downtime from November 25 to December 5.

Circle members realized this significant result and immediately started to switch the breakdown maintenance⁵ to the preventive maintenance (PM)⁶.

The first thing the circle team practiced to maintain this improved condition was to investigate causes of 4 machine tools which have the highest frequency of failures in this line. (Fig.3-3-3)

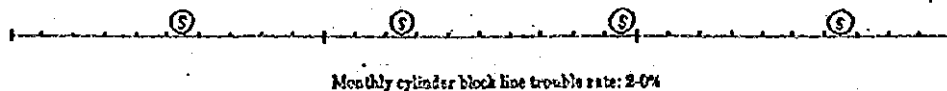
1. Present state: breakdown maintenance

Equipment trouble → Stopping of production → Repair (machining of reserve parts or procurement) → Increase in line in-process volume → Increase in interest.



2. After improvement: preventive maintenance

Checking of equipment → Repair plans → Prior procurement of reserve parts → Regular week shutdown → Decrease in equipment trouble



N.B.: Regular weekly shutdown was implemented starting Saturday, November 23, 1996. The operators accomplished 2S with respect to the cylinder block lines, and the maintenance department implemented checking, repairs and centering adjustment. The equipment trouble rate for the 2-week period of zero.

Fig. 3-3-2: Maintenance innovation and Improvement

Note: Each line indicates 30 days
X denotes failure
(S) denotes regular shutdown

⁵ The maintenance conducted after the failure or breakdown of the machine.

⁶ The planned and periodical maintenance to prevent the breakdown.

Actual Downtime of Cylinder Block Line Machining Equipment
(February 1998 to September 1998)

Designation of machine	Downtime (hours)	Number of times trouble occurred	Waiting time rate (%)
1 103900		22	
2 24-250		22	
3 103901		22	
④ 24-332		22	
5 103903		22	
⑥ 103904		22	
7 103906		22	
8 103908		22	
⑨ 103902		22	
10 103905		22	
11 103912		22	
12 103919		22	
13 103914		22	
14 103915		22	
15 103916		22	
16 GRT-352		22	
17 103909		22	
18 RF-31		22	
19 RF-31		22	
20 103911		22	
21 103913		22	
② 103920		22	
21 103921		22	
24 EL-902		22	
25 103907		22	
26 103922		22	
27 S2H2-200		22	
28 103924		22	

Fig. 3-3-3 Downtime of Cylinder Block Line

3) Reduction of machining time by 5%

Machining jobs which were operated by 6 groups of the total number of 13 was reorganized to two groups so that everyone can help each other when a problem arises. Consequently, on-line inspection time has been reduced. (On-line inspection time is included in the machining time.)

4) Practice of "3S"

While the study team was away between the two parts of the study the improvement team accomplished complete implementation of "3S" with respect to 350 meters of roller table. Rollers that did not rotate properly were replaced, and the supports were cleaned and painted different colors according to the part in question.

Furthermore, much of the machinery was repainted during the end-of-year production halt.

(Please see photo 3-3-6)

3.3.3 Improvements on the Engine Assembly Line

Team leader: Mr. Z. Kolodziej (foreman and shop chief).

Total team members of four: one production planning man, one production technology man and one procurement man.

The work of this team started with improvement concerning the problem of the part supply shortage but at the same time the team undertook 50% reduction of assembly line in-process volume because of the influence of the machining model line. As a result, it was proved that excess in-process volume had considerable correlation with the problem of the parts supply shortage.

(1) Reason of setting of task/problem

The problem "many parts supply shortage" was taken up because as a result of discussion by all of the team members it was determined that the high frequency of the problem was a common worry for everyone. Toward the end of the first part of the study there was a period of three days during which no engines were completed because of occurrence of the parts shortage.

Goal figures 50% reduction of the parts supply shortage

(2) Process and Result of the Activities

Following information is almost identical to the presentation materials by the team at the productivity seminar. It is introduced here for better understanding of seminar results presented by the circle team. The presentation material is well constructed according to the "QC Story"⁷.

① Determination of Present Situation

- * A large sheet was posted at a place where the assembly process can be clearly seen for keeping a daily record of information on the parts shortage.
- * The available data was sorted out, and graphs were formulated on the basis thereof.
- * The shortage rate with respect to the number of engines assembled was calculated.
- * The average shortage rate was calculated for every 10-day period.
- * Just by having them look at the data entered on the large sheet, it was possible to reduce the number of parts supply shortage.
- * It is assumed that efforts were made to reduce parts supply shortage as much as possible owing to the fact that everyone saw the data and was conscious of it.

⁷ A logic to solve problem practiced in the Japanese TQM. First current status is studied based on the facts. Then it is compared to the target status "what it should be".

The gap is studied to find problems to be solved. This logic is like that of the system engineering.

- * From graphs on which defective units were plotted, it was determined that the frequency of occurrence of shortage in the same part is low.

② Analysis and Verification (Factor Analysis)

- * During the 39-day period of the study 205 engines were assembled.
- * In-house machining and machining by outside orders were considered separately regarding parts shortage.

The number of parts shortage is analyzed by the different parts in two Pareto diagrams⁸.

- * A new Parato diagram is designed based on analysis of above Pareto diagrams with respect to the different companies with which the outside orders were placed.(Fig.3-3-4) As can be seen from this Parato diagram, three companies out of the thirteen accounted for the most defects: 62.7% of the total.

One of those companies with which outside orders are placed accounted for failure to assemble 83 units, and the other accounted for failure to assemble 73.

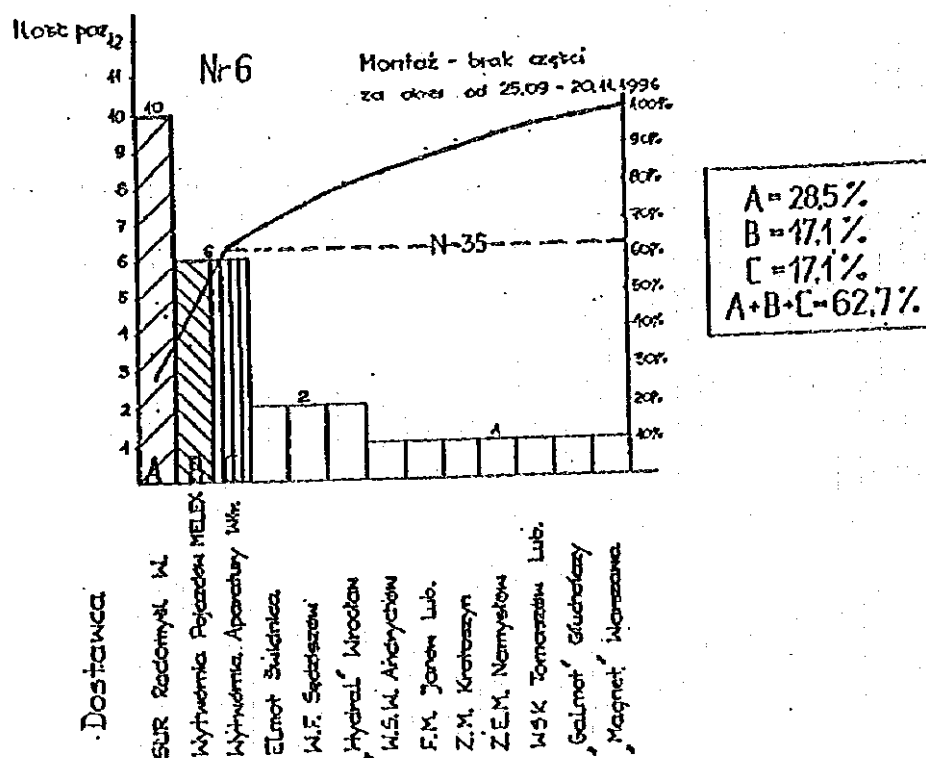


Fig.3-3-4 Frequency of Parts Supply Shortage by Companies

⁸ It is a simple graphical technique for ranking items from the most frequent to the least frequent. This is based on the Pareto principle originally found by Italian named Pareto. It is used to display the contribution of each item to the total effect in order of importance. It ranks improvement opportunities.

- * Of the parts shortage in in-house machining, some were affected by late delivery of materials from this company..
- * It was determined that one of the reasons for late delivery by this company was defective materials.
- * 25% of the in-house machined parts were affected by parts shortage.

③ Determination of Causes of Problems

- * Late notice of production plans.
- * Since the content of the 3-month plan is too rough, without definite figures, there are many changes in the plan.
- * Sometimes the company is forced at the last minute to temporarily pay for materials which one of the worst three companies (two of them are of Mielec Group) does not have enough funds to procure.
- * The quality of the materials is poor.

④ Countermeasures

- * Discussions with the sales department by Dec. 9 for consideration of earlier presentation of engine and parts plans.
- * Consideration of the method of monthly revision of 3-month production plan (rolling plan).
- * Consideration of implementation of earlier advance payment for procurement of materials.
- * Consideration of incorporation of a part of the machining.
- * Efforts to procure materials that meet the design specifications.

Comments of the study team on the above activities are as follows:

In the activities one of the aims was training in use of QC tools on an OC story basis, and the results achieved were sufficient to make one think that much can be expected in the future. Such training consisted in:

- Seeking out problems and repeating to oneself, "Why, why, why?"
- Thinking in terms of data.
- Use of Pareto diagrams as a statistical technique.
- Orientation according to strata and points of emphasis.
- Control by sight.
- Cooperative activities across organizational barriers.

(3) 50% reduction of in-process engines on the assembly line.

This item was added in the second part of the study because we believed that the parts shortage improvement team had already demonstrated by its active work and achievements that it was capable of that as well. It was also undertaken in response to the activities of the model machining line for 50% reduction of their in-process volume.

In spite of the fact that daily production was only 8 engines, the number of in-process engines moving on the assembly line was at times as many as 30. Therefore every other bench on the line on which the in-process engines are mounted was removed, reducing the number to 15 and doubling line speed. As a result, an engine came off the line after only 1.5 days instead of 3 days as before, and that added healthy tension to production. Before they had three days in which to deal with parts shortage, but after that change they had to deal with them more quickly.

If the problem with the parts shortage had remained the same as before, the above-mentioned measure would have meant only less on-line in-process volume but more off-line in-process volume, i.e. no decrease in in-process inventory. Therefore reduction of the parts shortage by 50% had the major side effect of reducing in-process inventory as well by 50%. Next pictures show the assembly line before and after the improvement. (photo 3-3-5, 3-3-6)

Photo 3-3-1
Circle Team Members
(Machining Line)



Photo 3-3-2
Roller Table Before 3S

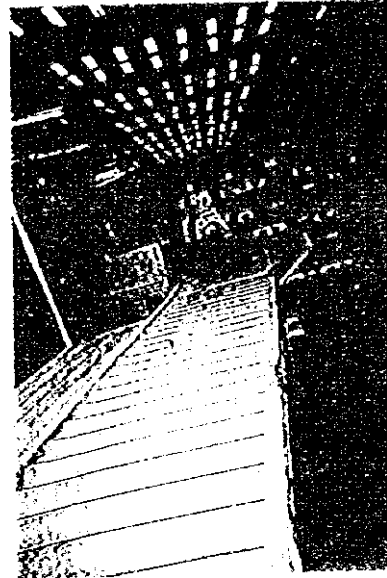


Photo 3-3-3
Roller Table After 3S

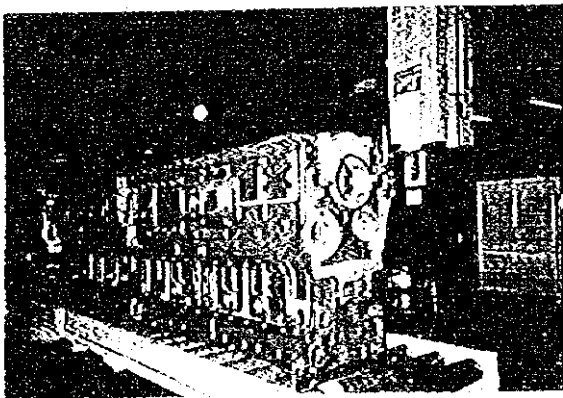


Photo 3-3-4
Repainting Machinery

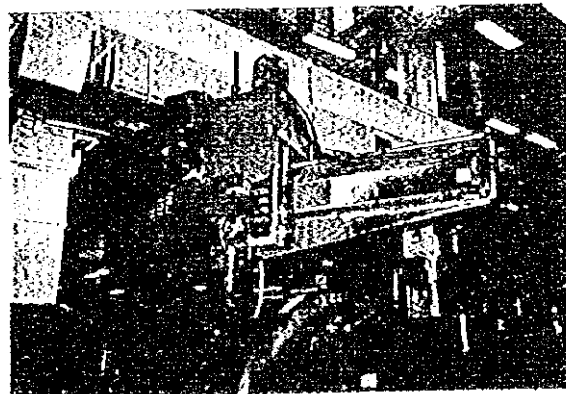


Photo 3-3-5
Engine Assy Line
30 Units on the Line

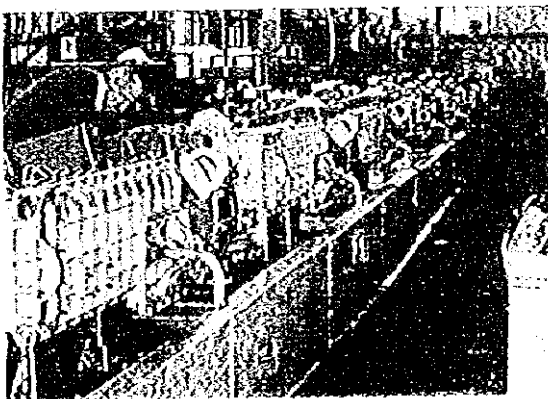


Photo 3-3-6
Engine Assy Line
15 Units on the Line



3.4 Productivity Seminar

The productivity seminar was held at Mielec Engines Co. on December 3, 1996

It is aimed at following points:

- ① Training of the productivity improvement for the Company
- ② Team leader as major player of the productivity seminar, motivate company employees by demonstrating achievement of their own company
- ③ Promotion of application of this results to other state owned enterprises by inviting people from outside.

