

CHAPTER 4 RAILWAY TRANSPORT PLAN

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4.1 Introduction

According to the economic framework, the study period is divided into three phases to focus attention upon the time frame for the changes that the Growth Period requires. The titles given to each period is to give direction to the changes that have to be made during the period:

- (a) Transition Period: 1993 - 1995
- (b) Consolidation Period: 1996 - 2000
- (c) Growth Period: 2001 - 2005

To develop a direction to the study it became apparent that the railway sector provided significant differences to other sectors.

The function of the railway is to transport passengers and cargo. To do this the railways own a very large amount of infrastructure and real estate, and also have a very high capital investment in rolling stock and associated facilities. These factors make the size of the changes larger than can be easily rectified because of the scattered nature of operations, railway lines penetrating almost over the whole country, and the large numbers of staff employed on the system.

However in the case of the railway sector, which has characteristics not found in the other sectors. The transition and consolidation period would see growth in new business but an increasing decay in non-competitive businesses, as the size of the organization would not respond within a short transition period. It is not intended that the study would restrict growth only until after the turn of the century. Studies and data collection would be on-going throughout the seven year period (1993 - 2000), the changes being implemented will in effect start turning the financial position of the railways around before the start of the growth period. It is acknowledged that to rigidly put activities into the constraint of the three time periods, the first two periods had to be amalgamated and re-described to give a more practical time frame for the changes.

Accordingly the new scenarios for railways are:

- Re-structuring Period : 1993 - 2000
- Growth Period : 2001 - 2005

The Government wishes to join the European Community and therefore there must be harmony between PKP practice and UIC recommended practice. The objective of the Study is to establish a philosophy that is necessary to implement changes that are found to be required in performing this function in a market economy and to recommend the necessary programmes and priorities to be implemented in the Short Term, the Medium Term and the Long term.

There are three levels of control over the railway, the Ministry level which establishes the political direction, the traditional enterprise Management level which establishes policy, and thirdly Operations which implements the policy. This study takes the two principle features of the railway organization, management and operations and examines the present situation and the restrictions that handicap the present organization. From these, the study discusses remedies for the re-structuring of the organization and promotes solutions that would assist in making the organization meet

the challenges of a free market. Where the need for hardware to change from the present operations to the new requirements is seen, the basic systems are identified. To assist in supporting the discussions, statistics and other relevant facts have been assembled into a separate section of Data following Section 4.6.

4.2 Major Issues in the Railway Transport Sector

4.2.1 Legacy from the Old Regime

The Railway Organization is large, and reflects a succession from the old regime in terms of railway network, employees and affiliated enterprises. As the successor it has inherited an old organizational structure that has a bureaucratic foundation capable of following the directions and instructions of a centrally directed command economy.

In this top down hierarchy the requirements of the users of the transport system are not adequately understood or almost neglected and a monopoly situation has existed where alternative means of transport were not made available.

The new situation arising in the country today has opened up transportation to competing operations which are changing the needs of the transport sector and the PKP must respond to these new conditions, competition with road transport in particular. It is therefore necessary that consideration is given to streamlining the railway network, concentrating on those transport modes where PKP has the right expertise, closing down lines of limited transport demand and reducing the number of employees by early retirement schemes and the reducing new recruitment. These conditions are a prerequisite for PKP to survive the contestable transport market prior to planning any new large investments.

These actions alone will not provide the required result. The present Railway Administration needs to be re-furnished to make the operations more flexible in a market economy as well as reducing state subsidies to PKP under a more tight fiscal conditions that are now arising.

4.2.2 Impact of the Market Based Economy

Since the introduction of the economic transformation programme in January 1990, PKP appears to have initiated some limited actions for market orientation, and though various discussions and studies have been made no particular modernization has yet been realized. PKP has now to take the necessary step to find out the customers demands, and to evaluate the competitiveness with other transport services.

To use phrases such as "equal footing", "separation of infrastructure and operation" and "environmental protection" from the view point of the railway is to call for protection from the real effects of the market. In order for the railway to be competitive it must provide a facility which is attractive to users in terms of convenience, speed, and price. It follows logically that where this attraction cannot be achieved, then PKP should not be in that business.

The rail sector has advantages in some types of traffic over those of competing sectors. These traffic advantages should be made into the core business for PKP, and these advantages should be marketed vigorously to attract users. But marketing is not enough by itself, weaknesses in performance have to be identified and the effects mitigated or eliminated, and strengths identified and reinforced by new technologies and practices. Only by eliminating weakness and promoting the strengths of the services offered by PKP can the effect of the market economy be used to full advantage.

4.2.3 Coping with Financial Difficulties

The present accounting system of PKP does not give enough information for the actions to be taken by management, excluding total balance of income and expenditure. The PKP management must have access to a management financial system that permits managers to take informed decisions on both immediate and also long term issues. The accounting system needs revision to take into account the recommendations proposed by various studies including the UIC standards.

However, the present processes are not adaptable without re-training staff to the new system. It is therefore a consequence that prior to any introduction of a new accounting system it is necessary to teach general accounting principles in a market economy to the financial and general managers. This has to parallel training in the rules and practices to the office accountants and trainees.

Financial self-reliance can also be assisted by the utilization of PKP's real assets. Whilst the present law does not allow PKP to dispose of real estate, the law does permit PKP to lease premises to other enterprises, to take share holdings in ventures, and to establish Joint Ventures with other enterprises on railway property and for the convenience of passengers. In this regard Central Regional Office of the PKP in Warsaw (DOKP) has signed four agreements with foreign enterprises to establish joint ventures for a department store near Warsaw Central Station, hotel and business centre near the railway museum, and similar enterprises. Warsaw DOKP is also negotiating for the establishment of ten other ventures in the Warsaw area. The potential for real estate development is large as PKP owns 41 hectares in Warsaw that is suitable for related business developments.

Railway stations have superior advantages over location, passenger stations generally have easy access and are places where many people gather. These advantages create many possibilities to operate various railway related businesses which will make suitable opportunities for the re-deployment of redundant labour. Such railway support activities would allow PKP to operate as profit centres leases on such diverse operations as shops, catering, advertising, accommodation, car rentals, travel agencies, coin lockers, public telephones, etc. Freight stations would make good centres for leasing space and buildings to road haulage firms, as product distribution centres and other activities that require space.

In addition to the above non-transport businesses, there will be some other services including: catering and kiosk services for railway passengers, travel agency and road transport services for general public, and feeder cargo transport services.

Combination of these non-transport services differs from station to station, depending on the potential quantity and quality of market demand of each station. Special attention should be given to the fact that revenue from real estate shows a substantial fluctuation due to the possible trade cycle.

The size of the potential market for PKP can be taken from the 1989 results of East Japan Railway which earned 10 trillion zloty from non-railway activities, or 7% of its annual revenue.

4.2.4 Limitations on Management and Operations

The railway authority is not the master of its own shop. Due to being considered a public service supplier, the authority of the railway management is severely curtailed. As an example, railway passenger fares are severely controlled by the government including discounted fares, also PKP is not permitted to stop train operations except in an emergency.

The Polish State Railways State Enterprise Act (Dz. U. No. 26 posn, 138), promulgated in 1989, stipulates PKP activities and responsibilities. However, the law does not stipulate the following points clearly which are important in regards to organizational autonomy.

- (a) legal position of PKP;
- (b) compensation for public service; and,
- (c) maintenance of unprofitable lines.

Furthermore, PKP is not authorized to determine fare levels, to abandon unprofitable lines, to discontinue public services such as those for national defence and for disasters.

Clearly, PKP is not independent enough to function as a commercial enterprise in a free-market environment. About 50% of construction and maintenance costs is subsidized by the state under the name of "subject related subsidy". Losses of the enterprise are subsidized under the name of "activity related subsidy". These approaches are quite different from the spirit and intent of EC agreements and/or regulations. The business activities of PKP are regulated by Government in various ways including, terms of entry to new business, tariff setting and exit from unprofitable business. These restrictions need to be eased to ensure more flexibility for PKP to compete in a free market. New business will be required to attract more customers to rail transport by offering more convenient services, passenger fares need to be revised for recouping costs, and exit from unprofitable lines will be required for the saving of capital to be invested in more profitable segments.

PKP must be given more economic autonomy to compete in the market economy. Whilst supervision should remain with the Government until further into the growth period, regulations will continue to exist for public services, so that to achieve the freedom necessary clear demarcated responsibility needs to be established to allow PKP's organization to compete with its commercial rivals. It should, however, be noted that in all countries the railways are regulated by Government and whilst this may not be a major issue, the regulations must promote the opportunity for PKP to be competitive in the transport market.

4.2.5 International Traffic and EC Railway Systems

Poland plans to become a member country of the European Community hopefully by the end of the century. This implies that a deadline is now determined by when PKP must have completed its restructuring to the extent that they are compatible with EC requirements.

PKP operates several cross-border services to the West (Germany), South (CSFR), East (CIS), North (Scandinavian ferries) and the North East (Baltic Countries). These crossings involve three considerations;

- (a) passport/visa inspection;
- (b) customs clearance; and
- (c) facility problems.

Border control on passenger trains are, with exception of the eastern border, conducted while the train is moving and thus causes a minimum of delay. Customs procedures for cargo trains are gradually easing at all borders except the eastern border,

nevertheless, delays of up to a day are not uncommon. Future status at the eastern border is unknown, but it is expected that EC shipments will soon follow the lead of EC nations in that customs procedures are being moved from border stations to inland container depots.

Locomotives are currently changed at border crossings due to international agreements (although, within EC countries, this will soon be eliminated) and differences in power supply. PKP is currently studying whether outlays for dual-voltage locomotives, which are considerably more expensive than standard models, are justified. A future difficulty exists at the eastern border in that wheel sets of some passenger cars must be changed due to the wider ex-USSR gauge. Facilities for changing wheels exist at Terespol, Sakolka and Medyka, although much of the equipment is in need of replacement.

Higher speeds (160 to 250 km/h) and higher axle loads (from 20 to 22.5 tons) are being introduced in Europe which will require upgrading of the Polish network. In addition Poland is a signatory to the AGC agreement; the first priority (the E-20 corridor) is currently being studied by a German consultant and recommendations as to required improvements are expected by later 1992.

The upgrading of infrastructure, details of which are contained in another section, can be achieved; however, at this point several administrative and managerial differences exist vis-a-vis EC standards. The EC has issued numerous documents which address the need of establishing an effective and competitive international railway network. To achieve this goal, the EC mandates compatible accounting systems and uniform transport statistics among member countries. Council Decision 75/357/EEC is specifically concerned with compatibility between accounting systems and annual accounts of all railway undertakings, who are obliged to record: expenditure and revenue relating to the operation of transport service and to each of all other activities; revenue of passenger transport should be separated by origin such as by rail, road or other means; and revenue of goods transport should be separated by origin such as full trains or wagons, packages or parcels and road. The type and style of uniform transport statistics is stipulated by Council Directive 80/1177/EEC.

The direction for future management and institutional action is therefore clear. Initially, the Polish State Railways Act of 1989 needs to be modified or replaced by legislation which, in fact, makes PKP an independently managed entity. Thus, PKP will be able to determine its own business plan, organizational structure, employment policies and fiduciary plans. Further it will be able determine tariff structures, and if management so chooses, discontinue services on unprofitable lines. An initial decision-point will be whether PKP chooses to separate its operations and infrastructure sectors, and whether it, or a separate corporation, manages the infrastructure. A critical requisite for this transformation is modification of the existing accounting system.

The new PKP must cope with severe competition not only from other modes, but European railway systems as well. Its managers must have access to accurate and timely fiscal information in order to execute corporate decisions. Therefore an accounting system compatible with EC requirements must be introduced at the earliest opportunity. Adoption of the EC transport statistics system is also recommended. Thus, information from EC railway enterprises, coupled with data from the uniform accounting system, would offer valuable data against which to compare PKP performance.