Guests:	Mr. A. Miklaszewski	Deputy Chief of International Cooperation, Ministry of Industry and Trade
	Mr. S. Zimmer	Advisor to Minister, ministry of industry and trade
	Prof. K. Leijda	Rzeszow Institute of Technology
	Mr. B. Ostrowski	Director of PZL-Mielec
	Mr. M. Kumagai	3rd Secretary, Japanese Embassy
	Mr. S. Kaibori	JICA advisor to Ministry of Industry and Trade
Chairman:	Mr. J. Stidnicki	President, Mielec Engines Co.

The day before the seminar was rehearsed with company employees as the audience. It was successful on both days in terms of the impression it made on the company employees and the favorable reception it received from the guests, and company morale was further boosted by words of encouragement by the guests.

The reports on the activities of the two improvement teams in connection with the theme of the seminar lasted 20 minutes. The format adopted was the same as that of QC circle reporting conference in Japan. In all respects, i.e. the content of the reports, the way they were presented, the attitude of those presenting the reports, etc. the level was of the international class. All participants of the seminar were very much impressed with them. Since the achievements of the activities of the improvement teams have already been described above, the following is a summary of the talks at the seminar by members of the study team.

- (1) "Productive Maintenance" by Hideo Tashiro, study team member in charge of production control
(Please refer appendix A14).

Abstract:

The cylinder block machining line consists of 47 machine tools from the initial casting to the final products. The maintenance of machines in such a continuous production line affects the productivity

significantly. At an initial diagnostic of the plant, the study team assumed that a major reason of the excessive inventory is caused by the breakdown maintenance which was practiced by the Company. In order to innovate the maintenance system of the Company by applying the system practiced at steel mills, the study team selected this theme. Since the presentation activities by the circle team on the PM followed, the presentation aroused a great deal of interest on the part of the audience.

The following is an outline of the talk.

1) History of development of the maintenance method in question.

There are 5 stages of the maintenance; namely,

- ① Breakdown Maintenance(B.M)
- ② Preventive Maintenance(P.M)
- ③ Modificative Maintenance(M.M)
- ④ Productive Maintenance(Pr.M)
- ⑤ Maintenance Prevention(M.P)⁹

The Company is in the process of transiting from the stage 1 to stage 2.

2) System for implementation of the productive maintenance.

3) Organizations, functions and personnels for implementation of such maintenance. There are recommended ratios of personnels for maintenance vs total manufacturing personnel. Necessary numbers are recommended for the Company.

4) The concept of implementation of the productive maintenance by participation of everyone involved (TPM: Total Productive Maintenance¹⁰)

5) Explanation of how different are maintenance terms(terminology) related to one another.

6) Steps for introduction and wide application of preventive maintenance on the cylinder block line.

- ① Changes and improvements in repair methods
- ② Regular shutdown for repairs
- ③ Planned (preventive) repair plans
- ④ Inspection methods
- ⑤ Inspection by the five senses
- ⑥ Daily duties of inspectors
- ⑦ Duties of maintenance technicians
- ⑧ Duties of maintenance control personnel

7) Activities for implementation of preventive maintenance

⁹ The Productive Maintenance(Pr.M) is to optimize the combination of PM and BM to increase profitability of the plant.

¹⁰ The TPM is a company-wide movement. Recently many Japanese manufacturing plants are conducting this movement as the first priority of the productivity improvement.

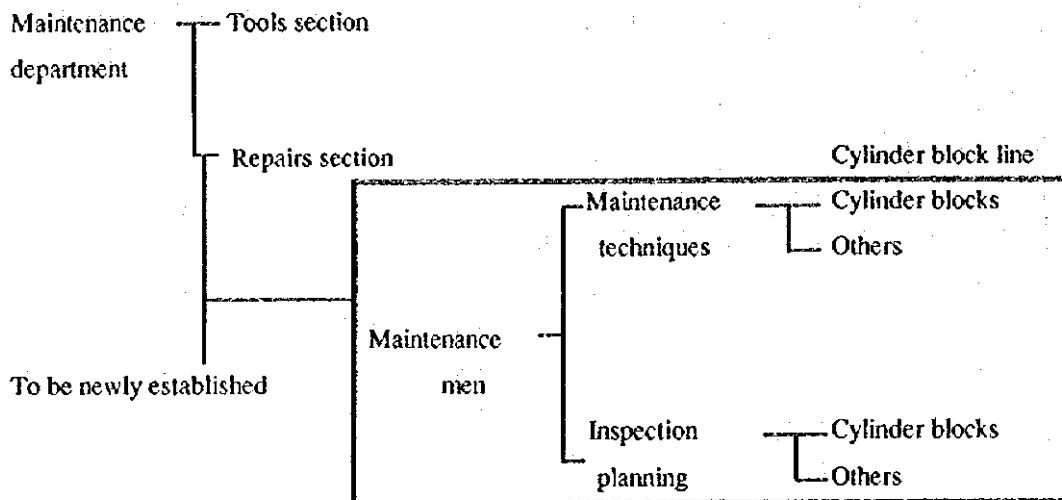
(Necessary tasks at each step of Plan, Do, Check, Action are explained).

8) What task should be done for "5S" activities on cylinder block line.

9) Proposals for wide application of productive maintenance activities at Mielec Engines Co.

The following proposals were made concerning Mielec Engines Co.:

- ① As indicated in the description of the productive maintenance implementation system, it is necessary to foster the inspection planning function and the maintenance assigned to the plant's maintenance department as per the following scheme:



One inspection planning man has already been assigned.

- ② Selection of yardstick for determining maintenance effect and using it to determine tendencies.
 - Equipment downtime/day and number of equipment trouble incidents/day
 - Number of repair incidents and cost thereof per day
 - Number of modifications made and cost thereof per day
- ③ Establishment of a productive maintenance implementation promotion committee in the company for making efforts toward wide application of productive maintenance throughout the company.
- ④ That committee should meet once a month for the purpose of studying and confirming positive results achieved and how the promotional efforts are faring. It is proposed that it be chaired by the director in charge of production and be placed under the restructuring committee chaired by the company president.

- (2) "Why Improvement Is Needed" by Naohisa Miyakawa, study team member in charge of production technology

The Japanese word for improvement, "kaizen," has become international, and that is the case in Poland as well. However, although people who have actually had the experience of being members of "kaizen" teams can be considered to have a fairly good idea of what it means, one does not feel that the concept is very well understood by people in general. It is therefore of vital importance that such actual cases of "kaizen" be used for repetitive education concerning the concept. This talk therefore centered on description of cases of "kaizen" in Japan and

experience concerning it gained at Mielec Engine.

In the initial stage of the study, the study team presented line improvement items as urgent proposals. The process followed was that of putting the proposals down on paper by filling out the forms for that purpose and submitting them to Mielec Engine's director in charge of production for his approval.

In the seminar improvements concerning crankshaft and bearing metal washing were taken up as actual examples of such improvements. In the past there was no gauging of the level of the liquid in washing vats, and because of that when the level went down too far, the washing was incomplete, often leaving unremoved shavings and other extraneous matter. The line improvement that has been made in that respect is that of installing glass tubes whereby it is possible to tell the level of the detergent oil in the washing vats. Furthermore, they are now going a step further and are studying the possibility of doing away with such washing altogether by changing the form of packing at delivery. Although that has already been implemented in Japan, the improvement team members thought of it by themselves, and that is an good indication of the flexibility of their thinking.

Next followed an explanation of the concept "policy control."

As pointed out by many of the members of the study team in the initial stage of the study, although the company had its own quality policies, it did not have specific goals concerning "QCD" of its products. But specific goals concerning QCD is the essence of Japanese-style TQM¹¹ and a technique that ranks alongside ongoing improvements by small group activities. In other words:

Policy = Issues + Target values + Ways of achieving them

But in many cases policy goes no farther than definition of issues because of inadequate study of issues with a view to setting of targets or goals and failure to decide on ways of achieving goals after they have been set. Although the study team explained policy control¹² to the company's top

¹¹ In recent years the term TQC (Total Quality Control) has been changed to TQM (Total Quality Management) in order to harmonize with the international definition. It is a company wide quality control activities. Its activities are not limited to the product quality but quality of the job. ISO 9004 new concept of the quality management introduced this concept. However, the TQM and ISO 9001 have based on the different philosophies. It is in complementary relations.

¹² It is a core concept and method of the Japanese TQM. The company policy, philosophy, goal or vision are in themselves an abstract idea. When these are to be implemented the policy must be broken down to individual target allocated to each business units. In order that, issues to implement the policy, its target value and necessary measures to implement it must be studied. The targets must be reviewed and analyzed by comparing the actual data of the previous year.

management on several occasions, one feels that guidance concerning it can be achieved only to a limited extent in the course of a study such as the present one.

(3) Closing remark by the Company's Vice President, Mr. Sirak

In his talk he mentioned the talk given by JICA Development Specialist Sato in March 1996, which was very favorably received, and said that from it he had learned that Japanese management style is based on democracy, that four important viewpoints for solving problems are ① expression of problems in easily understandable terms, ② "W5, 1H", ③ "5 why's" and ④ no awareness of problems is a problem in itself, that superiors feel gratitude toward their subordinates and make frequent visits to them on the line and that the basic idea is that the company's profit starts from the production lines. He summed up by saying that those ideas have been applied in the improvement activities in question. In this connection it might be added that Mr. Sato held a quality seminar again in August, and that can be considered to be a manifestation of realization of the importance of persistent repetitive guidance concerning basic concepts.

3. 5 Diagnosis of Situation Regarding Plant Management

The study team made diagnoses of the plant on two occasions for the purpose of determining the effect of improvements. In addition, Mielec Engines Co's vice president was asked to make his own diagnosis for comparison with those made by the study team.

As a result it was found that steady progress was being made.

In Japan such plant diagnosis check lists are used to determine the state of management of plants of one's own company and those of other companies cooperating with it so as to serve as information on the basis of which improvements can be made. Table 3.5.1 gives the evaluation results.

Item	Check item No.	Evaluation points (for reference)			Notes
		Study team in 1st study	Study team in 2nd study	ME	
Policy management	12	38.3	40.0	71.7	There are policies but no goals
Quality control	6	56.7	53.7	73.3	Implementation is good, but keeping of records is inadequate
Physical control of parts, etc.	5	48.0	53.3	56.7	Progress has been made
Process control	8	42.5	52.5	82.5	Improvement team activities have had an effect
Equipment management	6	43.3	66.7	73.3	There is hope if greater maintenance efforts are made
Orderliness	6	56.7	66.7	56.7	The efforts made have produced visible results
Overall	43	45.6	52.3	70.0	Steady improvement is being made

Under 50 points:	Not so good
60-69 points:	Not bad
70-79 points:	Good
80 or more points:	Excellent

The study team's rating is lower than that of the Mielec Engines Co. This is a common tendency the study team member experienced in Japan.

It is proposed that such diagnoses continue to be made on a regular basis by the same evaluators so as to be able to use the results in selection of tasks, setting of goals and definition and implementation of means of attaining them.

3.6 Plant Improvement Activities after the 2nd Field Survey

At the third field survey, the study team confirmed that a substantial progress has attained at the production line improvement after the second field survey. This is an indication of the positive and sincere effort of the Company for proposals of the study team. Following findings are obtained from the Company's reports submitted to the study team and from plant audit conducted by team members upon their visit to the Mielec Engines Co.

3.6.1 Cylinder block machining line

- * The plant remains keeping reduction of the inventory on the line by 50%
- * There was no line stop due the parts supply shortage during January and February 1997 on the machining lines.
- * Failure rate of the machinery dropped from 22.1% in December 1996 to 5.8% in 1997. This result exceeds the reduction target of 50%.
- * The regular shut down for periodical maintenance is faithfully practiced.
- * The Preventive Maintenance Committee was organized as Mr Sirak as a chairman, and the monthly meetings are held to promote PM activities.
- * A PM engineer was assigned.
- * Since January production, cost information is available thus it facilitates manufacturing cost reduction.

3.6.2 Engine assembly line

- * The circle team activities.
- * The target of reducing parts supply shortage by 50% was attained. However it is not satisfactory enough to reduce inventory on the assembly line. The number of engines on the line is now increased at the moment. They will be reduced by 50% when the parts supply shortage problem will be completely solved.
- * The board showing the daily status of the parts supply shortage is still working.

3.6.3 SS and other Kaizen activities.

- * All machinery in the machine shop as well as assembly shop have been repainted. Machine numbers are painted so that everyone can identify the machine.
- * 640 PLN cost saving per month is attained by improvement of the crankshaft cleansing.
- * From production of February 1997, cleansing process of crankshaft / con-rod bearing was eliminated by adopting vacuum packed parts.

4 Technology Transfer With Respect to Development of New Diesel Engine

4.1 Characteristics of the Technology Transfer

For technology transfer in the present study emphasis has been placed on technology transfer for support of diesel engine development and particularly on special engine design technology and product hardwares.

In general for consulting services concerning engine development clients enlist the services of some famous European consultant companies, there being the following levels as regards the content of the contract:

- (1) Periodical furnishing of general technological information.
- (2) Furnishing of technological information concerning a particular subject tasks.
- (3) Design review, concerning a particular product design.
- (4) Proposal of design concept and design layout.
- (5) Prototype development: design, prototype construction and testing.

What the study team has done for Mielec Engine is to furnish it with technological information and to carry out design review. The study team undertook such technology transfer centering on specialized design technology in view of the company's needs and its capacity to make good use of it.

Although the company is confronted with many tasks concerning management technology, but the technology transfer that has been undertaken by design review and other methods is limited to technology transfer of management techniques directly related to design work.

4.2 Background and Problems

The conditions and problems that Mielec Engines Co. development department is faced with are as follows:

- (1) Diesel engines are Mielec Engines Co.'s main field of business and will continue to represent the core of its activities.
- (2) The company is faced with competition from major European diesel engine manufacturers.
- (3) Since strict environmental measures are required of diesel engines, an urgent task of the company is development by the turn of the century of a new engine that meets the EURO-3 standards.
- (4) That measure will require advanced technology, many man-hours of work and enormous expenditures on research and testing.

Fig. 4.2.1 compares different diesel engine exhaust gas standards in the world, and Fig. 4.2.2 indicates the measures that will be necessary in order to meet the EURO-3 standards. Since EURO-3 requires further reduction of nitrogen oxides (NO_x), Japanese technology for that is very



A Improved combustion
B EGR
C Improved fuel
D Oxidation catalyst
E DeNOx catalyst

The main graph plots Particulates (g/kWh) on the y-axis (0 to 0.4) against NOx (g/kWh) on the x-axis (2 to 7). A horizontal line at 0.1 g/kWh is labeled 'Possible Euro 3'. A vertical line at 5 g/kWh is labeled 'C&D'. A line labeled 'Euro 2' connects (2, 0.15) to (6.5, 0.05). A line labeled 'Retard' connects (5, 0.1) to (6.5, 0.05). A point on the 'Retard' line is labeled 'B&E'. A point on the 'Euro 2' line is labeled 'Baseline Euro 2'.

The inset graph plots Increase in Cycle BSFC (%) on the y-axis (0 to 15) against NOx (g/kWh) on the x-axis (4 to 8). A line labeled 'Baseline Euro 2' connects (4.5, 10) to (6.5, 0). A line labeled 'B&E' connects (4.5, 10) to (5.5, 0). A point on the 'Baseline Euro 2' line is labeled 'A'.

Based on Figure 2, SAE 932959

Based on Figure 2, SAE 992959

Potential Strategies for Euro 3

- 

- 1) The research and development department has a total staff of 76, but its engine design group accounts for only 12 of them since it has many different other kinds of work, too, besides engine development, including ambulance and generator set development and services.
- 2) During the period of the study team's field everyone in the development group from the department head down was busy dealing.
Because of that the department has had no time whatsoever to devote to the necessary work for acquisition of ISO 9001 certification, which the whole company is working toward.
- 3) At first it had a not very positive attitude toward development of new products and design improvements for raising productivity with respect to present parts because of insufficient development staff strength, budget limitations and a current work overload.
- 4) It does not have a so-called development control group for overall support of design and development work.
- 5) For those reasons and because of its still untackled task of preparations for ISO 9001, it has not been able to do anything yet in the way of improving development efficiency and development techniques and processes.
- 6) In 1995 a part of the design function split off to a newly established marketing department. But engine design has remained in the development department. Most of the engines sold by the company are supplied to a small number of bus manufacturers, and one gets the impression that they would like to keep things as they are presently in order to be able to continue to meet the design specifications required by those clients. But there are many problems concerning their services to clients, and the situation regarding coordination within the company between the development department and the marketing department cannot be said to be very good.

Fig 4-2-3 shows the study team's evaluation of the R&D capability.

To summarize, one can say that the company's development department would like to obtain concrete technical information concerning engine design in Japan for the purpose of accomplishing planning and design of a new engine with its limited staff. Furthermore, one senses their desire to avoid, as far as possible, things like preparation of documents for control work. The study team certainly does not condone such a tendency but must admit that in the past Japan experienced a period much the same as that.

4.3 Reform of Attitudes and Thinking of Mielec Engine's Development Department

The attitude of the company's development department as perceived by the study team at the time of the first field survey can be said to have been conservative and similar to that of craftsmen. Initially

the study team proposed to them (1) improvement of productivity design and (2) a concept for the future engine, but their response was not very positive. Nevertheless the "teardown" that was undertaken at about the same time was a very significant example of technology transfer that enhanced the awareness of the development department regarding product competitiveness and got them more interested in productivity design in cooperation and coordination with the production department.

When the study team visited them again at the time of the second field survey, the team noticed that considerable change had already taken place. For one thing, during the team's absence changes were made in company organization, and personnel changes also took place. Furthermore, a part of the design changes proposed at the time of the first field survey had already been implemented and was reflected on the production lines. The study team was also asked to give its opinion concerning further possible organizational changes. And the biggest change of all in the development department was an about-face in their posture regarding future engine development to an attitude of active promotion thereof.

But the problems of closer cooperation with the marketing and production departments and yet unstarted work for ISO 9001 certification still remain unsolved. That being the case, we emphatically proposed establishment of a development support group.

Moreover, with improvement regarding such problems in mind, in the seminar the study team undertook technology transfer concerning the quality function deployment as an originally planned part of its technology transfer and felt consider positive response to it.

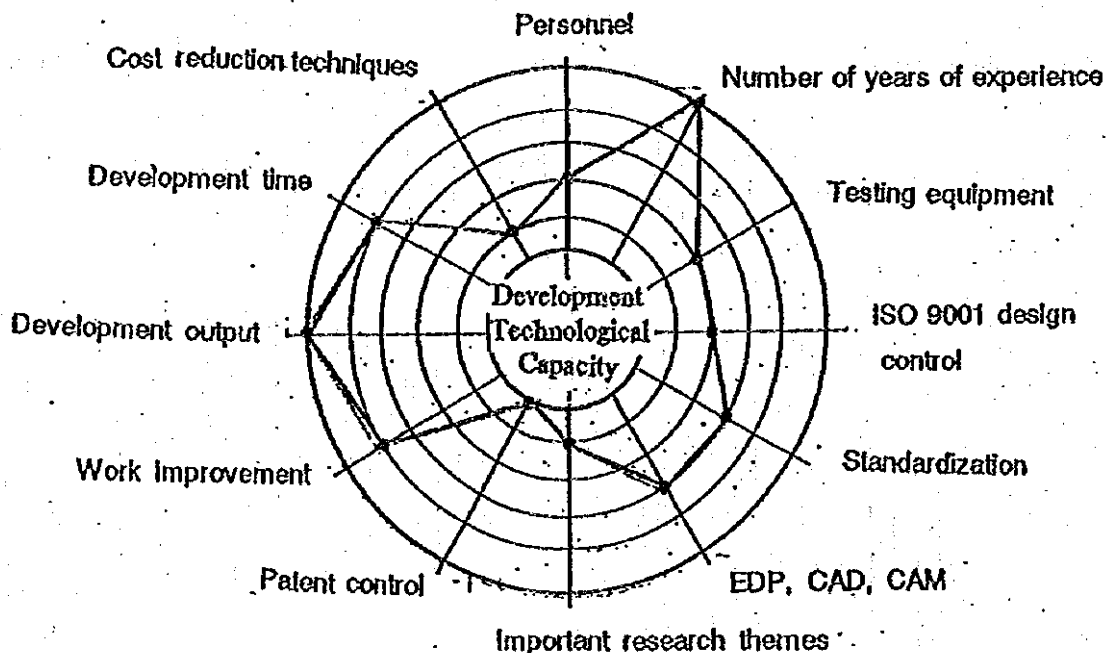


Fig. 4-3-1 Development Technological Capacity

4.4 Description of Technology Transfer (1): Special Technology

Most of the technology transfer regarding special technology was accomplished in the form of design review, and three seminars were also held. Table 4.4.1 indicates the data, design standards, testing standards, reference literature and seminar materials involved in the technology transfer. Such information represents a summary of the latest technological literature in Japan and abroad and includes information from technical documents of Japanese diesel engine manufacturers and technical materials prepared for Japanese foreign technical assistance. Such information concerns mainly technology for meeting future exhaust gas standards and design of the latest 10-liter-class diesel engines of the representative Japanese diesel engine manufacturers as Isuzu, Komatsu and Hino, and other information collected in Poland was also included at the request of Mielec Engines Co..

		↓ Number of sheet	
	Item		Note
1	Recent diesel engine emission control technology	60	Seminar material
2	Recent Japanese diesel engine technology	20	Ditto
3	Common rail fuel injection system for engines	60	
4	Diesel engine for automobile	32	
5	Reduction starter	2	
6	Dry cylinder liner installation	12	
7	No machining of the front plate	3	
8	Tightening method of the cylinder head	7	
9	Improvement of the crankshaft rear seal	6	
10	Thermal fit of the ring gear	9	
11	Con-rod and crankshaft design	10	
12	Design improvement of camshaft thrust bearing	5	
13	Taper-fit design of crankshaft	6	
14	Improvement of engine starting aid system	4	
15	4-valve cylinder head	5	
16	VB case study	2	

Table 4-4-1

4. 4. 1 Teardown

The first application of the teardown method was improvement of current products. By arrangement of the company's production department chief, who is actively interested in rationalization of product design, the study team undertook teardown of a Cummins 19-liter engine (model KT1150) at the Stalowa plant, which is engaged in construction machinery sales and services, for comparison with Mielec Engines's parts and thereby were able to identify 13 items of necessary improvements in terms of production design and reliability. That was followed by a meeting for consideration of such improvements, which was attended by people at the company in charge of development and production. The reaction of the development department was not very positive. But the company president later intervened, and the situation took a turn for the better, the final conclusion being 2 items already implemented, 6 items in the testing stage or with design changes scheduled and 5 items to be reflected in the next model.

Secondary, the study team recommended to utilize the teardown method for new engines development. Later there were reports in the press of intention on the part of the firm DAF of the Netherlands and the Czech firm Liaz Engine to start production in Poland, which had the effect of heightening the sense of crisis on the part of Mielec Engines management. At that time a comparative study was made between the DAF engine and Mielec Engine's engine in terms of production design on the basis of a parts list of the DAF engine. Since that DAF engine was the same model as the Mielec Engines Co. introduced from Leyland, there was a possibility of a cooperative tie-up between DAF and Mielec Engines Co. in the past.

As already mentioned, such teardown can be considered to have contributed to change in the attitude of the Company's development department.

Furthermore, teardown of the Labaman engine owned by Mielec Engines Co. is also being considered.