4.3 Railway Management

4.3.1 Railway Administration

1) Railway Administration by MTME

The railway has to operate in a market economy, even if it remains as a state owned enterprise. It is one of the transport entities which must compete with competitors to expand their businesses activities by offering better services involving the least costs to user and supplier. This function is where the Ministry of Transport and Maritime Economy (MTME) becomes involved.

The railway is an important economic tool that is considered to be indispensable to the national economy and to the citizens of Poland. Although as a principle, the market economy expects such functions from the railway as a public tool, these can be realized through equal competition, there are some exceptions. For example in many countries in the free economy, suburban transport, from the commercial stand point of the railways is not profitable because of high costs due to the great fluctuation of the demand between peak and off-peak hours and the relatively short travel distances. For this service the railways have to either take subsidies or to hive off the services to other owners and operators. The existing railway administration system needs to be strengthened in the MTME by establishing a railway unit which covers every aspect of railway administration. There are a variety of issues to be addressed in the railway sector in terms of coping with expected increase of PKP deficits, preparing for market integration with the EC, and securing public transport services under a free market principle. These issues are unlikely to be solved by an ad-hoc team comprising staff from functionally divided departments.

As a consequence MTME needs to establish criteria from which PKP receives the necessary guidance by defining the basis for equal competition between transport systems and by defining the policy to achieve that competition. MTME has to provide policy by addressing the deficiencies in the Polish State Railway Act, and for these policy decisions to become part of PKP's management activities. However, in order to reduce the Government's commitment in the railway activities MTME must define PKP's authority on:

- (a) define policy for elimination of government subsidy
- (b) basis for fares and tariffs
- (c) procedures to be followed to close lines
- (d) procedures for the railway to receive service from ex-railway activities
- (e) real estate income

2) Future relationship of PKP with the State

There is a growing trend, reinforced by the EC directives, that the railway infrastructure is maintained by the public sector while the operations are carried out by the private sector. At the moment it seems that it is too early to discuss this matter in Poland because railway costing principles are still unclear. Evaluation of assets has a critical importance in this regard. This issue needs to be studied in a long term perspective by taking account of the possible contribution to the efficiency improvements in both sectors as well as the integration with the EC railway systems programmed in the future.

The function of the State in transportation is to ensure that there is equal opportunity for each transport mode to operate in a competitive manner. For the railway this means that it has to meet EC requirements, and the legislation controlling the railways has to reflect this requirement. It will be necessary for the government to put into legislation how this will be achieved.

There are currently three models to choose from, the UK model of sector services, the Japanese model of regional activities, and the Swedish model of a split between infrastructure and operations. This is a subject that has to be closely studied and a Polish solution found that satisfies the conditions that reflects the Polish will.

4.3.2 PKP Management

1) Adaptation to Market Economy

Under the old regime, it was the responsibility of PKP to carry cargoes and passengers in accordance with the target planned by the Government with less attention paid to efficiency improvement. Under the new regime, however, changes in management and operations are considered crucial for an organization to survive in a free market.

Reaction to change, "we've always done it this way" syndrome, has to be considered closely. The development of a process or procedure used for a long time is always based on certain criteria, and, with due respect, was usually well determined and has proved to be usable and effective. However, with time the underlying principles used may change and this brings into doubt the validity of the existing process or procedure. The establishment of a new procedure is based on examination of the underlying conditions, each being closely examined under certain and differing circumstances. Each segment is examined in turn, modified as needed to meet criteria established by other segments and from which the whole system amalgamates the differing requirements of each segment. This is the "Systems Approach" and each segment is a sub-system.

Operations - the application of management's policy - has to follow certain procedures and processes, established and organized by management for a certain way of obtaining the required result. The Government has ordered certain changes to be made to the underlying political approach to running the railways. This represents a philosophical change that must be reflected in the way that the railway carries out its function. In order that the train operations, and the methods used to operate trains, have to be changed then the management organization needs to be changed. The railway has to develop a philosophic approach to change.

- (a) What the final form of PKP is to be is not discussed in this study, but the final result will be a change that will be substantially different from the present system. The change in the "system" i.e. management can be achieved by dividing the existing organization into its several business units (sub-systems) which are independent in terms of products, market, and management strategy, for example passengers and cargoes; International, Inter-city and Local; Regional Territories; Infrastructure; and Operations. The logical conclusion for this study has been shown in other railway organizations for management to be smaller and flexible, for layers of bureaucracy to be reduced. The conclusion that would appear to be necessary is that the PKP organization needs to be reformed through the introduction of a decentralized decision-taking system with a concise headquarters' functions. This requires both Institutional and Organizational change.

- (b) Cost accounting system of PKP needs to be re-structured to support the decision-taking of each of the business units (sub-systems). Cost reduction is achieved in each business unit by identifying the exact items that incur excessive costs. The cost accounting system should follow the UIC prime cost evaluation methods as a rule for facilitating the future integration into the EC railway system.
- (c) The main fields for better asset utilization (productivity improvement) in the PKP operations are to be found in streamlining management, improved management information, raising train speeds, reducing the number of freight yards and stations, reducing the number of trains using marshalling yards, and promoting inter-modal transportation services.

But these gains will be lost unless management has the ability to focus on the real needs that improvements require to be implemented. In re-structuring itself, it is necessary to review if there are any tasks that can be carried out by the private sector. Asset maintenance is a candidate in this respect, also some of the passenger services on-board trains. At the same time, it seems necessary to develop business opportunities for attracting more customers to the railways as well as for offering additional services to railway customers.

2) Management Training

This is the important factor to successfully implement the re-structuring programme and to determine the efficiency improvements needed for the future of PKP. The object is to foster the creativity that perpetually seeks a better solution to the usual way of doing things. This attitude is a common human trait that exists in both market and centrally controlled economies, but the different attainment of efficiency in both regimes seems to lie in their different policies, organizations, and priorities to deal with the situation. An organization in a market economy recognizes and encourages improvements but management's need to learn how to do so.

It would be a great help in this regard for senior staff, initially, to participate in management and supervisor training courses organized by Productivity Centres in various regions. Managers also need to learn the managerial functions covering such fields as business policy, organizational behavior, marketing, financial management, human resource management, and management communication. Supervisors, who have the critical function of translating management decisions into productivity at the working level, must have special training courses to promote their understanding of, and their initiatives to, obtain the best results from PKP staff. The supervisors must also be responsible to ensure that PKP employees at the working level are properly trained, or re-trained into the skills necessary to increase efficiencies, productivity and overall job performance. Training at the middle management and supervisor level in new technologies applicable to their work, is crucial to improve quality and productivity. This technology must then be transferred to the working level by supervisor conducted courses.

The management training is to provide staff with the necessary competence to perform their tasks. This is Improved Asset Utilization where the staff are the asset. The operational objective is to increase the technological level of the staff. The marketing objective is to employ these new skills to improve services.

3) Addressing Staff Redundancies

In common with other countries from the previously centrally controlled economies, there has been a considerable down turn in business on the railway, reflecting general economic conditions as well as the effect of competing services. During 1991 some 12-13% of the labour force of 332,000 at the start of 1991 have been released from railway service. This was achieved by terminating the over-aged, and by attrition of staff reaching retiring age and offering special retirements allowances for early retirement. However the continued down turn in business during 1992 will make a further 10% liable to release.

There are significant impacts in these retirements as many workmen will take away special skills acquired over many years, and which will not easily be replaced. However, many of these skills are no longer required with technological improvements, or by changes in operating methods which reduce the numbers of staff required. In addition there will be a reluctance for many workers to move with their jobs when depots close or new facilities opened, in which housing may well be a significant factor. The matters of training and re-training are also important in this regard.

It is therefore necessary for PKP to establish a long term employee plan by which redundancies and releases can be controlled to a certain extent, and to ensure that new recruits are brought into the sectors that are experiencing expansion. The transfer of business from the shrinking sectors, or the removal of jobs by technological change will reduce the requirements for staff in certain skills, and similarly retirements will create vacancies in other skills. It is necessary that PKP creates the necessary administrative skills to promote active and accurate planning for re-training and opportunities for redundant staff to create a pool of competing non-railway support activities to railway centres. These non-railway private sector support services should be obtained by competitive contract from the companies formed to promote added value to customer attraction.

The largest scheme so far established to redeploy redundant staff occurred with the privatization of JNR. The staff were assigned to many commercial operations to support the transport sector, some working inside railway property, such as food stalls and shop/kiosks, and others outside as taxi services and delivery services.

However not all ventures were successful because of lack of understanding of the new skills required or poor decision taking by the new managers. Some ventures have succeeded and it would be wrong to condemn the approach. However, when people who are used to receiving orders and then translated into a position of taking decisions in somewhat more unstructured circumstances the experience can be very painful.

Management policy is to streamline the organization to promote better asset utilization.

4) Fares and Tariffs

Fares and tariffs represent the traditional source of revenue, and the beneficial user principle requires the user to pay the full cost of the service that he receives. When the full cost is not paid, there are discounts authorized by the government, then the non-user has to support the users cost through taxation. This represents an inequitable situation. The transportation system in Poland is important for the best utilization of the country's assets, for industrial development and for the satisfaction of the population's need to travel. Where the cost of providing a service is high, and the perceived value (price for service provided) is not seen by potential users, then PKP will not attract

customers to its services. It is necessary to determine the quality of the service and the price of that service that will attract customers. A marketing exercise needs to be undertaken to determine the level of service and the price levels that will attract and retain customers.

Railway transportation needs to be improved, not only for the future development of the country, but also for the benefit of the citizens, and to provide better services based on the beneficiary pay principle. However, implementing this principle will not be easy when consideration is taken of the enormous need for technological improvements, all of which require substantial capital investment to implement the EC requirements.

But it is not only in the direct charges made to users that provides a source of income. PKP needs to develop other sources of income that may be used to cross-subsidize fares and tariffs. Consequently, alternative sources of income should be sought. Leasing of property, selling annual concessions for services, the leasing out of services all provide income on a regular basis. There is little monthly fluctuation from this type of income source.

4.3.3 Rationalization of Operations

1) Route Reduction

The profitability of railway routes cannot be obtained at the moment due to the lack of a structured cost accounting system. According to the 1986 OBET information, the total length of unprofitable lines amounted to 6,300 kilometres out of a local line total of some 14,000 - 15,000 kilometres. Closures of these lines or the suspension of train operations should be promoted to the maximum possible extent. It is natural that most local governments neither accept these proposals nor take the responsibility of taking them over. The MTME should be involved in settling this matter with a definitive time limit to find alternative solutions. Where there is opposition or where there are marginal situations established techniques such as expanding the numbers of one-man operations, use of rail-buses, on-train fare collections, unstaffed stations, opening of new halts to serve new housing and works areas must be used to remove heavy staff overheads and capital maintenance costs.

Management policy is to promote operational and management efficiency throughout the system. The operating objective is to remove services which do not offer main line traffic, or boost new traffic patterns. The marketing objective is to promote the use of main line services.

2) Higher Train Speeds

Faster trains make a significant contribution to productivity improvement in terms of releasing rolling stock and train operatives which are restrained within the current framework of the train running production process. At present, the highest average speed of the fastest train on major lines is 110 kph between Warsaw and Krakow, whilst the lowest is 47 kph between Krakow and Katowice. The average speed of the fastest train on major lines is 79 kph although the maximum design speed is 120 kph on most lines. The first objective then is make efforts to increase the average start to stop speeds between stations to the order of 100 - 110 kph. This can be done by eliminating speed restrictions, removing general delays that are not required for operational reasons, and by rescheduling.

Management policy is to improve asset utilization by increasing traffic at lower costs/km. The operational objective is to reduce transit time to release rolling stock for additional or extra services. The marketing objective is to capture traffic from road competition.