4. 4. 2 Design Review

(1) Improvement of Production Design

In the second field survey, the team undertook design review regarding the above-mentioned 13 items with a view to proceeding to specific design changes. Such design review was also carried out concerning design measures for improvement of engine B10 life¹

(2) Concept of Future Engine

¹ The life of a product in operation when failure rate reaches 10%. In case of the B10 life of 1 million km for the heavy duty diesel engines, the engine is operated in highway drive of almost same speed and load. The life is the overhaul km.

As a result of engine seminars and other discussions the team was able to obtain a consensus on the part of the company's top management and its development department concerning a new engine with 4 valves ² and cross-flow ports, ³ and the same thing was decided on separately by the restructuring committee.

CYLINDER HEAD
2 VALVE: ONE SIDE FLOW 4 VALVE: CROSS FLOW

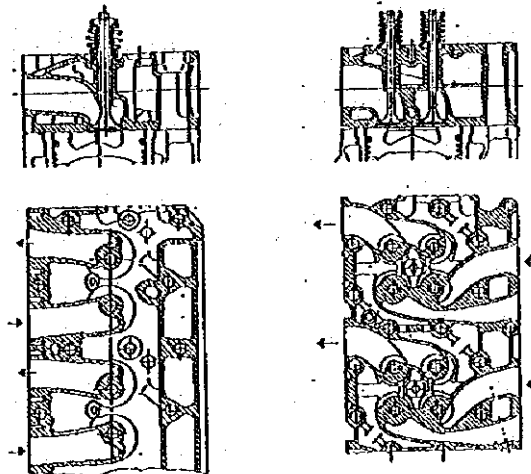


Fig. 4-4-1 4-valve structure.

The main things studied were trends concerning competitor engines, measures relating to EURO-3 exhaust gas standards, engine body improvement, development schedule, development cost and estimated plant and equipment expenditures.

After such preliminary design review Professor Zabrocki Professor Sglachta of the Krakow Institute of Technology were invited to the company in order to provide guidance in final consideration of the matter, and they were also requested to undertake a part of the cooperative development efforts.

² Diesel engines with 4 valve for each cylinders is the state-of-the-arts. It improves combustion and volumetric efficiency for induction system. There are other advantages like variable controlling of valves.

Heavy duty diesel engines with the 4 valve cylinder head is the state-of-the-arts, even smaller engines have this design. It improve combustion due to the best fuel injector location and increases volumetric efficiency. There are other advantages as variable control functions.

³ Inlet air comes in one side the cylinder head and exhaust gas goes out from the other side of the cylinder head. Since the flow is through flow, thus total combustion efficiency is higher than one-sided flow configuration.

4.4.3 Seminars

Since the technical information prepared by the study team matched Mielec Engine's needs, the team were repeatedly asked by them to hold seminars concerning it and therefore the team responded by holding three such seminars.

(1) 1st Diesel Engine Seminar, September 19, 1996

This seminar was held a full day with four invited professors, including Prof. Zabrocki of the Krakow Institute of Technology and Prof. Lejda of the Rzeszow Institute of Technology, both of whom have been providing technical support to the company, in the presence of the company president and other top management figures of Mielec Engine. Prof. Zabrocki is one of the most eminent figures in the academic field of engine technology in Poland, and the president and other top management figures of Mielec Engine as well as Prof. Lejda represent the generation below him that has benefited from his guidance.

The seminar themes were:

- (a) Exhaust gas countermeasures (video produced by Isuzu Motors).
- (b) The recent situation concerning technology for dealing with exhaust gas.
- (c) The situation regarding representative Japanese large diesel engines.
- (d) Polish exhaust gas control standards (presented by the Company).
- (e) The situation regarding research on diesel engines in Poland (Prof. Zabrocki and Prof. Lejda).
- (f) Discussion

The seminar was a success. In particular, presentation of the situation in Japan regarding exhaust gas countermeasures and details on the design of Isuzu, Komatsu and Hino cylinder heads with cross flow and four valves as being characteristic of the latest Japanese engine design was recognized as being useful in design of a new engine for meeting EURO-3 standards.

Furthermore, the other side expressed the wish to hold an engine seminar at the Krakow Institute of Technology at the time of the second part of the study and to undertake design review with drawings laid out in front of them. That was a clear sign that there would be improvement of (1) productivity design and (2) the future engine concept.

(2) 2nd Diesel Engine Seminar, Nov. 29, 1996

The 2nd seminar was held at the Krakow Institute of Technology with participation of its teaching staff and researchers. That was because the study team recognizes the importance of the fact that that institute will be providing Mielec Engines Co. guidance in its new engine development as a joint effort between industry and the academic world. The institute has one of Poland's three diesel particulate matter (PM) measuring devices, the dilution tunnel⁴. It is also the place where state certification testing takes place. The same institute also provided development support twenty years ago for the 2.4-liter diesel engine that Andoria is now producing, a strategic engine that has contributed to Andoria's business success.

(3) Quality Function Deployment (QFD)⁵, Dec. 5, 1996

The study team had planned to accomplish technology transfer concerning the Quality Function Deployment on an OJT basis for the purpose of achieving closer cooperation and coordination of the company's development department with the production department as improvement of the development department's way of doing things, but as a suitable opportunity did not present itself, the study team had to be satisfied with just a mini seminar at which actual cases in Japan were presented. Still, in spite of the limited time, quite a positive reaction was obtained.

4.4.4 Guidance With Respect to Casting Technology

The biggest obstructive factor in the company's engine production is cylinder block and cylinder head castings and the machining technology for them. The defect rate of those casted parts is sometimes as high as 30%, and that represents a big loss to the company. Anywhere the rate of defects in castings varies according to engine size, and in Japan the rate is about 3-5% for large engines and normally only 1% or less for small engines.

In the diesel engine business, it is often said in Japan that a company with a good situation regarding castings will win out in diesel engine competition. That being the case, in Japan engine manufacturers make their own castings and have accumulated specialized casting technology within the company. The Company, however, depends on the nearby Rzeszow casting company for its supply of castings. In Europe the general practice is for engine manufacturers to place outside orders for their main castings, but Mercedes-Benz and Poland's Andoria produce their own castings. In

⁴ There are two types depending on the test requirement, the full dilution tunnel and the mini tunnel. The full tunnel is big and expensive. The dilution tunnel measures diesel engine PM contained in exhaust gas.

⁵ The method was originated and developed in Japan. It is widely utilized internationally. The QFD method transform customers needs(voice) to firm's product requirements, then design requirements, design specifications until the final product manufacturing requirements.

Andoria's case, the defect rate is only 1% for its castings for small diesel engines, its main production item.

In the heyday of the Mielec Engines Co.'s plant 60% of the Rzeszow casting plant's production went to Mielec Engines Co. but that figure has now slumped to 12%, and as a result there is a rather poor situation now regarding technical cooperation between the two. Since the Company's design department is without (1) casting parts design know-how and (2) know-how concerning machining methods that take internal stress distortion of the castings into account, it presently has no idea how to resolve the problem once and for all. That situation is the study team's biggest headache, too. At the time of the first field survey the study team visited that casting plant along with top officials of Mielec Engine Co. to study the situation there and was able to identify the problems but was not able to suggest how to start going about solving them. Subsequently, however, the study team were able to accomplish technology transfer and present proposals as described below for resolving the problem on the basis of further consideration of the matter, including a study of the situation regarding castings at Japanese engine manufacturers:

(a) Cylinder Block and Cylinder Head Production Technology

At the time of the first study in Japan the study team visited the casting and machining plants of major diesel engine manufacturers for the purpose of finding possible ways of making improvements for solving the problem.

A particularly big problem is deformation of the parts after machining as a result of internal stress distortion at the time of machining. That is due to considerable differences in casting wall thickness in the cylinder block, and therefore machining sequence is an important factor in preventing deformation.

We subsequently undertook technology transfer regarding such know-how, and the present stage is that of consideration of the effect that such technology transfer has had.

b) Request for Cooperation of Major German Casting Manufacturer

Friz Winter (FW), the biggest casting manufacturer in Germany and one of the largest in the world, supplies castings to major engine manufacturers throughout the world, including Japanese and the U.S. companies. It boasts high productivity and low cost, superior quality and a high design technology level. It also appreciates the strategic importance of the neighboring Polish market. In the belief that technology cooperation with it could contribute to solving the Company's problem concerning castings, the study team has suggested to the latter that it contacts it concerning the matter, and the team is told that they are now in the process of doing so. Estimates show that supply from FW will mean higher procurement cost, but the overall effect can be expected to be advantageous considering a much lower casting defect rate than at present. Other possible alternatives include modernization of

the Rzeszow casting plant with or without the help of FW.

4.5 Description of Technology Transfer (2): Management Technology

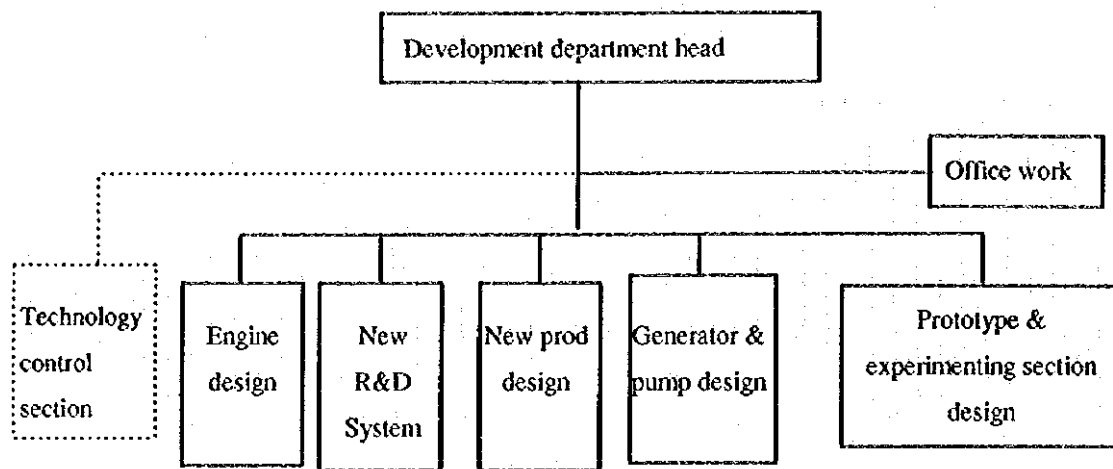
The study team had at first intended to make proposals concerning rationalization of development techniques on the basis mainly of ISO 9001 acquisition of certification concerning which the Company is presently working for, but in view of the fact that the company's development department had not yet made any progress at all concerning ISO 9001 it instead started out by proposing ways of promoting ISO 9001 efforts by the development department.

The company was in the process of studying possible organizational changes for coping with ISO 9001 to be implemented in January 1997 and the study team was asked to comment on the contemplated changes. The above-mentioned proposals were in response to that as well.

The company's ISO 9001 efforts are seven months behind the original schedule, applying for certification and submittal of quality manuals now being rescheduled for May 1997. The company as a whole has completed preparation of 25 of the total of 50 documents that it has to prepare for ISO 9001 purposes, but its development department, which is responsible for preparing 4 of them, including one on the company's "design control" system and one on design review, has not even started preparing them. As pointed out by the company's secretariat for promotion of ISO efforts, the development department tends to make light of the process of quality control, attaching importance only to product quality results, but that connection it should be remembered that the situation in Japanese companies around 1960, when TQC was first introduced, was exactly the same.

The study team's proposal is that a control group be set up under the development department head to provide necessary support to that department and promote the concurrent engineering⁶, collaborative work with production people since its inception of the new product development. The province of the proposed new group would be promotion of ISO 9001 efforts, budget and personnel control, control and preparation of different standards and specifications, patent control, etc., and it would carry out only control for the sake of promotion of the work, leaving the work itself to the different sections as at present (see Fig. 4.5.1). A very small group consisting of a manager with experience in development work and a couple of people under him would suffice.

⁶ It is a collaborative and inter relational activities of joint product engineering and manufacturing engineering people for the new product development. The design review and tear down are its typical methodologies. As an example sharing one room or organizing a team are good solutions.



To be newly
established

Fig. 4-5-1: Research and Development System

5 Formulation of a Restructuring Plan

5.1 Summary of Company's Operation

5.1.1 Principal Management Indicators of Mielec Engines Co.

(1) Comparison with the mean values of the small and medium enterprises of Japan

As shown in Fig. 5-1-1, the per capita sales, production value added and mechanical equipment ratio indicative of productivity is remarkably low amounting to about. 1/10 of Japan.

Profitability, ratio of net worth to total capital, etc. on the other hand are normal, and in this sense the management can be said to be retaining soundness and stability.

The lowness of productivity of the enterprise is based on the negative heritage at the time of dissolution of the parent company and its division. Namely:

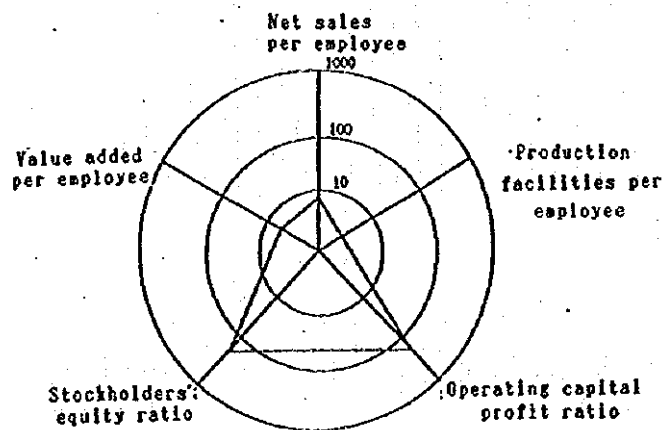
- 1) It lost the large market of Eastern countries with the collapse of COMECON.
- 2) It succeeded production facilities having a capacity 10 times as much as the present production.
- 3) The special circumstances of the Mielec area do not allow it to reduce its personnel.
So that it can join the EU and shift to a market economy, it is necessary to ultimately raise its productivity up to that of Japanese small and medium enterprises, and the study team has made the doubling of production a restructuring target for the time being.
- 4) Comparison with other Polish enterprises

Fig. 5-1-2 and 5-1-3 compare the principal management indicators of Zasada group enterprises that have placed under their control many of the Polish automobile conveyance manufacturers with those of the enterprise, but Mielec Engines Co., as shown in the figures, does not compare unfavourably with them at all in the respect of per capita sales and profitability.

Jelcz and Autosan appearing in this figure are leading assembly manufacturers of buses and trucks having 3,200 and 2,700 employees respectively and both are principal users of Mielec engines.

The above can be summarised as follows:

- (1) The study team assessed that Mielec Engines Co. has to focus on raising productivity in the restructuring process. Should reducing the personnel is not allowed the Company has to double its sales.
- (2) The Company is sound in that it lays emphasis on profitability and safety, but lacks such a positive attitude as attempting its growth by resorting to borrowings.
- (3) As observed in the Zasada group also, the above tendency seems to be a characteristic of Polish enterprises. The tendency to seek the support of strategic investors such as Zasada group is also common to many enterprises.



Note: Unit of indicators,
100 as average values of Japanese small and medium enterprises

Fig. 5-1-1: Principal managerial indicators of Mielec Engines Co.

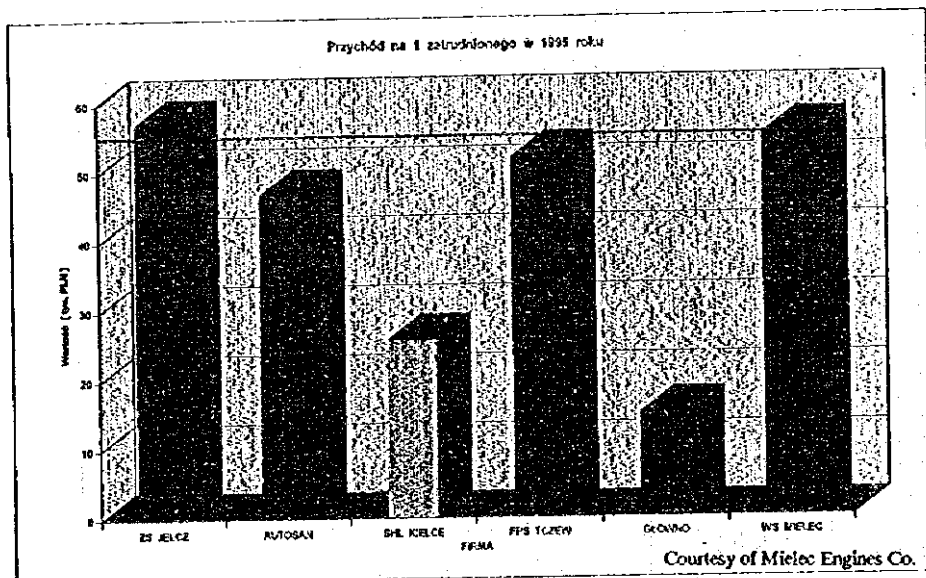


Fig. 5-1-2 Sales per one employee

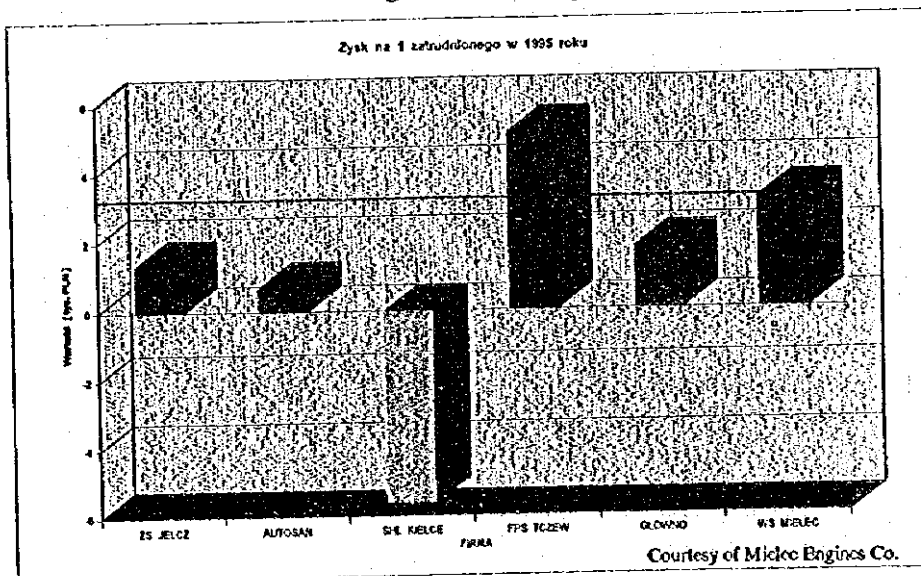


Fig. 5-1-3 Profit per one employee

5. 1. 2 Features and problems of Mielec Engines Co.

The study team pointed out as the result of the study following special features of the Company different from Japanese companies. It is assumed that these features are common to other Polish state-owned companies.

(1) Personnel management

Wage and personnel management is based on the job categories. Since movement by employees from one category to another is generally difficult not even considering special job type qualification requirements such as welder work safety regulations, personnel flexibility is extremely low.

(2) Wage system and management

Each person's wage or salary is determined on the basis of a wage table with a breakdown by the job categories and job positions.

There is no big difference between Japan and Poland as regard as difference in remuneration between a department head and general employees as far as basic wage or salary according to job position goes. It is estimated that basic pay is about 62% of total pay.

Looking at pay as the basis for employer contributions by enterprise unit, one sees that, as in the case of the Company, an amount equivalent to "55" is charged and paid into the national treasury as social security contributions ("48" out of the "55")

Of the total amount of pay not including social security contributions, etc., the part that can be managed, i.e. that can be decided at the discretion of the section or other chief is 30%. They do have the power to exercise considerable authority.

(3) Suggestion system

Suggestion applications are in principle made by the employees in the particular work area, and the bonuses for ideas concerning particular work, activities and mental labor are in most cases granted on the basis of evaluation by their superiors. Such suggestions are not treated together with proposals in activities for raising of productivity and quality control activities. It would appear that the background for that is reaction against the movement for increase of production and material and other savings under the Communist regime in the past.

In those days the results of efficiency improvement activities by workers were converted to money according to provisions stipulated by law, the amount of savings of materials, etc. being paid in bonuses. Savings were recognised with respect to materials, time and number of man-hours, and everyone was eager to make suggestions, with the result that quality and product reliability declined. What is more, there were many cases in which the goals attainment of which the suggestions were supposed to ensure were not attained. Considering that historical background, it would appear to be necessary to implement improvement activity in a manner based on proper planning.

(4) Accounting management

The Company also has many accounting problems. In particular, in cost accounting, estimated cost (let us call it "standard cost") is still being determined by the same method as under the old regime. On the other hand, regarding actual cost, it is difficult to make a comparison in a way in which it

corresponds to such standard cost.

In the Company's accounting system (which is based on the Polish accounting system) the treatment is different than the Japanese method, the two methods not strictly coinciding. However, in order to proceed with the analysis, it is necessary to make a few comments concerning definitions of account headings for comparison and concerning differences. Appendix A12 compares the calculation of Profit/Loss Statement(P/L) and Balance Sheet (BS).

P/L: The Company's accounting system is one that lumps manufacturing cost and overhead together in sales cost without considering overhead apart, but there is no difference between the two methods as regards calculation of operating profit. However, in calculation of profit/loss from disposal of fixed assets the operating activity profit based on the Polish method and the ordinary profit based on the Japanese method do not coincide. It might be added that in the present situation calculation of manufacturing cost may not be impossible in terms of practical handling, but nevertheless it is difficult.

BS: In the order of arrangement, the order of asset liquidity is opposite, and in the case of liabilities and net worth in Poland, net worth comes first, followed by long-term liabilities and then short-term liabilities.

Below are indicated some accounting treatment methods of the Company (Poland) that should be borne in mind in connection with some important items proceeding with analysis of the company:

- ① Regarding depreciation, residual book value is put at zero, and straight-line method is used.
- ② Treatment of inventories is based on the "first in, first out" (FIFO) method.
- ③ Revaluation is assets in accomplished on the basis of rules stipulated by law. Change in capital due to revaluation is indicated in the item "net worth".
- ④ Corporate tax is 40% of profit before taxes.
- ⑤ It is not customary to use promissory notes for settlement of accounts receivable and payment accounts. Usually settlement is made in cash by way of bank accounts about two weeks after delivery of merchandise or provision of services.

5.2 Status of Restructuring of Mielec Engines Co. till now

Restructuring of Mielec Engines Co. dates back to the time when the parent company Mielec Traffic Conveyance Manufacturing Co. (WSK-PZL-Mielec) was dissolved in April, 1993 and the present enterprise was born through company division.

Such a document as restructuring program does not exist. What is now available with the company are annual programs only. The case is not that they had no vision nor plans but that these are borne in the minds of managing people only. This will be described later.

- (1) Born of a plant of the parent company through division, the enterprise had to construct functions of an independent company. Namely, personnel, finance, development, purchasing, marketing, etc.
- (2) The pressing need was to shift from the paradigm of planned economy to that of market economy. The present president who had a passion in the latter half of his forties for progressive thoughts and reform started restructuring activities, studying domestic model enterprises advanced in terms of privatisation, etc. half a year prior to the division already and has continued with the efforts till today.

Matters that have been implemented meantime are as follows:

(1) Personnel reduction

The workforce was cut from 1,091 to 713 men at the time of division, but because of the special circumstances of the Mielec area also, no reduction has been made at all since. Although the company recognises that they have an excess personnel of 20% and are dealing with this situation by partially shifting workplaces by education, but there is a limit to this approach. The company is keeping good labor-management relations, but is paying a close attention to them.

(2) Consultation

Consultation by Americans was performed in 1992, but no outcome was seen. In 1995, they sent 3 managing executives to Sweden and had them study management techniques and know-haws for dealing with the market economy. These three men are now contributing to enterprise management as reform promoting advisors to the president.

(3) Organisation

In connection with the above mentioned training, Swedish consultants were invited to form the present company organisation. This organisation can adapt quickly to new circumstances and is highly estimated by the study team. The Company appreciates the JICA consultation the most beneficial

(4) They are propelling preparations for the acquisition of ISO 9001 approval as principal state-owned enterprises do. This is based on a direct business need of winning the confidence on the part of customers and the leadership toward suppliers, considering the possible admission to EU on one hand, and on the need of strengthening the quality education to employees and the quality management to executives and managers on the other.

(5) Development of the Euro-3 engines, principal products of the Company, was effected in cooperation with the Krakow University and by the use of national fund KBN. It was acquired in November, 1996, but was marked as the first Polish domestic engine.

Furthermore, as a foundation in strengthening the future products, ambulance cars and small-sided generator sets which are end-user products were added to the product line. These are the products under a plan of having all the components purchased from the outside for assembling within the company so that added value can be produced through marketing and selling. Outcomes have been so far attained small volume, but this can be appreciated from the angle of strengthening the

product quality and product line as seen in a long-range view. In 1996, the newly developed ambulance car won an award for the best product from the Rzeszow prefecture.