3) Reducing Numbers of Goods Yards and Stations

These matters should be taken into account when the railway network is being streamlined. The need for a station/yard has to be considered from two aspects, one being the revenue generated at the station in outgoing traffic for freight, and the other being the inward traffic. It is important that the amount of long distance traffic generated inwards and outwards is identified and separated from local traffic.

Long distance traffic is the market that is seen for PKP to dominate and must be fostered. Where traffic is marginal or is decreasing, in this era of motorization, parking lots should be provided in station areas to stem the fall in numbers of passengers and to attract long distance passenger traffic by offering alternative and attractive travelling conditions. Where freight traffic is decreasing and wagon load traffic falling off containerization should be promoted with the last short haul to destination by road from a container depot. The low volume goods handling stations/yards can be closed.

Management policy is to eliminate unprofitable services and to increase viable asset utilization. The operational objective is to eliminate wagon-load traffic. The marketing objective is to promote long distance haulage and containerization.

4) Reduction in Marshalling Yards

It is probable that a yard based wagon-load transport system will not survive under intensifying competition from road haulage which can provide flexible door-to-door services at very competitive rates. It was found during the 1980's in Japan that wagon-load traffic passing through automated transfer marshalling yards could not compete with direct service road transport. Investigation showed that the fixed overhead costs of operating a marshalling yard were too inflexible when compared with direct train-load traffic which by-passed the intermediate marshalling yards. The difference in costs was significant and large savings made by changing from wagon-load traffic to direct origin-destination train-load traffic. This traffic must be encouraged by the closing down of the existing yard based system in favour of the direct transport system.

Management policy is to promote efficient operations and improve services. The operational objective is to reduce wagon-load traffic and reduce overhead costs. The marketing objective is to promote direct door-to-door train load traffic as a preferred service in place of wagon-load traffic.

4.3.4 Maintenance and Repair Works

1) Maintenance of Assets

The railways own a vast amount of fixed assets (real estate, buildings and rights-of-way) and renewable assets which is the capital tied up in locomotives, rolling stock, equipment and plant. It is also a fact that these assets require a large staff to carry out the tasks of cleaning, repairing and inspecting to keep the assets in service. It is therefore hard to provide an adequate base for measuring productivity with such disparate service activities. However, once a price can be identified a value can be put on the services provided. Thus by contracting out the work to the private sector the

contract becomes the price for doing the work from which the performance for that price can be measured, and the commercial value obtained.

Furthermore, this process will allow the railways to displace large numbers of workers into the private sector, and keep the more highly skilled staff as small teams of emergency staff, inspectors and supervisors. It is probable that the displaced staff will quickly be recruited into the private sector to perform the duties they had previously undertaken. Whilst one argument will be made is that PKP will be paying more to a private company because of the profit component in the contract price, the inherent efficiencies that PKP will gain will permit PKP to effectively monitor the value of the works obtained and to adjust requirements in terms of quantities or standards. It is probable that the raising of standards will have the most beneficial effect for PKP, even from the staff who previously were employed by PKP.

The pursuit of profit will require stricter supervision than previously required for direct labour by PKP staff, but this will also benefit PKP with the achievement of higher standards from closer supervision. This will also spill over into the ex-railway employees who will be required by their company to raise standards to meet the PKP requirements. The PKP organization for the new system will require the staff to be trained not only in inspection and supervisory skills, but also in higher technological skills to meet the new standards being introduced by the contractors. Skilled and dedicated staff are assets that must be well maintained and utilized effectively.

For rolling stock it can be argued that the public safety requirements dictate that all work should be performed by the railways, however, this could be in conflict with EC requirements and alternative methods have to be considered. If locomotives and rolling stock are to be eventually owned by commercial undertakings it also follows that the commercial undertakings should be responsible for keeping that stock up to a satisfactory condition and in safe working order. The acceptance of locomotives and rolling stock should be subject to PKP inspection and approval. That is to meet established standards. Likewise rolling stock must have inspections carried out at set intervals with penalties raised for infractions. The railways would be able to keep control over the status of rolling stock through management information systems using the data network since the movement of each locomotive, coach and wagon would be recorded in that system.

It was discussed in the combined transport section that a systems approach should be made to the subject so that each sub-system of the whole system is strictly analyzed and conclusions drawn, such that the system contains all the requirements of the sub-systems. The maintenance of assets is a similar situation, it is a complex subject that cannot be resolved without a careful analysis of each component of each sub-system to achieve the required objective.

Management policy is to have a tangible cost system for budget purposes.

2) Civil Engineering Databases

Track and structures requires a large expenditure in annual sums to maintain the railway for relative low speeds. When the speeds are increased there is the logic that the maintenance requirements will increase, and hence the cost. However the present budget calls for maintenance outlays to fall with the fall in revenue, but there is no direct relationship between the two. There is the situation that maintenance standards must rise yet costs must decrease. Potential methods to decrease maintenance costs are to provide improvements in: quality of materials, rules/regulations, railway structural organization, and productivity of maintenance works. Two significant approaches are available.

- (a) The first is to computerize the data collection and analysis of track conditions through the use of special track-geometry and rail recording vehicles to establish track condition databases. The use of the data base will allow PKP to get away from day-to-day track maintenance planning and into more accurate and more economical year-to-year planning and scheduling. Computer models will allow PKP to predict short and long term needs and the effects and costs of deferring maintenance.
- (b) The second is to restructure the track maintenance works and system. It is recommended that private sector companies are formed to provide track maintenance works. This is an accepted procedure in regular practice in the world. In Japan these companies have access to suitable technology and provide the necessary daily and special maintenance and repair activities on the Shinkansen routes. It is recommended that PKP send suitable study teams to Japan to examine necessary techniques such as: tender preparation, work time and track possession control, central office facilities, safety, contractor licenses and training requirements.

Management policy is to obtain a reliable basis for budget formulation.

3) Structure Investigations

Bridge maintenance deficiencies have accumulated and there are many superannuated bridges, and many that have been replaced without adequate design or construction control. A bridge survey should be carried out specializing in non-destructive testing of the strength of members to evaluate the structure more precisely and more importantly to determine the fatigue resistance remaining in the structure. Based on the data obtained, and by using computerized data processing, long term planning for replacement and repair can be established. The safety of bridges can be determined and appropriate speed restrictions placed on the structures until replacement. Using the data priorities can be established and suitable budgets prepared for urgent replacement of bridges on the important routes.

Management policy is to obtain a reliable basis for budget formulation.

4) Rolling Stock Repair

Non-transport affiliates of PKP were legally separated from PKP by the end of 1991 and are now under the direct control of MTME. PKP needs to establish contracting procedures with these enterprises.

The railway workshops (ZNTK) have been devolved from the railways and now come under the umbrella of MTME. It is inevitable that PKP will initially turn to them for work, and this is to be encouraged, but in the process PKP should establish reasonable cost basis pricing and conditions of contract and technical specifications. When experience has been gained from the handling of contracts and contract negotiations PKP will be able to obtain procurement on a basis that is required under EC regulations. Poland also has a vigorous carriage and wagon building industry which is also available to PKP and this industry will also be able to compete with the ZNTK's for PKP business. To promote the necessary efficiencies for PKP the ZNTK's must be carefully examined and considered with respect to the technology, machinery and requirements of PKP. The maintenance of rolling stock is an important and basic sector for railway operations and a careful philosophy must be established by both MTME and PKP to maintain a vigorous industry.

Rolling stock maintenance costs have been implemented by PKP through a review of inspection items. A subsequent study is to be the expansion of the times between periodic repairs. Such extensions are possible through the improvement of rolling stock quality and increasingly reliable analysis of rolling stock condition.

The quality of PKP rolling stock has not been improved significantly over time so this factor is not a major consideration at this time. The second alternative is to analyze the reliability of rolling stock and its components by database study of breakdowns, troubles and repairs.

Management policy is to lower maintenance costs.

4.3.5 Combined Transport

The term "combined" is used to describe containers and semi-trailers which use rail as the long-haul overland segment of the journey. In this sense the "combined" refers to the change in transport mode: for example, ship-to-rail-to-road for sea originated traffic for imports; or the reverse for export traffic; road-to-rail-to-road for internal transit within Poland; the traffic which is received on-rail at the borders with rail-to-road for imports; and road-to-rail for export at the national boundary.

This traffic is time sensitive because the competitor is road haulage. Combined transport is the railway answer to door-to-door road haulage. For this reason the control and operation of the terminals for both originating and receiving traffic is crucially important. It behooves PKP management to insist that the whole operation from door-to-door is carried out by PKP, to provide a "total" service to the customer. The complete operation must be considered on a system basis using the rigid application of systems approach to the complete operation. The sub-systems involved are, loading and unloading sub-system (transfer between modes), collection and delivery sub-system, terminal sub-system, motive power and line-haul sub-system, rolling stock sub-system, maintenance equipment and yard operations sub-system.

Management policy is to promote international integration by encouraging "total" services. The operational objective is to reduce transit time. The marketing objective is to capture the traffic from road haulage.

4.4 Railway Operations

4.4.1 Declining Market

Cargo and passenger transport markets have grown in accordance with economic expansion. It is, however, a general trend in most countries that the market share of railway transport has been shrinking vis-a-vis an increasing share for road-based modes of travel.

In Poland, rail utilization is clearly declining. Cargo shipments, which totaled 482.1 million tons in 1980, have dropped to 388.9, 278.1 and 227.7 million tons (47.2% of 1980) in 1989, 1990 and 1991, respectively. This, in 1990, represented modal share of some 15 percent of cargo tons transported. Rail shipments accounted for almost 60 percent of ton kilometres shipped in 1990, although this trend is also on a decline. Passenger transport is similarly decreasing. PKP, which carried over one billion passengers in 1980, transported 952, 790 and 650 million passengers (59% of 1980) in 1989, 1990 and 1991, respectively.

PKP cargo transport has historically generated an operating profit which off-set negative returns on passenger transport. Therefore, due to drastic reductions in cargo carried, the financial health of PKP has noticeably deteriorated. It is anticipated that this situation will worsen in coming years due to a high dependence on coal transport (over 60% of PKP tons loaded in 1990) which has recently been, and will continue in future, to decline due to decreasing exports to former CMEA countries as well as stagnant domestic heavy industrial production.

Major reasons for shrinking railway market in cargo transport can be attributed to: a shift in industrial emphasis from heavy production to consumer-oriented production, thereby necessitating more flexible and timely transport services; rapid response and adoption of road haulage companies to these changing market conditions coupled with the convenience of door-to-door services offered by the road sector; slow response by railways to changing demand scenarios due, in part, to a lack of market-oriented experience and attitudes as well as rigid regulations, including tariff structure, imposed by government.

Losses in the railway share of the passenger transport market can principally be attributed to the explosive growth in motorization. The private car enjoys an overwhelming superiority over public transport in terms of convenience, comfort and privacy, unless specific constraints are imposed. Worldwide experiences indicate that this trend is almost universal with exception of high-speed long distance trains and commuter rail services in large urban agglomerations.

4.4.2 Market Orientation

The Polish transport sector has, since 1990, been in transition from a centrally planned system to one responsive to free-market stimuli. The trucking industry has taken an initial step in this direction through privatization and deregulation. This action infers that stimulated competition in the road sector will inevitable encroach into areas of cargo transport previously monopolized by railways. Increased road haulage of containers from Gdynia port to inland destinations and coal from Silesia to Warsaw are examples in this regard.

It is expected that Polish transport practices will gradually be integrated into the EC transport market which, generally speaking, is guided by free market principles. This implies that PKP, as part of the EC railway system, will also be confronted with

competition from international road hauliers. An example would be the transport of containers between major ports such as Hamburg as well as Bremerhafen and Poland.