(6) **Cost control**

It is said that a computer system is being constructed with March 1997 as a goal and the per product cost can then be obtained. Breaking down of the budget control by operating units is also being studied. This will be a start of the profit centres.

The above is the status of restructuring which Mielec Engines Co. is stepping up for itself, but they consider the restructuring process as proposed by the study team important by positioning it at the second stage.

- (7) In September 1995, the president of the Company manifested the "Philosophy and Policies for Quality Management" for employees. (Exhibit 5-3-1 in the next page) This can meet the management responsibility prescribed in the quality system requirements of ISO 9001. The study team appreciates this policy as a basic concept of the new restructuring plan.

5.3 Restructuring Plan as Proposed by the Study Team

5.3.1 Managerial problems of the company

In working up the restructuring plan the study team took up the following three items as problems.

Problem 1: The company has no mid- and long-term plans

Problem 2: The company is not performing the policy control embracing the entire staff

Problem 3: The design of engine is old and can not meet the future market competition

Actions taken to these:

Problem 1: The company set up a restructuring committee and has proposed a restructuring plan of its own after repeating discussions with the study team.

Problem 2: The policy for the entire company as shown in the Exhibit 5-2-1 was at first supposed to be allocated to each department, but things did not advance so far. The restructuring program submitted by the company specifies however that it will be executed by itself.

Problem 3: The company has decided in the new restructuring plan on developing a new engine Euro-3-compatible, 4-valve and cross-flow-headed.

Philosophy and Policies for Quality Management for Mielec Engines Co.

Corporate Philosophy: "The Company will provide products and services which may satisfy the customer, aiming to improve the quality and productivity in the prospect of 21st century. The Company will be sure to success if it provides good products and services which satisfy the customer."

Policies and urgent issues the Company face for implementing the Quality Management include:

- to increase in taking orders for the Company to develop itself to be competitive continually in the future.

For achieving the goals, the Corporate Management encourages employees, individually and also in groups:

- to solve problems by reducing defects and promoting the improvement of quality and production processes, by arranging incentives in a way the efforts by individuals may link to the growth of the Company and consequently to the increase of compensation for those who participate.
- to respond to customer needs and provide new products, recognizing that the customer buys only the products and services they want.
- to improve the function, reliability and durability of the company's products, placing the importance on preservation on natural environment in the process of product development.
- to cooperate with the suppliers to be the permanent member of the Company who would supply quality parts and components for the Company in the future.
- to manage to achieve targeted quality goals in the course of production processes.
- to confirm that the end-users of the company's products are to be ensured with a long-term service after they purchase.
- to establish a quality standards and its management system, PN/EN — 29001(ISO-9001) in the Company.
- to make an effort to improve products to meet the requirement for preserving natural environment after the company's products would have been used.

In Mielec

Jan Studnicki
President

5.3.2 Outline of restructuring plan

Since the Company has been exposed to the threat of competitors of boring neigh country to enter in Polish market, strengthening of the product competitiveness is an urgent issue.

In order to develop a new engine to meet future stringent environmental requirements, and to satisfy customer's needs of higher power and less fuel consumption, company has to acquire a great deal of money. However the financial condition of the Company is noted that its cash flow has become considerably smaller.

The Company has to answer following questions.

- ① Can the Company afford invest R&D cost and facilities?
- ② Can the investment money be paid back?
- ③ What strategy the Company has to implement the development program..

Under these circumstances, three scenarios were studied according to the business planning simulation. Despite the scenario-1 is most aggressive, the Company could be not survive if it takes other ones. The following is major items of the Scenario 1. (Fig. 5-3-1)

(1) Vision 2001 for the Company

The company will survive as a "major player" of the Central European diesel engine market having a sufficient competitive power in the market economy.

- (2) Doubles its sales by 2001. Builds up generator sets and applied vehicles steadily as end-user products, such as ambulance cars, though it will naturally focus on diesel engines, the core product of the company.
- (3) Attains a financial structure that can earn an annual turnover of 20,000 PLN (new zloty).
- (4) Develops a world-level engine that can meet the European diesel engine exhaust gas control Euro-3 expected to be effective from 1999.(Fig.4-2-1)
- (5) Invests about 28,500,000 PLN for the research cost, and plant and equipment investments.
- (6) The study team estimated the effectiveness of investments through several methods and made sure that they have no problem in the Scenario 1.
- (7) The company covers the investments with net profits. Loans will be repaid by 2001.
- (8) Will become a stabilised enterprise from 2001.
- (9) Will keep the existing workforce unchanged.
- (10) This program presupposes that Mielec Engines Co. attains the goal independently and by itself.

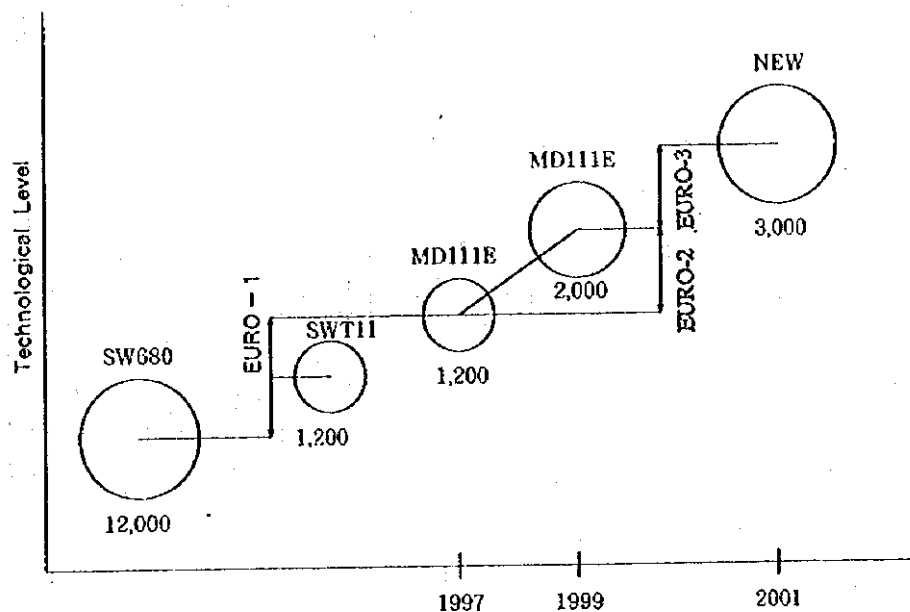


Fig. 5-3-1: Restructuring Target for Diesel Engines

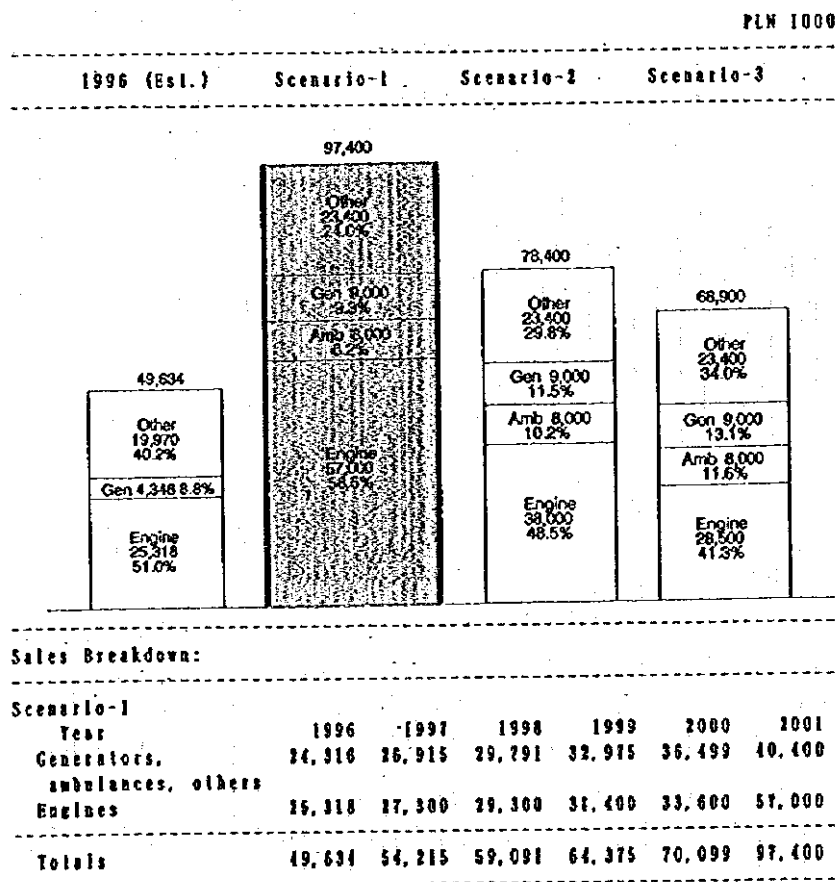


Fig. 5-3-2: Simulation: Scenario in 2001

5.3.3 Prerequisite for the achievement of the plan

In order to achieve this plan the following requirements must be met .

- (1) The cost of purchased materials and in-house expenses are reduced by 5% annually.
- (2) The Company will enter the Mielec special economic zone in near future and enjoys the following tax system favours.

- ① It receives the exemption of fixed asset tax.
- ② Against an investment of more than 20,000 PLN after entry into the zone, it receives the exemption of income tax for 10 years and that of half the income tax for the following 10 years.

Scenario 1 includes fulfilment of this condition. The entry into the zone brings with it a condition and this requires that the company maintains a 15% increase of its sales for 6 months than in the preceding year. A large scale business talk is under way and attainment of the goal is expected.

The above mentioned favours are important and the resultant funds can be allotted for the purpose of repaying the loan interests etc.

- (3) Attaining the goal of doubling sales
 - ① The Company enhances the confidence of customers
 - ② Opens up a new market and creates a new business.
 - ③ Expands exports and attains an export ratio of more than 20% (at present 2% against 20% in the past).
- (4) Developing world-level engines with efficient development (with the least time, cost and investment)

In order that:

- ① The development must be proceeded based on the well established procedures. A very general concept is shown in the ISO 9001 manual.(Fig. 5-3-3)
- ② The Company has to invest necessary resources, namely human, technology, R&D cost and facility.

It must be noted that the Euro-3 goal is too stringent for the Company, therefore, the very drastic reinforcement to the engineering department of the Company is inevitable.

- (5) Continuous improving efforts and aims at elevating productivity.
Continuous with maintaining activities.
- (6) Early acquiring of the ISO 9001 approval
 - ① Establishment of a quality system affecting the entire staff and practising the policy control into.
 - ② Establishment of a developing process and strengthening the tie between the marketing and factory departments.
 - ③ Improvement of the confidence of customers and customer service.
 - ④ Attainment of leadership toward suppliers.

Legend: FBL = Functional Baseline
 DBL = Development Baseline
 PBL = Production Baseline
 SRR = System Requirements Review
 SDR = System Design Review
 DDR = Detail Design Review
 FCA = Functional Configuration Audit
 PCA = Physical Configuration Audit

CI = Configuration Item
 CM = Configuration Management

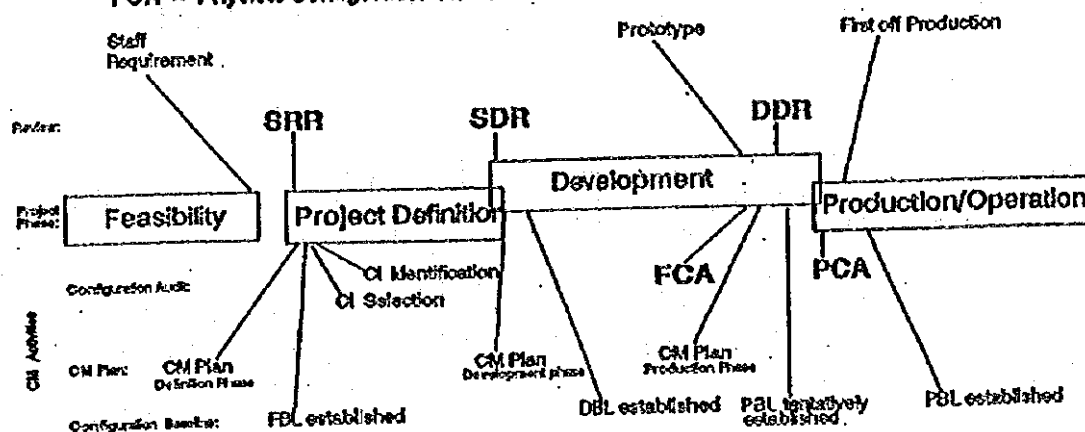


Fig. 5-3-3: Project Phases - CM Activities

5.3.4 Characteristics of the approach in the present restructuring plan

A conceptual diagram for preparing the restructuring plan is shown in Fig. 5-3-41 at the next page.