In terms of passenger transport, railways will, in addition to bus transport, face two major competitors: private cars for short/medium distance trips; and air transport for medium/long distance trips. The present competitive advantage which railway hold is reduced as construction of motorways/expressway inexorably proceeds. The competitiveness of railway vis-a-vis air transport, which depends largely on service frequency, travelling time, cost, and feeder transport services, is likely to modify as the transport system is improved.

It is very likely that the Polish market will steadily change in accordance with economic restructuring of industries as well as economic integration of the Polish economy into the EC market. Economic activities will likely diversify with a focus toward consumer products rather than energy and heavy industrial production. This shift will encourage the growth of road transport rather than PKP unless the existing railway system is adjusted to confront changing market demands and the emergence of efficient competitors. Under these circumstances, market orientation is a key factor for the survival of PKP. Initially, however, PKP must address various issues which prevent attaining such a market orientation: the organization of PKP is large and unwieldy which prevents top management decisions from reaching lower echelons of the organization; the management structure is too centralized to quickly respond to local market demand; uniform wage rates discourage employee initiative; and the government imposes regulatory and fiduciary burdens which prevent PKP from properly re-acting to market conditions.

The present PKP organization needs to be restructured to make it more responsive to market demand. PKP seems to have fallen into a vicious cycle of management because of its huge and complicated organizational structure. Significant portions of middle and lower management's working day are absorbed in preparing reports to headquarters to the detriment of more productive business. In addition, employee duties have been specialized and segregated for a number of years, resulting in almost a complete lack of cross-pollination among sectorial specialists and a lack of multi-disciplinary approaches to problem solving.

These drawbacks should be resolved through the introduction of a decentralized decision-making system with a concise headquarters' functions. This can be achieved by dividing the existing organization into several business units which are independent in products and market strategies.

4.4.3 Cost Saving and Productivity Improvement

Cost saving and productivity improvement are key factors for the financial restructuring of PKP. An appropriate cost accounting system is a basis for effective cost savings just as the reduction of excessive employment is a key for improved productivity.

Gross profit of a company is basically determined by four factors: price, cost, size of a market and market share (Fig. 4.4.1). Tariff cannot unilaterally be increased by PKP due to governmental regulations. Size of market is largely dependent on economic growth and diversification which are out of the PKP's control. PKP's future market share is threatened due to intense competition from road transport. Of the four elements, cost is the only factor the PKP can control. Cost reduction, therefore, is the most important factor for PKP to implement immediately.

Cost reduction is meaningful only when it is put into practice. A cost accounting system is a basis for cost reduction analysis and should first be developed stratified by business units (and by railway lines) to clearly identify problem areas and responsible persons.

The financial performance of business units can best be measured, as shown in Fig. 4.4.2, by profit/capital ratio which reflects efficiency of capital utilization toward earning profit. This indicator is useful in planning long-term profit management. Break-even analysis is an important tool in profit management, showing necessary sale amounts as well as composition of fixed and variable costs at a target profit/capital ratio. PKP should establish a clear and concise framework with which to disperse cost items into fixed and variable components.

The PKP cost accounting system needs to follow the UIC prime cost evaluation methods which are commonly adopted among EC railway administrations. This method assigns costs in accordance with traffic activities: type of traffic; traffic categories; phases of transportation process; type of trains; type of traction; and line categories. It is necessary, however, that PKP adopts an appropriate method that provides cost accounting information for each decentralized decision making unit, that is each business unit. It is also necessary for PKP to develop a clear and reasonable framework to demarcate individual and common costs to respective business units.

4.4.4 Rationalization of Loss Producing Lines

The present cost accounting system, among other things, should be reformed to indicate the profitability of all railway lines. It is, however, likely that the transformation of the accounting system will require several years until completion. Since the immediate curtailment of ineffective expenditures are of paramount importance efforts should focus at once on closure of the 6,300 kilometre lines identified by OBET and provision of replacement service (if needed) by bus. The Ministry of Transport and Maritime Economy (MTME) should be fully involved in this matter to facilitate negotiations between local governments and PKP, and particularly in selecting an alternative means of public transport as well as associated financing mechanisms.

The Japanese railway network, which totaled 23,400 kilometres in 1983 was classified into 13,300 kilometres (57%) of main lines and 10,000 kilometres (43%) of local lines. A local line was defined as a railway line carrying less than 8,000 passengers per rail kilometer per day. Local lines carried as low as 3.0% of the total rail ton kilometres and 4.5% of the total rail passengers kilometres, and earned 7.0% of total rail revenue while accounting for 14.4% of total rail expenditures. The average expenditure/revenue ratio of local lines reached as high as 314% while that of main lines reached 134%. The net loss incurred by local line reached 29.4% of total Japan National Railway (JNR) losses.

It was consequently decided that JNR's local lines whose ridership was less than 4,000 daily passengers per rail kilometre were to be closed and replaced by bus services, while lines with ridership of 4,000-8,000 daily passengers per rail kilometres were to be operated with an improved management system. According to a model calculation, replacement of railway by bus services was estimated to increase revenue by about 55% and reduce expenditures by about 40%, resulting in a 205 point improvement in the expenditure/revenue ratio (331 for railway and 126 for bus). Service quality was considerably improved by the bus replacements particularly in terms of service area (more bus stops than railway stations) and operating frequency.

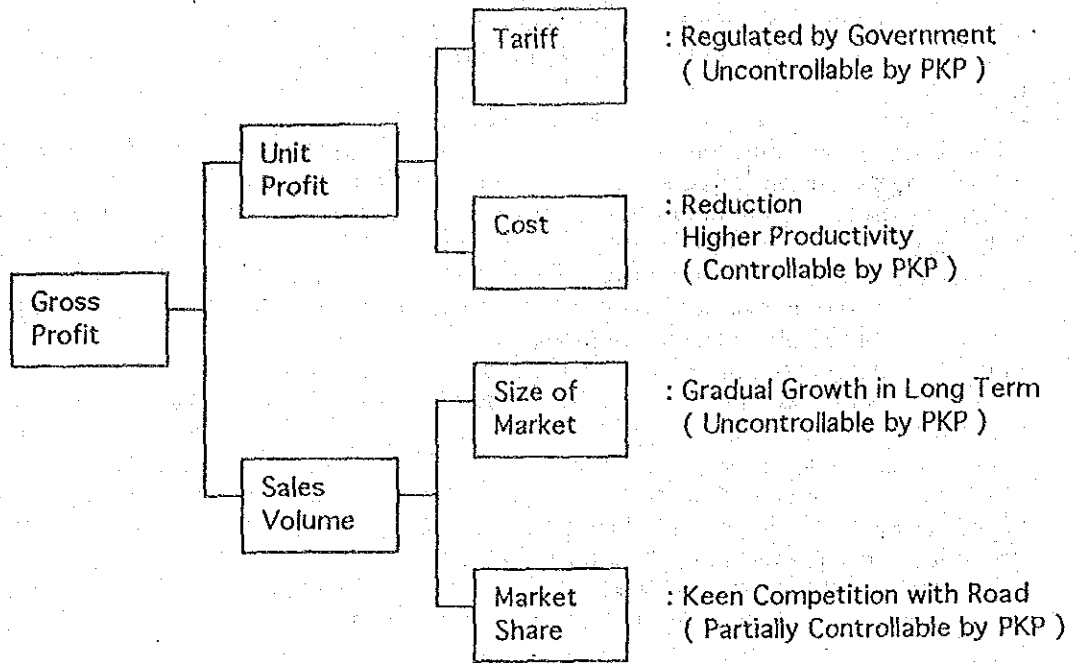


Fig. 4.4.1 Structure of Gross Profit

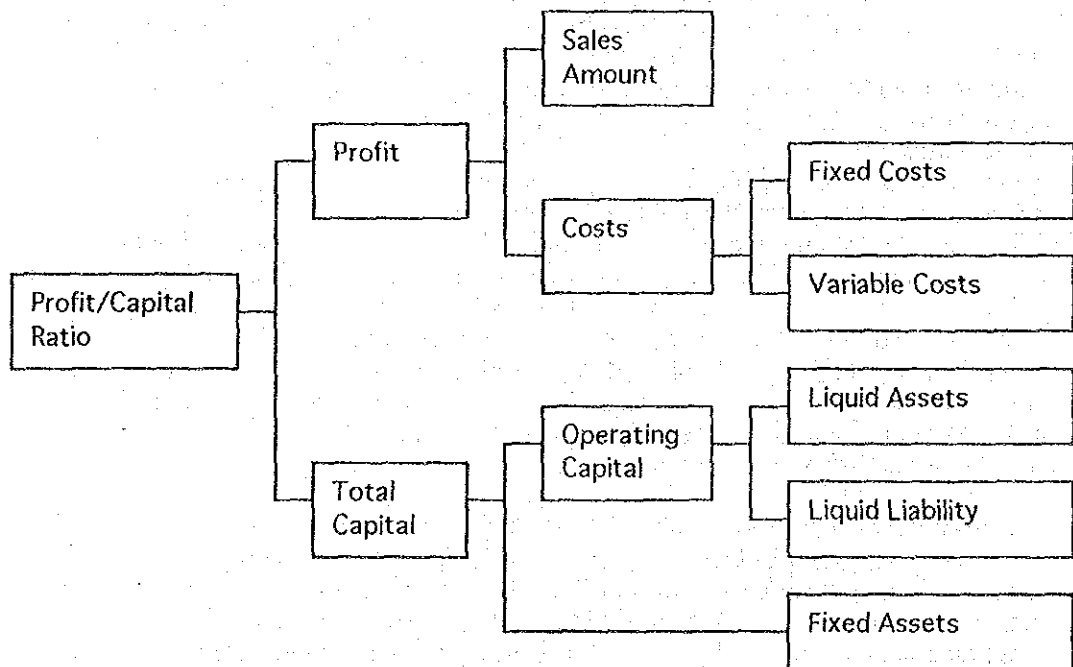


Fig. 4.4.2 Structure of Financial Performance

The transfer of local lines from JNR to local governments was not successful because it was perceived as simply a transfer of losses from one party to another without any improvement in service. Furthermore, no local government was willing to take on such a money-losing proposition. It was, as a matter of course, difficult for JNR to persuade local governments of the merits of closing unprofitable local lines. A Transport Policy Council, which was an advisory committee attached to the Ministry of Transport, played an important role in this regard by developing guidelines and schedules that JNR and local governments should follow in their discussions. Finally, it took five years to close seventy-one lines totaling 2,818 kms.

4.5 Future Role in the Transport Sector

4.5.1 Overview and Market Identification

The previous Sections have looked at aspects of the existing traffic patterns and discussed methods that will provide improvements in the railway sector. The market economy needs fast, regular and cheap transport. A transport system that will achieve total cost savings through productivity, flexibility and availability is definitely wanted in Poland. A railway system has its advantages and disadvantages. Its exclusive track and information network brings various advantages, such as large transport capacity, high speed, timely, safe and clean transportation. On the other hand, railways shows its limitations in the handling of small lot and short distance traffic.

Discussion has shown that if the railway is to activate a competitive position in the market economy it has to promote the use of its advantages in preferred activities:

- (a) To develop inter-city and international passenger transport. In Poland as well as the surrounding countries, there are many cities with populations of several hundred thousand people located within a few hundred kilometres of each other. This is likely a good situation for high speed passenger rail transport. Railways in Europe and Japan have achieved considerable commercial success in this area of transportation.
- (b) To develop urban and suburban passenger transport. Future economic forecasts indicate progressive concentration of populations in urban districts, emphasis should be placed upon improving suburban transportation by electric traction in terms of frequencies and punctual train operations. However it is found that in many countries in the free market economy, suburban transport is not found to be commercially profitable, because of the high costs arising from hourly fluctuations in demand and relatively lower fares. However, railways are the most suitable means of transport for the public benefit including large carrying capacity and environmental protection, and consequently this makes Governments in many countries give subsidies towards the cost of providing these services.
- (c) To withdraw from rural passenger transport as much as possible. Short distance traffic in rural areas of low density is generally thought to be more suitable for road traffic. Popularization of private cars in rural areas will bring about significant decreases in railway traffic and generally buses can provide better rural public transport at less cost. However, some rural transport might be required to fulfill social needs such as environmental preservation. In such cases subsidies by the government or the local authority should be considered.
- (d) To develop train-load transport for freight in bulk. Traditional wagon-load transport, which depends on shunting and train reforming in marshalling yards needs more time for the shunting than in main line travel, and requires much manpower. In some countries in a market economy all the traditional wagon-load

traffic has disappeared, and the world-wide trend for train-load transport which travels only between origin and destination points by unit train is now prevailing. In PKP, bulk cargo, which accounts for 88% of total cargo carried are mostly carried in exclusive trains. Most have to be reformed in marshalling yards, but attempts are now being made to reduce multi-handling operations.

- (e) To develop combined transport. This transportation system aims to save time and manpower in loading and unloading cargo between transport modes and has been popularized rapidly over the past two decades to meet the needs of developed industries. Railway systems have to prepare exclusive trains and terminals to be involved in combined transport. Presently PKP operates only a few exclusive combined trains each day in comparison with the hundreds run on a daily basis in the western countries. PKP has to develop the combined transport with the co-operation of neighbouring railways and other transport modes. However, it is still uncertain when the combined transport should be fully developed because this depends largely on the recovery of Polish economy. Market observation is crucial in this respect.
- (f) To close small freight stations. There are approximately 2,000 freight stations, many of which have only small traffic and are to be closed and the present wagon-load traffic handled in small stations can be substituted by combined transport from a suitable centre.
- (g) To reduce the total costs as much as possible. PKP is facing severe competition with other transport modes, and it should be noted that market share for rail is user cost dependent, even if the railway remains a state owned enterprise. Personnel costs of PKP now account for 40% of total operational costs and will increase with salary rises. Because of significant decrease of traffic in recent years, PKP has surplus employees. Further more there are service improvements that reduce the number of working employees, such as closing of lines, closing of small freight stations, reducing shunting operations, and the introduction of automated and centralized control systems and changes to operating procedures. To implement the reduction of employees in a huge enterprise like PKP, it is essential to establish a long term prospects for employees by controlling the numbers of new entrants.

To achieve these basic objectives, concrete methodologies should be established in the various fields of organization, financial systems and technical developments. It should be noted that the international integrations, which Poland needs most keenly, will also be realized through achievements of these objectives.

This diagram (Fig. 4.5.1) shows the outline for the philosophy for developing a restructured PKP to meet the new conditions. The external input of EC Regulations and the need to reduce costs promotes reforms. The reforms inside of the box are the condition to achieve the results of the perimeter.

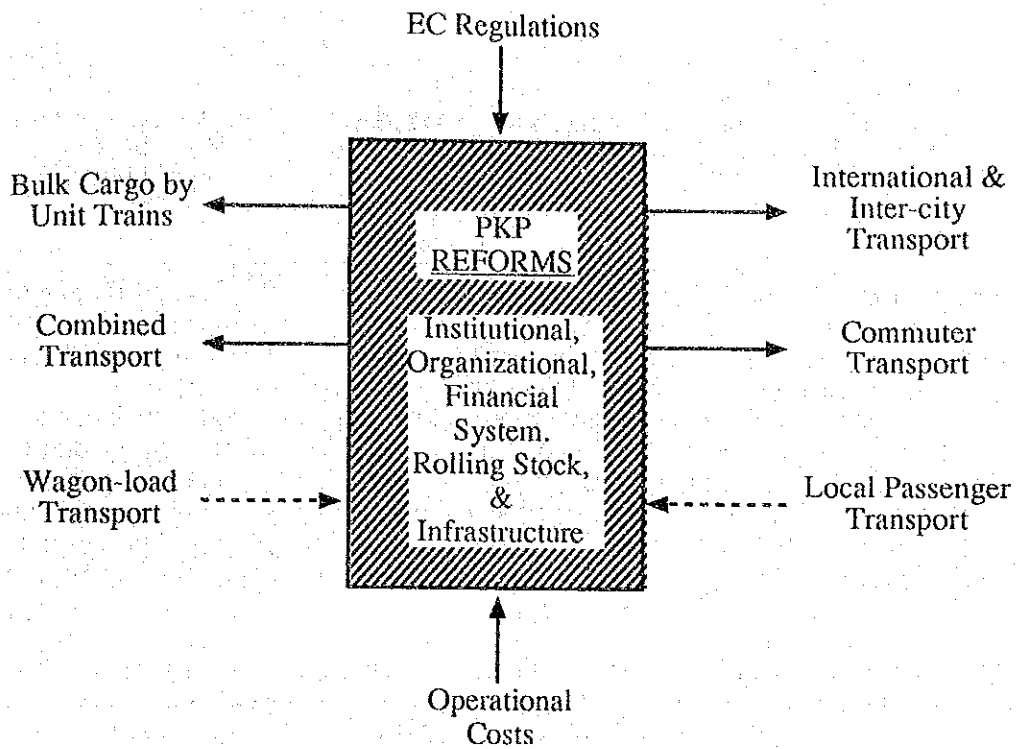


Fig. 4.5.1 Philosophy for Restructuring of PKP

4.5.2 Freight Transportation

There are three subjects to be taken into consideration for the freight transport on PKP which are discussed in the following paragraphs.

1) Bulk Cargo

At the present time 88% of the freight traffic on PKP is bulk cargo, of which about half is coal from the mines near Katowice. Of the coal traffic, about 80% is transported in exclusive coal trains. However the trains are assembled in marshalling yards near Katowice and destined to other marshalling yards before being resorted to reach their destinations. There are only some 30 unit trains (10,000 train kms/day), which connect PKP's customer's loading points and arrival points directly, out of a daily total of 2,600 freight trains. An attempt has been started to reduce shunting operations and the number of marshalling yards. In 1990 PKP operated 63 hump marshalling yards, but this will be reduced to 11 main marshalling yards and some 20-30 freight stations with yards. PKP has started to offer special discount rates for shippers making use of unit trains.

One of the reasons for shunting is that the trains from the mines are shorter than those from the marshalling yards. There are two reasons for this, the short siding lengths at the mines and the steep gradients near the mines. A further reason is that several kinds of products are offered from the mines to different customers. These are not insoluble problems as longer trains could be assembled nearer to the mines than the marshalling yard, and the mines could stockpile the various products at the mines and then make larger shipments. The increase in the number of unit trains should be sought from the mines by stressing the mutual benefits to be obtained.

At the present time there are some 6,000 paths shown on the train diagrams for freight trains, but only some 2,600 trains are run. The time taken to assemble a train in the marshalling yard is not constant, depending on the particular conditions occurring that day. Trains will use the path that is ordered by the train despatcher, and consequently freight trains take different schedules each day. This operating procedure creates many deficiencies such as irregular running patterns, and uncertain arrival times. PKP is planning to operate some 1,200 trains a day on rigid timetables commencing in 1992-93. This procedure will bring about significant benefits to punctual operations of all trains, particularly passenger trains. Rigid timetable operations for freight trains are required as soon as possible.

The operating objective is to reduce transit time for unit trains. The marketing objective is to promote the advantages and pricing gains to be obtained from unit trains.

2) Combined Transport

At the present time there is a daily container train from the Russian border to the German border, and a piggy-back train between Gdynia and the Czechoslovakia border which also makes a round trip to Vienna once a week. There is a large traffic in containers between Europe and Poland of which 20% arrive by sea and 80% by road. PKP has started operation of new container trains connecting Germany to Warsaw, and in addition, PKP is planning to operate new container trains from the Czechoslovakia border to Gdynia, and a piggy-back train from the German border to Poznan.

It is understood that MTME is preparing to set up a container operator with the cooperation of PKP, Port Authorities and international forwarders. The container operator needs data processing facilities for handling the containers for which the data transmission network, terminal sets and the processor of PKP's Management Information Systems can be used. The operator will also need to prepare a stockpile of containers of different types to meet the varied customer needs.

In designing the layout of the terminal, consideration should be given to the yard layout so that containers can be loaded and unloaded on arrival/departure tracks without shunting by using fork lifts or top lift cranes with hard standing access to each side of each track. A well designed container terminal prepared through a systems approach enables the handling of containers to be performed in a short time, and transit time can be much reduced if the terminals are located on the main container traffic routes.

The present situation is that domestic container traffic is not interesting potential commercial users as it is not as advantageous as road haulage. Therefore emphasis should be placed on international container trains in the early stage. However, customers in Poland could be promoted by a fast regular transport by exclusive container trains. Where some lines are foreseen to have too little traffic for exclusive container train operations, fast freight trains with container wagons in the make-up should be considered. However, all container traffic is dependent on speedy, efficient train loading operations with accurate data recording and transmission facilities.

The operating objective is to gain traffic onto fast container trains from slow mixed freight trains. The marketing objective is to promote the speed, efficiency, and safety of door-to-door collection and delivery services.

3) Reduction in Freight Stations

Currently there are some 2,000 freight stations with about 6,700 loading points, but over 50% of the loading points handled less than one wagon a day in 1991. There is a strong case to concentrate small wagon-loads into area freight stations where road traffic can take over the final distribution. These freight stations need to be provided with suitable handling gear, including container lifts and other equipment. This concentration of activities will permit the closing of small freight stations with the attendant cost savings and the benefits of increased freight train speeds and reductions in shunting at marshalling yards.

The operating objective for general freight traffic is to reduce the number of short train trips. The marketing objective is to promote the alternative handling arrangements available at a central location.

4.5.3 Inter-City Traffic

Inter-City trains in Poland are not characterized by high speeds, and start to stop average speeds only exceed 100 kph only on two routes, the Warsaw - Katowice and Warsaw to Krakow. A 200 km long line, the CMK route as it is called, was constructed some years ago for a design speed of 250 kph but maximum train speed on this line was recently raised to 160 kph. Other routes have a maximum speed limit of only 120 kph and in one route between Warsaw and Poznan of 130 kph. Inter-City train services are quite dense with over 10 trains a day in each direction on the principal routes. Three situations concerning Inter-City traffic are discussed, the International E-20 route, the CMK route, and seat and ticket reservations.

1) Route Improvements

Priority for route improvements and increased train speeds should be given to the AGC route E-20 route. The AGC agreement established various parameters for upgrading existing lines for international traffic such as nominal speed, axle loads, elimination of level crossings, and other matters. However these improvements are to be carried out by PKP by considering priorities based on cost-effective studies of each type of improvement. It has been promoted that about half the 3,200 km long route will be improved to 160 kph or more by 2000 and the remainder by 2005.

2) Higher Train Speeds

The CMK route will be the first PKP route to be cleared for 200 kph running. This route now carries the densest passenger service and connects the most populated areas, and a part is cleared for 160 kph. It is logical that this route would be the first to be selected for 200 kph operations. A reason for the financial success of high speed traffic in Japan has been put to the superior utilization of rolling stock. To connect the short distances such as Warsaw - Katowice and Warsaw - Krakow, train turn-round in the arrival platform will give better utilization of rolling stock. The alternatives of train types are either multiple units or "Push-Pull" operations. Where traditional locomotive hauled trains are used, the coaches should be cleaned and prepared in the arrival platforms for the immediate next dispatch, and not sent to a depot.

3) Seat Reservations

The present seat reservation system utilizes small computers located at several major stations for the trains that start at that station. The statistics are somewhat meager concerning, a total of 63,000 seats and beds were reserved in 1991, and 54% were taken up. A central computer is being installed at Warsaw to handle international trains (the number of seat and bed reservations is about 30% of the total) in the first stage and all trains in the future.