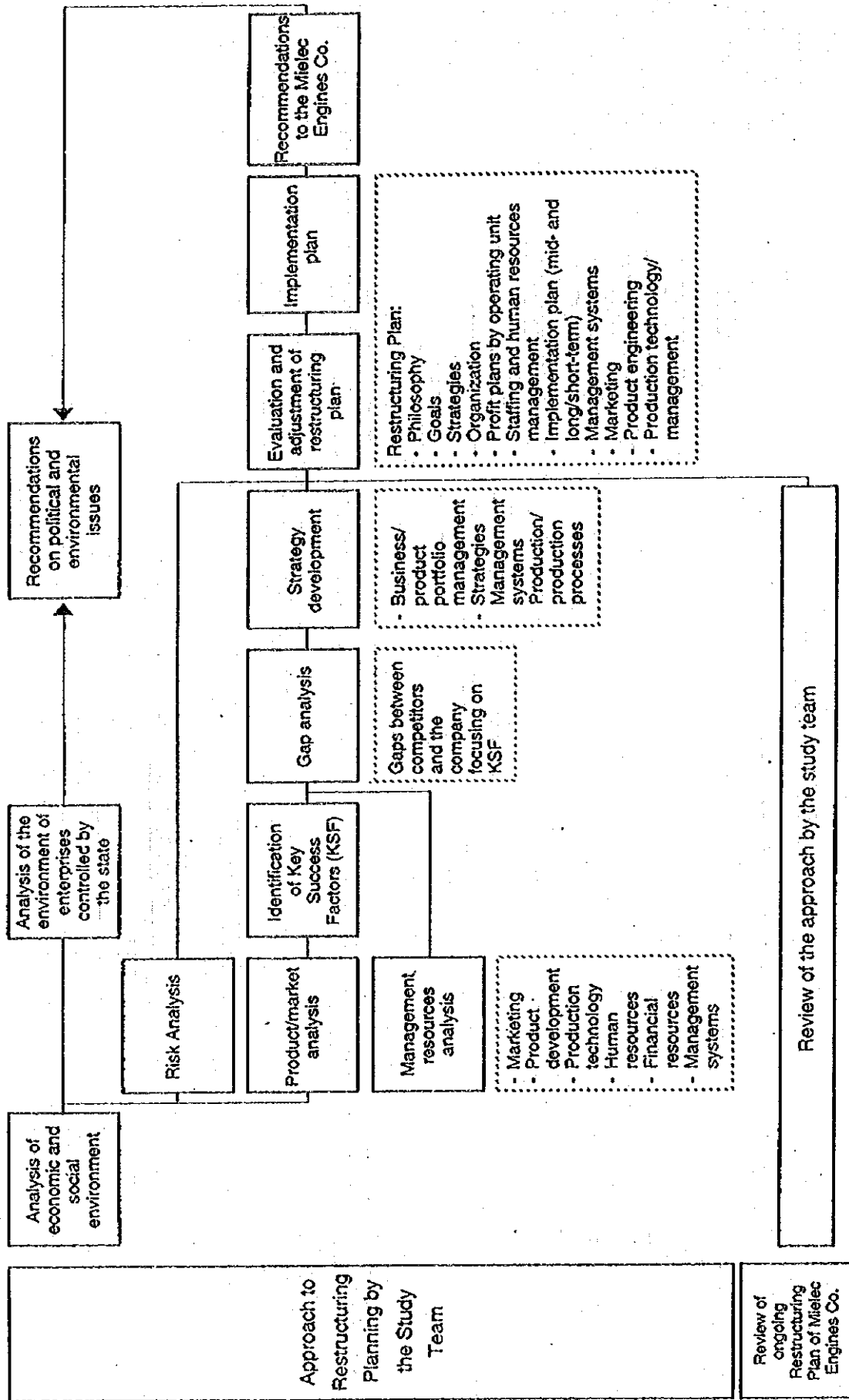
The method has a special feature in employing the "key success factor" (KFS). With KFSs the possibility of winning competition in the market economy is studied by analyzing the external environmental factors surrounding the Company and the market competitiveness of its products in terms of the Company's capability.

The action plans for implementing KFSs is completed by allocating the corporate resources based on the portfolio analysis and setting departmental goals.

The KSF is a characteristic to be required of the individual products in their proper markets.

As these methods require data as one sees from the side of markets, they may take time, but have a merit of taking things market-oriented.

Fig. 5-3-4 CONCEPTUAL DIAGRAM OF THE RESTRUCTURING PLAN OF THE ENTERPRISES CONTROLLED BY THE STATE



5.3.5 Circumstances for propelling the restructuring plan

Reasons for not having framed a mid- and long-term plan were explained by Mielec Engines Co. as follows, but this is supposed to be helpful in understanding the way of state-owned enterprises in general toward management.

(1) The company cited the following points as reasons for not having a mid- and long-term plan.

- 1) Laws, tax systems, etc. are frequently changed without notice in Poland and they have trouble trying to adapt themselves. So they have to reconsider the plan every time.

Introduction of the value added tax is an example.

Cash settlement was prohibited by an instruction of the Ministry of Finance on January. 1, 1994 to make settlement between enterprises in cash impossible and they were forced to make it with checks or through banks. This directly affects the payments to workers and may be likened to paying the state a tip. The state intends to control the wages to workers. They had trouble adapting themselves for more than half a year. The law to privately-operated enterprises changed and it is a year since we were exempted from paying the tip to the state. The state-operated enterprises however had no interest in profits and were not changing salaries by the type of industry.

2) Inflation policy

The inflation rate exceeded 20% every year and it is estimated to be 17% this year also. In order to check the inflation rate, the ceiling of salary was determined in the beginning of the year at the tripartite meeting among management, labor and government representatives. The growth rate of salary for the whole year 1996 was set at 21.8%.

This method is applied to state-operated enterprises only, but this can be said to be an example of characteristic of the transitional economy.

3) Management conference and decision-making organ

Between the board of directors and stockholder's committee is a joint enterprise management committee composed of stock-holder and union representatives, etc. vested with a decision-making authority. For example, the president proposed allotting the dividend to stockholders to an investment for new products, but this was not approved.

To deal with above mentioned problems the following managerial control is being made (Fig. 5-3-4).

- (1) Plans are made out every year. Plans for the coming year are made out comparing the plans and results of the preceding year.

Sales target and wages are controlled using the inflation rate as yardstick.

- (2) Taking it a point of enterprise management to promptly cope with the changes of the outer environment without being confused, 3 Scenarios have been made always ready.

In addition to the above, it looks as if there is a lingering allergic tendency from the long accustomed planned economy.

(2) Activities of the restructuring committee

Restructuring committee meeting was held three times at the second field on-site survey, but estimation of the enterprise then was as follows.

(1) Proposal of Mielec Engines on its own

* It enter will the special economic zone and will shape up financial plans positively utilizing its favours.

This possibility has arisen on the prospect that a large scale business talk will be closed to increase the company sales of this year by 15%, thereby satisfying the qualifying condition for its admission.

* A profit centre will be set up from the next year which will allot a budget to each department.

* Efforts for elevating the confidence of customers have been shown, such as considering the introduction of sales expansion activities in cooperation with bus manufacturing companies.

(2) Weak point

* The company has no concrete know-how in drawing up a mid- and long-term plan. It has no business plan, organizational activities for the development of new products, and process.

As a result, it can not for example make out any estimate of the investment necessary for Scenario

1. The study team therefore was forced to perform the trial calculation.

5. 3. 6 Implementation of the restructuring plan: Shaping up into an action plan.

This plan equals to a short-time restructuring plan.

Fig. 5-3-5 of the next page shows the total picture of restructuring plan being propelled.

The study team made proposals up to the stage 5. Development of Restructuring Strategies this time, but did not go so far as to summarise the activities made separately by the product design and production control departments regarding the part of 6. Goal by Functional Area of Management. Mielec Engines in particular considered a plan of making demand estimates in cooperation with the study team, but as the other party was not in a position to act correspondingly, they became impossible at the stage of secondary domestic work. Accordingly, this will be executed by Mielec Engines Co. itself hereafter along with the framing of the plan as per 7. Development of Implementation Plan.

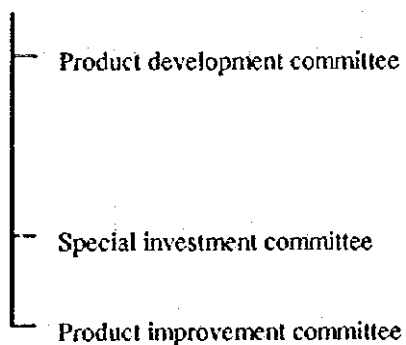
5.3.7 Preparation of rules of managerial techniques

The company has not come to possess a managerial technique yet. A quality control rule has been prepared as a documentary version (Fig. 5-3-6, see the next page).

To frame a medium and long-term plan it is necessary to prepare the following system and its rules.

The following is an example being practised in Japan.

(1) Development committee



President presides, the mid- and long-term strategies are reviewed and framed

Development manager presides, propriety of development of individual new products is reviewed and each stage of development is estimated

Various investments are estimated with expertise and their propriety is judged

Design change-related matters are reviewed and propriety is judged

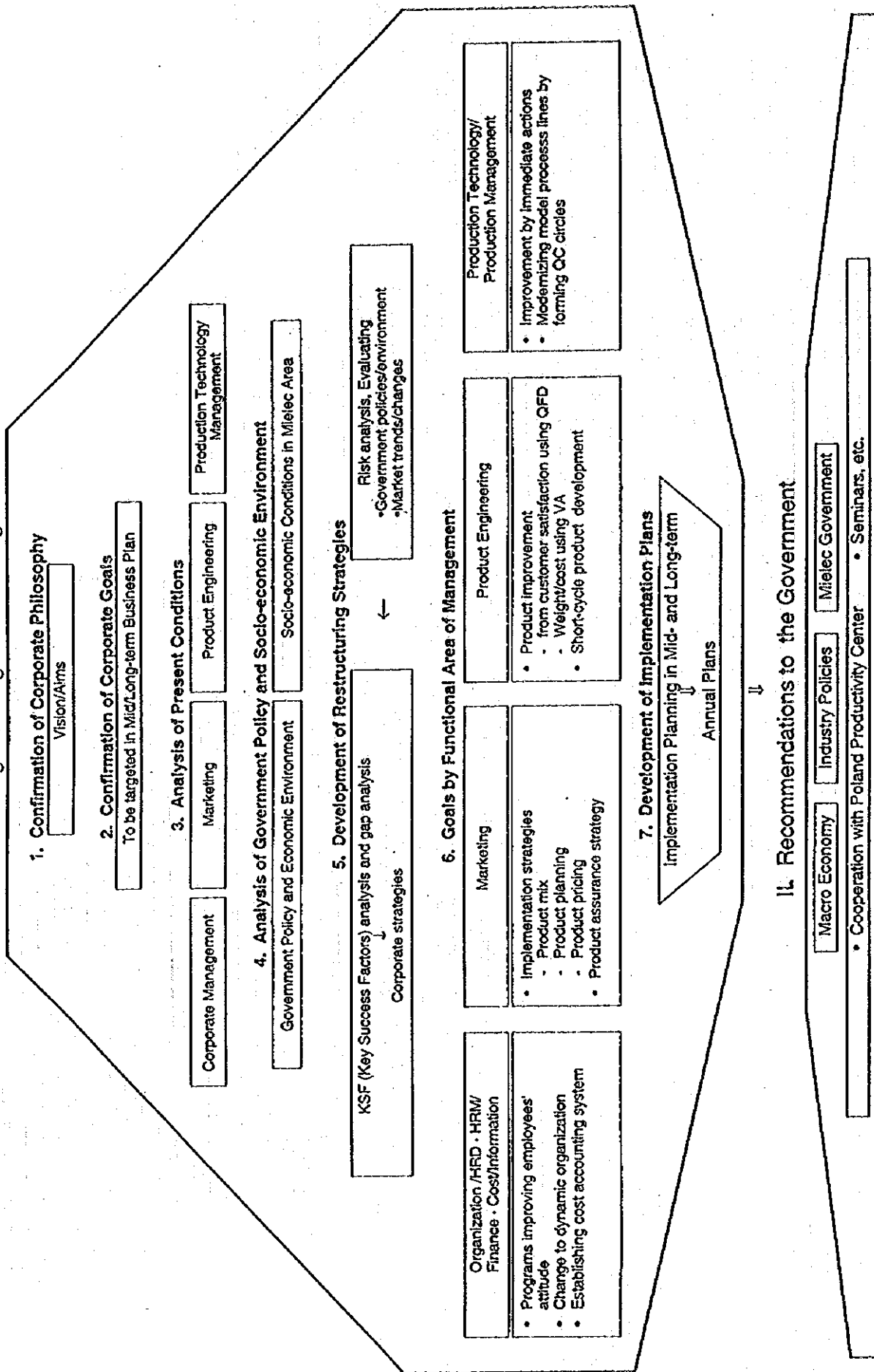
(2) Quality guarantee conference

Settlement of important quality problems is reviewed so as to reduce claim costs

The above committees are composed each of representative committeemen of respective departments and the rules specify more clearly their respective responsibility, way of carrying forward the job within the competence.