The centralization of seat reservations will improve the service for the selling of seat reservations, and up-to-date reservation information could be used in planning strategies for supplementary coaches or trains. Improvements to ticketing would be to computerize the issue of tickets, to have indicator boards showing the status of available seating and to improve the facilities at the ticket issuing positions.

The operating objective for Inter-City traffic is to reduce transit times and to improve ticket selling facilities. The marketing objective is to promote the advantages of fast train travel.

4.5.4 Suburban and Commuter Traffic

PKP has been carrying out a considerable role in this field utilizing some 1,000 electric multiple units (EMU) over 1,000 kms of route kms in major cities and their suburbs. However considerable drops have been observed in the numbers of season tickets purchased by passengers in 1990 due to reduction of commuter train operations, economic conditions, and rising private car ownership. An outcome is that in urban areas the increase in car ownership is bringing about traffic congestion of the city roads and car parks.

The suburban and commuter trains predominately use the Inter-City routes although there are multiple tracks but timetable conflicts occur which disrupt all three services. The subject of management of these services is complex with many factors to be taken into consideration.

4.5.5 International "Bridge" Traffic

Combined transport services need to be developed by PKP to satisfy with increasing demand, particularly in an international context. First priority should be given to the East-West connection between seaports on the North Sea Coast to Warsaw, and the North-South connection between Gdynia and Vienna through Katowice. The share of International freight transport is 14% of total PKP daily transport in export traffic, 6% in imports, and 0.8% in transit. These were obtained during the course of the study and represent the daily average volume in April 1991. PKP transports containers between the former Soviet Union and Germany and a piggy-back train between Gdynia and Vienna.

The volume of this combined traffic is not large at the moment, but demand will increase, not only as a result of the world wide trend but also because of the increasing foreign investment by Europe and the USA into Poland and also the former Soviet Union Countries. The transit time for containers over the Siberian "Land Bridge" to Europe used to be 10 days shorter than by sea. However this traffic is price and time sensitive as the traffic volume fell by half recently as a result of an increase in tariffs and destruction of systematic operations by the Russian railway system. The setting of a competitive tariff structure by concerned railways is an important factor to compete with the sea-borne traffic.

PKP has purchased 40 container flat wagons in 1991 and plans to purchase 100 pocket type flats for piggy-back services in 1992. A study on combined transport has been carried out by Dutch consultants and another on container and bi-modal transport has been commissioned through USAID to start this year. These studies should be used by PKP to emphasize the need for combined transport by PKP.

4.5.6 International Tourist Traffic

Until the economy of Poland reaches the level to be able to support a big internal domestic travel industry the tourist industry will cater predominately for the international tourist. The PKP must start a close liaison with ORBIS and the new private venture travel agencies that are starting up to actively promote and market tourist attractions. This also implies that PKP should set up its own links with International travel agencies and organizations, particularly the Eurorail pass organization. There is a strong sentiment in Europe for steam railways, and Poland has a unique opportunity to convert some lesser profitable railway lines into tourist attractions by keeping or converting lines or branches to steam operation. Further these attractions will also provide experience to graduates of the management training courses to implement the practices studied, as there is nothing more commercial and fickle than the tourist industry.

The international tourist either travels in a group or as individuals. The railway service to be provided to them can be a complete service. One role is during travel to the destination, that of meeting and greeting tourists, to help and guide in changing trains at main stations, to provide meals and to see that the services offered en-route are provided. However when the tourist arrives at their destination the railway service to be offered must be local and immediate. Tourist railways are essentially local operations with a local management capable of reacting to local situations with full flexibility. The

railways have the opportunity to provide a full support service in the name of the local railway line. The essence of the International Tourist Service is to persuade the tourist to return, or to for them to recommend positively to their friends. This is the measure of the level of service provided.

4.6 Railway Infrastructure and Facility Development

4.6.1 Basic Policy

PKP needs to restructure the present railway system to comply with the market demand under the effects of increasing road traffic. The re-structuring comprises two aspects:

- (a) improvements in services where the railways can compete
- (b) reduction of the network where the railways cannot compete

1) Basic Policy to Reduce Total Transit Time

PKP has been facing an intensifying competition from road transport which provides a flexible door-to-door service. To effectively compete PKP must pay more attention to reducing the total travelling time from origin to destination. A balanced improvement of railway services is most important to this end including higher train speeds, frequent services, convenient changes of trains and easy access for transfer to other transit modes. Computerized train seat reservations and easy to read signage using international signs and English language for foreigners will help to reduce time and frustration during travel. Competitiveness with road can be achieved under this concept without large investment.

2) Identification of Important Domestic Market Segments

Inter-city passenger transport, some commuter services in large urban agglomerations, bulk cargo transport and long distance container transport are the prospective market for railways. Focus should be given first to the 3,200 kilometres of arterial lines and then to the remaining electrified main lines of some 8,800 kilometres.

3) Investment for Modernization

A large part of PKP infrastructures and facilities are outdated from a view point of western railway standards. Modernization is needed in telecommunications, railway traffic control, rolling stock and total train operating systems.

(1) Telecommunication System

The telecommunication system is the basic infrastructure for train operations. There are 59 telephone exchanges needed for the entire system including headquarters and regional offices (DOKP). However, most of the existing exchanges are more than 40 years old without spare parts availability. The existing system needs to be replaced by a digital system which can be used for speech and digital transmissions. First priority should go to headquarters and the DOKP offices. Capacity increase of the telephone network started in 1991 with the installation of optical fibre cable between Warsaw and Krakow. It is planned to expand to 3,430 kms covering all the trunk lines. This system will serve for PKP's Management Information System network and other data processing functions such as seat reservations, management information and container handling services.

(2) Uniformity with Europe

The EC railway community intends to establish a uniform traffic control and signalling system in the member countries. Poland therefore, in line with its intention to join the EC, needs to develop a control system as compatible as possible with the requirements for future integration into the EC railway system. Automatic Train Stop (ATS) system should be simple, as those used in Europe. Semi-automatic signal blocks should be improved by transmissions to a central despatcher to confirm the passage of trains automatically as a means to reduce personnel costs. A Centralized Traffic Control (CTC) should be developed based on the technically and financially superior electronic systems.

(3) Rolling Stock

Considerable numbers of rolling stock are idle due to the sharp drop of transport demand in recent years. Most of the stock is over 20 years old and its life expired. At the same time it is necessary to find a way for converting the younger freight locomotives to passenger traffic. During the old regime, PKP imported rolling stock from the former CMEA countries mainly because of the division of production between them. It seems worthwhile to develop the domestic technology to modify or to develop an innovative re-use of the existing rolling stock instead of importing new from the Western countries which are now two or three times the cost of re-utilizing existing stocks. For example, the Mongolian railway system, which uses similar locomotives to PKP, has a spare parts crisis and PKP may be able to develop a re-sale market from its own surplus fleet.

(4) Freight Transport

The existing system needs to be restructured to meet the changing market demand which would place more importance on flexibility and controllability in the transport process. The traditional freight transport system which comprises freight handling over a number of scattered small stations and repeated shunting at yards should be eliminated. Freight transport for large customers, including coal should be rationalized to the maximum possible extent by introducing direct transport services.

(5) Investments for Environmental Protection

Environmental problems experienced by the railway do not appear to be as serious as those of the road sector. The problems are associated with noise, vibration, and waste effluent from trains, workshop and depots. PKP does however need to establish a section to start dealing with these environmental issues because it takes time and considerable amount of money to mitigate the problems.

(6) Investment in Safety

Most accidents involving the railway occur at level-crossings. In 1990 there were 18,700 level crossings consisting of 1,400 automatic protection (7.5%), 4,700 manually operated gates (25.1%), and 12,600 unguarded crossings (67.4%). PKP must improve these crossings, firstly with a focus on arterial main lines to ensure undisturbed main line traffic and also to reduce possible rail/road accidents. Improvements in worker safety is essential for morale. Education and modest investments in warning devices for track workers are merited.

4.6.2 Investments in Modernization

There is an urgent need for PKP to acquire the technology developed over the recent years in:

- (a) higher train speeds
- (b) telecommunications, train control and signalling
- (c) management information system
- (d) environmental controls

Technology in accelerated train timings and speeds needs to be developed by PKP as it is the basic technology of the railway system. PKP has a plan to establish a high speed test section on the CMK to get data and experience for high speed running. This test section is to be operational by 1993 with a target speed of 200 kph. In order to attain speeds of 200 kph experience is suggested to PKP that the technological plan for high speed operation allows for:

- (a) 200 kph is not an extension of 120 kph technology as there are technical barriers at about 170-180 kph and the technology is different.
- (b) Media announcements are only made for success stories, therefore to avoid errors PKP should despatch specialists to Japan and European railways to survey the practices and technology involved in either constructing separate high-speed lines or upgrading existing alignments to 200 kph.
- (c) The technology of measuring data is the basis of technical improvement. Such analysis will reflect in the criteria, maintenance and systems of rolling stock and fixed facilities for operation not only at 200 kph but also 160 kph.

Telecommunications, signalling systems and equipment needs to be developed in cooperation with the manufacturers, as systems already in use need adaptation for PKP's procedures. The management information system development is underway through the assistance of Canada and the World Bank.

Development in technology will continue over 15 years as there is the possibility of operating at 300 kph at the start of the 21st Century. Therefore the necessary formation of groups and teams should be organized and integrated into the PKP structure.

It is recommended that PKP head office opens a "Technology Development Department" with the inclusion of or cooperation with the Railway Technical Institute (CNTK). This department would be charged with the responsibility of preparing targets and strategies for the application of technology to upgrade facilities initially to meet EC requirements. The team should involve engineers and economists to play key roles in managing the development of appropriate and suitable technology in an open working environment. The immediate activities of the Department would be to investigate outside Poland:

- (a) modern management technology, quality assurance and quality control methods;
- (b) reliability in maintenance and operation of rolling stock and electrical facilities; and

- (c) energy conservation for rolling stock, operations and environment.

In preparing the PKP investment plan the following conditions should be considered:

- (a) The transportation volume of PKP has been decreasing drastically and this trend is forecast to continue for some time. Freight transport the major traffic carried has decreased by one half of its peak, and consequently PKP revenues have decreased;
- (b) Recovery cannot be expected probably during this decade;
- (c) Polish national debt is currently US\$ 40 billion and debt re-scheduling has allowed interest payments to be met in the past financial year;
- (d) The Government budget is in a serious position, so that the case for Government subsidies becomes more tight each year; and
- (e) Construction costs have increased each year with a change to a market economy and the current cost for electrification is US\$ 0.9 million/km compared with US\$ 0.1 million/km in the past decade.

4.6.3 EC Requirements

A stated goal of the European Community is that transport sectors are, in line with economic sectors, to be integrated among member nations. A number of regulations, decisions, directives and resolutions have been issued in this regard, all with the objective of achieving smooth and efficient railway transport services. The basic theme can be stratified into four groupings:

- (a) free competition among railway enterprises;
- (b) efficient international transport network;
- (c) strategic co-operation among railway enterprises; and
- (d) monitoring of international railway transport.

Poland is an associate member of the EC and is expected to become a full member in the future. Thus, PKP must, at some point, be in full compliance with EC guidelines.

1) Free competition among railway enterprises

European railways have historically enjoyed close relationships with governments, either as a direct arm thereof or as a closely allied entity. Sizable investments were made in railway systems both in terms of capital projects as well as operating subsidies. In many cases, management efficiency was not a primary concern which, in turn, contributed to increasing subsidy requirements.