Fig. 5-3-5 OVERALL PICTURE OF A STUDY ON RESTRUCTURING PLAN OF ENTERPRISES CONTROLLED BY THE STATE OF POLAND

I. Restructuring Planning of Mielec Engines Co.



5.4 A New Restructuring Plan with Mielec Engines Co.

The third restructuring propulsion meeting was held in the second field survey, in which the restructuring proposal was reviewed and an active discussion carried out. Mielec Engines Co. shaped a program based on Scenario 1, a positive management plan, into a document and presented it to the third committee meeting of Dec. 7, 1996. The basic target is to double the sales in 2001 as proposed by the study team. This program is of the following details:

Other sources of income: When the approval of ISO 9001 is acquired in 1997, production of spare parts and new automobile components at competitive special prices will start.

(1) Doubling revenue increase by 2001

The target sales volume of diesel engines and generator sets until 2001 are studied. The validity of the target is under investigation by means of the market research and the sales demands estimation.

(2) Conditions for a success

(1) Approval of this plan by stockholders, etc.

A definite policy will be made available to the board of directors of Mielec Engines Co.

(2) Elevation of staff consciousness to a higher possessiveness toward restructuring and product development

* Effective organization

* Necessity for lowering in-house expenses

* Winning of ISO 9001

* Continuous improvement of restructuring process

(3) Increase of selling chances in the new markets

(4) Lowering of per cent defective in products by 75%

(5) Lowering of per cent defective in purchased parts by 75%

(6) Reduction of stock by 30%

(7) Lowering of equipment failure rate by 30%

(8) 3~7% reduction of expenses and substantially 3~7% reduction in the ratio of general expenses to total annual income

(9) Maintenance of selling prices, and absolute conditions

The development cost of MD111E Euro-3 engine (R&D, trial manufacturing, tests, measuring instruments, equipment tooling, etc.) is estimated at 25,000,000–30,000,000 PLN at the 1996 price level.

Financing is a challenge. Its object will be KBN and strategic investors.

5. GRAFICZNY SCHEMAT POSTĘPOWANIA.

5.1. Struktura organizacyjna Systemu Zapewnienia Jakości.

品質管理システム組織図

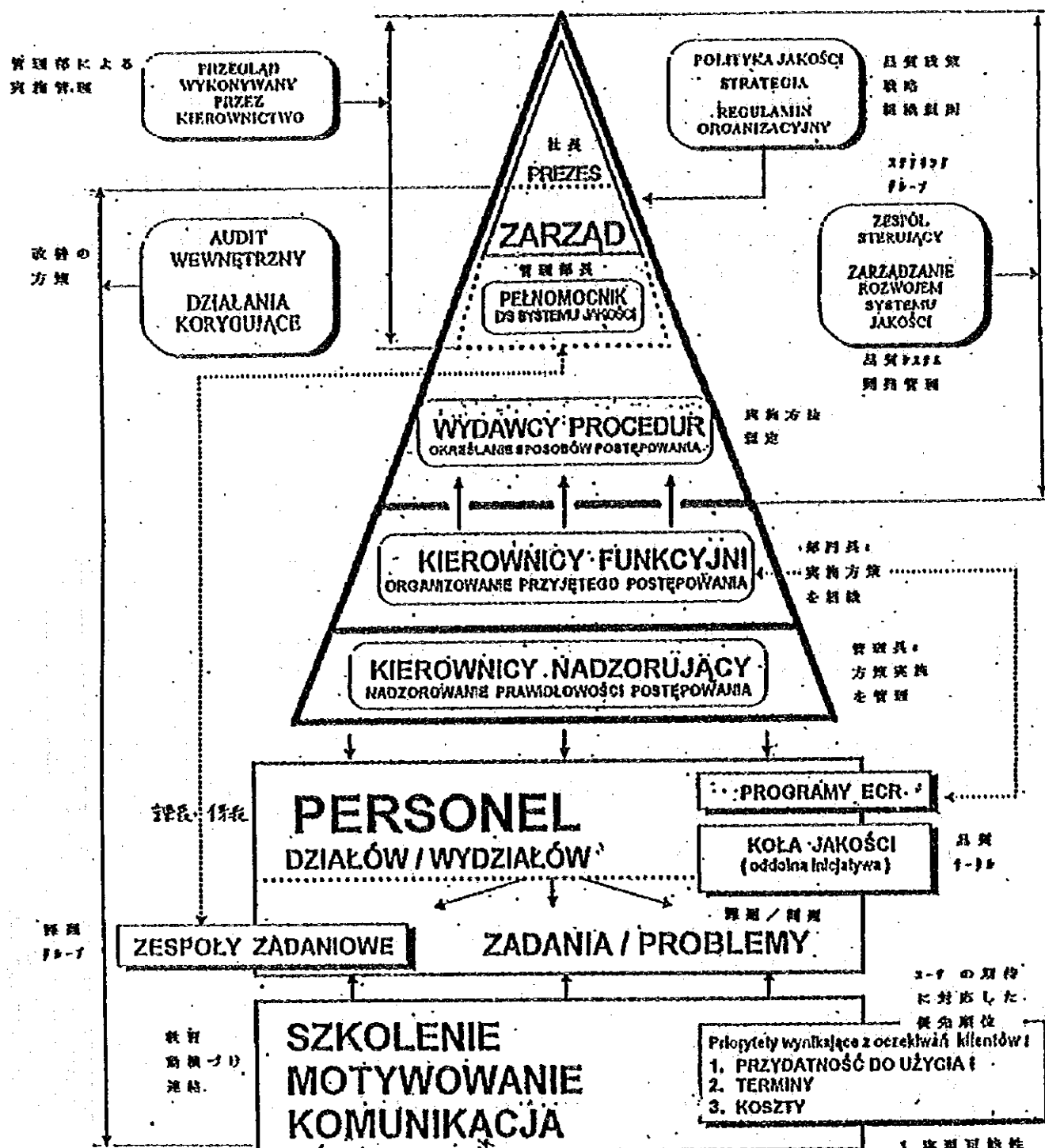


Fig. 5-4-1 ISO 9001 Quality Management

System Organization Chart

Mielec Engines Co.

Should this item not have been attained by the first quarter of 1997, normal performance of the company itself would be more problematical, leading to inability to cover the expenses for performing even a sales level of minimum 1,000 units of engines in 1998.

5.5 Restructuring Status of State-Owned Enterprises in Poland and Hungary

In order to verify the validity of the restructuring plan it had proposed to Mielec Engines, the study team visited the related enterprises and inspected the restructuring situation at each firm. Among the Polish and Hungarian automobile and spare parts manufacturers for which the results of the above survey are introduced below are state-owned enterprises, and it has discovered many instances that would offer a guide to Mielec Engines.

(1) Andoria

Andoria received in 1965 a technology transfer on diesel engines from the British Leyland as Mielec Engines Co. did. Andoria introduced a medium-sized model 400 of 8-liter as against the large-sized model SW 680 of 11-liter which Mielec Engines Co. introduced, but the paths which the two companies followed afterward contrasted with each other.

What is worthy of note is that while Mielec Engines Co. continued with the introduced engine till recently, Andoria originally developed 4-cylinder and 1-cylinder engines on the basis of the original 6-cylinder engine.

The 2.4-liter diesel engine in particular developed entirely on its own 3 to 4 years ago offered a decisive factor in expanding the enterprise. This is a world-level engine which has adopted a Ricard-type sub-combustion chamber under the guidance of Krakow Institute of Technology and includes an overhead cam and a rubber timing belt. Considering its design that dates back to 20 years ago, we can gather how this enterprise possesses a progress-oriented structure.

Comparison with Mielec Engines is given in the following Table 5-1-1.

Table 5-1-1

	Andoria	Mielec Engines
Basic line of engines	4	1
Appl. target of ISO 9001	1997-1	1997-6
In-house production of large castings	○ (% defec.:1%)	X(% defec.:20-30%)
Export ratio	23%	2%
Vehicle assembly	Van type, car body imported, own engine mounted	Ambulance assembled, most parts imported

At Andoria, the experience of having borne the most difficult time at the beginning of 1990 and developed a new engine saved the company. They have newly employed about 700 workers in 1996 as in 1995.

2) Star S.A.

As this company manufactured medium-sized trucks and was making military vehicles such as all-wheel drive trucks, its output had reached the 30,000 level, but it sharply fell after the reform and amounted only to the 1,600 level in 1993. This situation resembles that of Mielec Engines Co. closely. Star S.A. however succeeded in doubling its output in 1996 to 3,200 units. According to the Industrial Development Agency, that concerned itself with the restructuring process of this company, this is a model company in Poland that succeeded in restructuring with self-helping efforts, and this is why this company was chosen for inspection. In particular, the pattern of the fall of output and succeeding recovery closely resembles the restructuring process as proposed by the study team, and this was extremely interesting.

Factors which were implemented by the company and which are supposed to have led to the restructuring success are as follows.

1) They have a precise grasp of the market and have hired a consultant for this.

They estimate that the future demand will come to the 4,000 level and further reach the 5,000 level.

2) Construction of an overall purchasing function

- Purchase-logistic center

Inaugurated in February, 1996. They visited sub-contractors and surveyed the outer environment affecting the manufacture.

Estimate the quality, method of payment, delivery time and prices and decide on the scale of orders.

Place plural parts orders. Transact with about 300 firms for components or about 700 firms including materials.

- Joint purchasing

They purchase frame steel plates jointly with Star/Autosan and purchase pressing plates jointly with 4 firms including Jeicz etc.

Inter-trade cooperation too is on the increase as in Japan in negotiating on prices etc.

- Export center

They send responsible specialists by country. These take charge of negotiating on prices under a rationalization goal against economic fluctuations of 3% on parts in general and 2% on auxiliary materials.

- Increase of outsourcing

They lower the conventional insuring ratio of 90% to 60%. It has now reached 70%.

3) Jelcz

The largest bus and truck maker in Poland. As in other makers, its product demand fell to a few tenths by the reform.

A series of restructuring programs is as follows, at the initial stage

- Reduction of operating costs
- Modernisation of products
- Elevation of quality
- Setting up of a marketing department for the sales expansion
- Effective management of funds
- Reform of the organisation. Division of functions not directly related with production.

Filtration plant, transport, meal providing with a boiler, hotel management

- Regulation of the land and buildings, 23% reduction of the total site and 14% reduction of buildings

Leased land was used for 43,000m² of the site.

- Reduction of employment by 54% to 3,192 persons, currently employing, from the present number of 3,200 men
- Coming into contact with customers and organizing a marketing function for meeting their needs
- The Continuous improvement of products

4) IMAG (Ikarus Component Parts Mfg Ltd.)

This is an affiliated auto-parts maker with the internationally well-known Hungarian bus manufacturing co. Ikarus Ltd. having 13,000 employees and is manufacturing passenger car seats (60%), seat belts (25~30%), and door and plastic parts. What is destined for the Hungarian local plant of Suzuki Automobile of Japan accounts for the majority amounting to 60%.

Although the parent company Ikarus fell into a structural depression after the collapse of Soviet Union and its recovery is still doubted, the company is doing very well and this will offer a useful information for the restructuring of state-owned Polish enterprises.

Restructuring status

The time the organisation was altered: 1992

Increase in the performance: Compared with that in 1992, 6.5 times in 1996 and 20 times in 2000, and after this, 5% increase every year till 2005.

Factors for success:

1. The company set mid- and long-term targets
 - It will be the No. 1 seat maker in Central Europe.
 - Will attain sales of 15 billion, which matches those of German counterparts. 20 billion in

2005.

- Will maintain the present number of employees

2. Profit centre

- Will set up 7 implementation departments
- Will eliminate waste

3. Implementation of improvement activities

- Attained the ISO 9001 approval in June, 1995
- Will continue with improvement activities for reducing inventories