The new EC focus is that rail enterprises must now be in a position to effectively compete with other transport modes in a free market environment. Thus, the role of government and railway are effectively separated, and the ability of the state to intervene in railway affairs strictly limited. The autonomy of enterprises is stipulated by Council Directive 75/327/EEC. A portion dealing with harmonization of rules regarding financial matters, has been replaced by Directive 91/440/EEC. Article 4 stipulates autonomy in:

- (a) management;
- (b) administration;
- (c) control over economic and accounting matters; and
- (d) assets, budgets and accounts separated from those of the state.

Furthermore, Article 5 states that railways are free:

- (a) from international groupings;
- (b) to define internal organizations;
- (c) to control marketing and set tariff levels; and
- (d) to decide unilaterally on staff, assets and procurement.

The most basic change in the directive is a possible separation of train operations from rail infrastructure (per Article 1). Section III suggests separate entities and accounts to fulfill each function. It also introduces the concept of a user fee for railway infrastructure. Receipt of aid from the state in the form of a general subsidy to compensate for operating deficits is ruled-out. However, compensation for performing unprofitable public service undertakings is permitted.

2) Efficient international transport

The EC issued resolutions aimed at efficient international railway transport. These are:

- (a) technical norms and standards;
- (b) tariff system and revenue allocation; and
- (c) efficient border control.

Technical norms and standards determine physical compatibility of the international railway operation. Tariff systems and revenue allocation will be determined by the EC Council in the near future; however, costs incurred by each railway enterprise should be covered by incomes.

Border control is considered critical. The EC member states have histories of excessive controls; however, the EC aims at achieving efficient border controls via the following means:

- (a) state of departure is responsible for border formalities;
- (b) decrease the number of documents;
- (c) use uniform documents;
- (d) increase the number of border control officials;
- (e) simplify procedures for transit and empty vehicles; and
- (f) extend operation hours of border processing points.

3) Strategic Cooperation between Railway Enterprises

The EC is striving to enhance international railway transport by issuing Council Resolutions regarding high speed international passenger trains, combined transport systems and computerized seat reservation systems. These are strategic programmes to strengthen railway service throughout the EC transport market. Fundamental to this is the requirement that railways should be competitive with other modes in terms of passenger and freight transport.

4.6.4 Establishment of Data Networks

To increase the present capacity of the telecommunication trunk lines PKP has started the installation of optical fibre cables between Warsaw and Krakow. The cable has 12 fibers and two transmitting systems. One mode is 140 Mbits (1,920 channels) for the trunk lines and the second is 2 Mbits for local networks. The next stage is to extend the cable to the Czechoslovakia Border at Zebzydowice.

The logical extension of the network should be between Warsaw and the DOKP offices and to the border stations, together with electronic exchanges. This network will be the basic data network for management information systems, seat reservations and container handling systems. With the restructuring of PKP it may well be determined that DOKP offices are no longer in the correct locations and therefore the review of the data network requirements must be carefully analyzed to ensure that information is correctly routed. This indicates a system approach in the analysis.

At present PKP has 40 telephone exchanges, including those of the headquarters and DOKP offices, which are superannated and old technology with no spare-parts support. These essential communication links are to be brought up to date by replacement with electronic exchanges capable of switching both voice and data communications.

4.6.5 Electric Traction Equipment

There is currently a Centralized Substation Control (CSC) system in use on the CMK line which controls 260 kms route with 12 sub-stations. The control equipment has been designed by CNTK and is operated by duplex micro-computers and multi-audio frequency transmission. Should the CSC be provided to serve all 430 substations there would bring a saving of 1,500 operators. But introduction of CSC is a requisite for high reliability of electrical equipment such as rectifiers and circuit breakers.

An examination of the present contact wire system by CNTK has shown that to operate satisfactorily for 160 kph the overlaps of the contact wire system and the tensions in the wire and anchorages need to be improved. Technical studies have shown that the design for the CMK line will be suitable for 200 kph running but testing is needed to confirm this.

Generally speaking high speed traction has a greater power requirement depending on the characteristics of the locomotives, and consequently the capacity of the substations may have to be raised. Modern locomotives with thyristor control AC motors are usually provided with regenerative braking, for which substations have to be able to receive power from the locomotives. This aspect cannot be separated from locomotive design.

4.6.6 Environment Protection

Environmental problems from railway operations are noise, vibration, waste effluent from trains, water and oil from depots and workshops. Whilst there is common knowledge about the atmospheric pollution from industry, it is only a matter of time before public opinion develops to make PKP conform to accepted international standards. It is therefore recommended that PKP establishes an Environmental Bureau within the Technology Development Department staffed with specialists in specific environmental affairs.

1) Noise

PKP should commence paying attention to noise, as it is not easy to remove noise from railway operations, and there are severe conflicts arising within communities. JR and its predecessor JNR have spent much money in retro-fitting noise abatement devices which could have been avoided if installed at an earlier time. Noise abatement walls are not enough, the walls have to harmonize with the environment. To examine noise the Bureau should: research available data including regulations regarding noise; study measuring technology, particularly to separate noise spectrums from wheels, rails and coach borne noises to obtain research data on noise and noise mitigation procedures.

An essential feature for railways is to promote relocation of hospitals and schools away from rail lines, particularly high speed rail because of the disturbance caused by noise. Corrugated rail is prevalent on PKP particularly on the CMK down line where it is continuous. Currently the technology is to grind rails, but where there is extended corrugation then research must be carried out to determine the causes and mitigation methods proposed and tried. Research must also include database from track geometry and rail recording vehicles.

Bridge structures generate much noise, particularly steel bridges in urban areas, where the mass of the structure is inadequate to attenuate the vibrations caused by rolling traffic loadings. Re-construction in concrete with ballasted tracks will remove most of the noise element, but the use of rubber mats and elastomeric direct fixation fasteners will mitigate effects and present a cheaper alternative for a short term temporary fix.

Control of train noise by drivers particularly relating to engine noise and whistles can be emphasized, but cannot be eliminated for safety or operational reasons.

2) Vibrations

Ground vibrations generally are not a major environmental problem, but changes in operations can stimulate complaints from residents living adjacent to the track. These changes can present severe problems of different sorts, primarily arising from faster trains where the effective mass is larger due to the increased speed and secondly with changes in vehicles where the bogie distances of rolling stock are changed in relation to the distance between rail joints in jointed track. Much vibration can be eliminated by welding rails into LWR (long welded rails) or CWR (continuous welded rail) and by increasing the track modules by strengthening the track.

3) Passenger waste effluent

The discharge of crude effluent from railway trains has been a traditional practice but it is gaining recognition that this is environmentally unsound. Waste re-circulation systems, the closed-circuit systems as used in aircraft are now becoming normal

practice. It is recommended that all new passenger rolling stock be provided with these systems as the time to phase out existing stock will be lengthy. The supporting sub-systems for this service is complex, and until facilities for servicing are available on a national basis then the coaches so fitted will require routing only between depots so equipped.

4) Draining and Spillage of Fuel and Oil

The draining and spillage of fuel and oil, and the contamination of water, requires special attention. Spillage will occur, and it is necessary that concrete aprons are built at all likely points in depots where oil or fuel spillage will occur. The drains for these points should be considered on an individual basis and oil separators and filters must be constructed at all places where locomotives stand or are serviced. This is to prevent petroleum products entering sewers, streams and ground water.

4.6.7 Traffic Safety

Railways operate on the "Safety First" principle, but budget constraints have always restricted full investment in necessary facilities because it is hard to quantify the effects of safety. Safety is essential in a modern railway and therefore investment in safety must be an on-going item in each years budget, based on PKP's philosophy on safety. Identified areas for safety application must include train signalling, level crossing facilities and work force safety.

1) Train Signalling

(1) Improvement of ATS

CNTK is carrying out tests to improve the present ATS system that has no relation to signal aspects on the CMK line. The trial system provides cab signalling by audio-frequency signals. However the following comments are made: (a) It is recommended to set speed limits for the automatic block signal, so that the ATS system will stop the train at higher speeds than the limits to provide security and safety; (b) It is recommended to employ the ATS to generate a speed pattern before a stop signal, or to duplicate signals to prevent the danger of going past a stop signal.

The trial system is more complex than systems currently available and it is recommended to develop a more simple system. ATS should be provided first on the routes with speeds of 160 kph and higher.

(2) Automatic Block

There are two types of automatic block signals currently in use, one is to provide three aspect signals for lines at line speeds less than 160 kph, and the other is four aspects for line speeds in excess of 160 kph. Four aspect signalling is used on the CMK line and three aspect on other main routes totaling about 1,600 kms. There are semi-automatic track circuits provided at boundaries of the block sections on over 14,000 kms of route where operators confirm the passing of trains.

(a) To secure train safety at high speed it is recommended to set a speed limit for signals before stop signals which will permit the ATS function to perform reliably.

- (b) To meet train speeds of 160 kph automatic block with four aspects is necessary, to meet 200 kph either five aspect signalling should be used, or the ATS modified in some manner. To meet speeds in excess of 250 kph track side signalling should be abolished and substituted by Automatic Train Control.
- (c) For semi-automatic block and to reduce the number of operators at block stations, the passing of the train as complete should be registered either by tail-end devices or by axle-counters. An alternative is to institute short track circuits at boundaries of block sections by regarding that train separation has not occurred when brake functions are proper.

(3) Installation of CTC

Installed on the CMK line in conjunction with Centralized Substation Control. Experience is limited, and CTC is preferably installed on lines for 160 kph or more or on lines with heavy traffic. The requirement is for every station to be equipped with power interlocking using solid-state technology which depends on computer technologies. The systems so far developed show that this technology is economically advantageous than relay technology. The track-side hardware remains the same, but the conventional relay room is replaced by cabinet sized racks with plug in modules occupying small space.

2) Level Crossing Safety

The number of accidents at level crossings have been static over the past decade. However there are some indications that the number may be on the increase due to increased road traffic. Should the 1991 figures be higher than 1990 PKP should promote a driver education scheme.

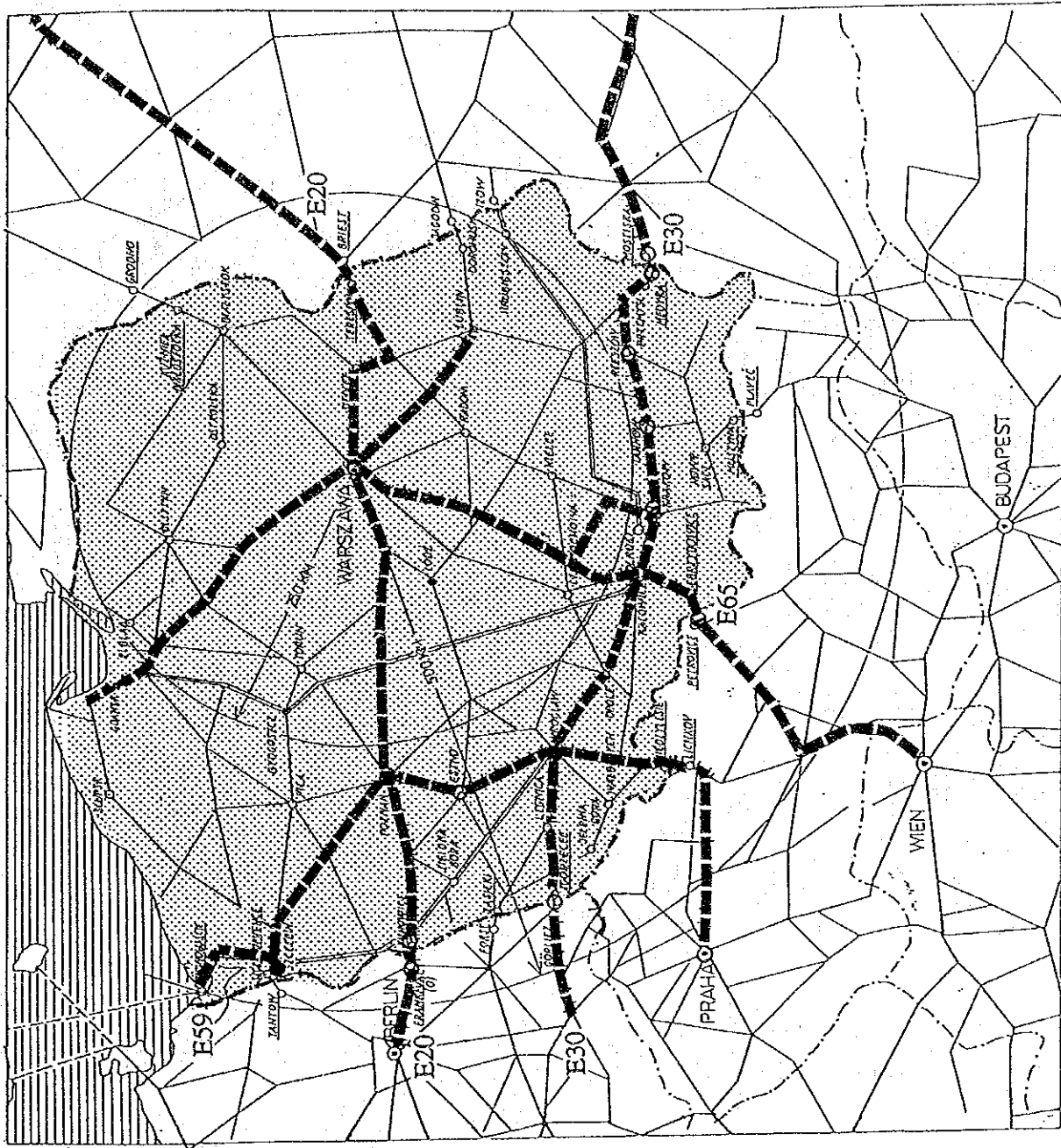
The following actions are recommended:






- (a) survey of traffic volumes. Traffic surveys are important for the basis of any improvement plan and to provide statistics to develop a budget requirement.
- (b) finance sharing for flyover construction. The benefits to the railway are not great from the construction of a flyover, but for the road are large. The rule for sharing the cost of flyover construction should be established between the railway and the road authority. In Japan the criteria used is established at about 1/3 by the railway and 2/3 by the road owner, usually the regional or city government.
- (c) closing of level crossings. PKP should use the noise value created by level crossing warning bells to be provided at unprotected level crossings as a bargain to negotiate for the closure of crossings.

3) Workforce safety

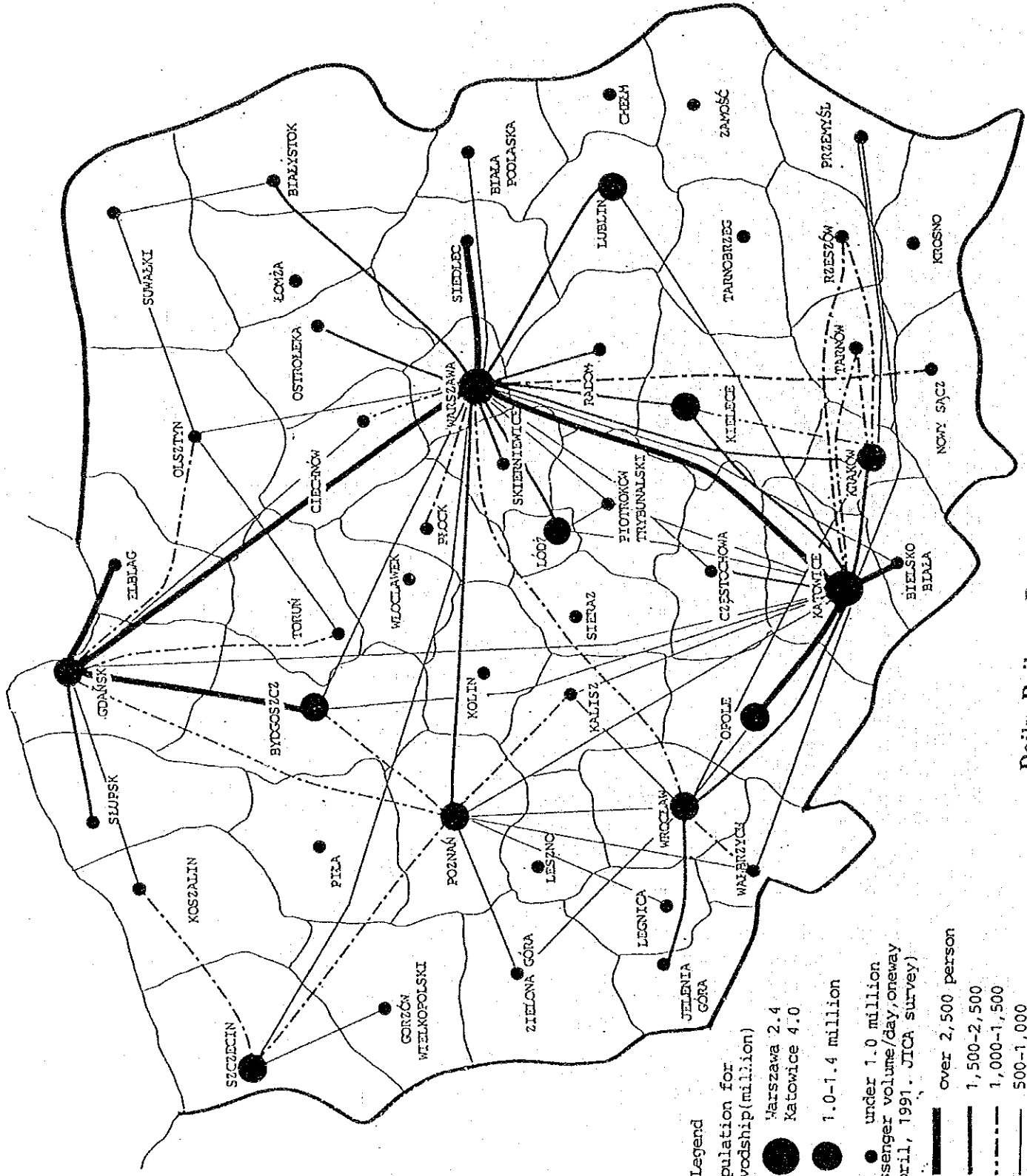
There are two considerations to be made in workforce safety, the safety of track workers and those who work for the railway. The greatest danger exists for track workers and for them special hardware is necessary to give warning of approaching trains. The second group of workers needs education of the dangers of being near the track. Worker safety is of great importance to the morale of employees and since most hardware is readily available it needs only an investigation to determine the needs and the conditions for the equipment. High speed trains require much earlier warning than conventional lines, and the elimination of steam trains has removed a well known warning signal to track workers.

4.7 DATA

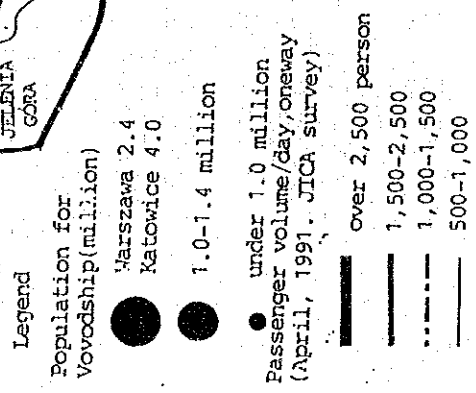


 INTER-CITY AND INTERNATIONAL TRANSPORT LINES
 BULLET CARRIED TRANSPORT LINES
 NATIONAL CAPITALS
 OTHER MAJOR TOWNS
 NATIONAL BOUNDARIES

4.7 DATA Railway Network of Poland and Its Neighboring Countries



Daily Railway Passenger Flow between Voivodship





Export Cargo by PKP, Origin and #Export Gates

Financial Situation of PKP

Unit: billion zloty

		1990	1991	1991	1992
			(A)	(B)	(C)
Passenger traffic in mil. p-km		50,300	34,200	41,040	38,000
Freight traffic in mil. p-km		83,600	52,300	62,760	61,600
Exchange rate in zlt./US\$		9,500	11,000	11,000	11,000
Number of employees in thous. P		332.6	290.1	290.1	290.1
Total revenue	A	16,906	18,971	22,765	21,800
Contents of revenue					
Passenger revenue	A1	1,712	2,499	2,999	3,600
Freight revenue	A2	14,854	16,127	19,352	18,200
Other revenue	A3	340	345	414	0
Total costs	B	18,934	24,018	28,822	37,503
Contents of costs					
Depreciation	B1	2,527	5,364	6,437	6,851
Personnel costs (1)	B2	6,027	8,967	10,761	11,501
Other costs (2)	B3	10,380	9,687	11,624	19,151
Subsidies	C	3,535	2,632	3,158	15,361
Contents of subsidies					
for passenger transport	C1	1,535	1,573	1,888	6,202
for maintenance and repair	C2	2,000	1,000	1,200	7,500
for development			59	71	1,659
Balance					
with subsidies	A+C-B	1,507	-2,415	-2,898	-342
without subsidies	A-B	-2,028	-5,047	-6,056	-15,703
ditto before depreciation	A-B+B1	499	317	380	-8,852

Note (1) "Personnel costs" include wages, income tax, social security, and employee fund.

Figures in 1991 include estimated figures.

(2) "Other costs" include fuel and energy, material, contracted repairs and services, tax and interest

(A) Up to end Oct. 1991

(B) Estimated for 12 months 1991

(C) Budget for 1992

Revised Passenger Fares

The fares were revised in 1991, which increased average passenger revenue in 1991 to 102 zt/person-km from 34 zt/person-km in 1990. However, the passenger fares covers only less than one fourth of the costs for passenger transport in 1992 budget:

Passenger revenue	3,600 billion zt
Passenger transport costs	18,906 ditto
Freight revenue	18,200 ditto
Freight transport costs	18,597 ditto

Sharing of costs by kinds of transport. Cost sharing by passenger transport and freight transport was revised in 1991.

	1989	1990 (revised)
Passenger traffic in bill.p-km	55.1	50.3
Freight traffic in bill.t-km	111.2	83.6
Total costs in bill.zt	2,684	18,777
Passenger costs in bill.zt	919	9,081
Freight costs in bill.zt	1,734	9,696
Other costs in bill.zt	31	0

In 1989, most of the costs for infrastructure are shared by gross ton-km of the trains, but after the revision the infrastructure costs are shared equally.

Comparison of Average Works Per Employee

Name of country	Poland PKP 1989	France SNCF 1988	West G. DB 1988	Japan JR 1988
Route length in km	26,644	34,365	27,284	21,271
Electrified in km	11,016	11,911	11,669	11,138
Pass. traffic in bil. p-km (A)	55.9	63.1	41.0	204.7
Freight traffic in bil. t-km (B)	111.0	53.8	60.2	20.1
Total traffic in bil. pt-km (A+B)	166.9	116.8	101.2	224.8
Total traffic km in mil. km (C)	411.8	483.5	589.9	558.7
Number of employee in thous. (D)	348.8	204.6	240.8	187.4
Average works per employee				
Traffic/employ. in thous. (A+B/D)	478	571	420	1,199
Train km/employ. in km (C/D)	1,180	2,363	2,450	2,981

Number of Employees and Traffic Volume

		Actual results		
		1989	1990	1991
Passenger traffic in bill. p-km (A)		55.8	50.3	39.9
in %		100.0	90.1	71.5
Freight traffic in bill. t-km (B)		111.2	83.6	67.3
in %		100.0	75.2	60.5
Total traffic in bill. (A+B)		167.0	133.9	107.2
in %		100.0	80.2	64.2
No. of employees in thous. (C)		348.8	332.7	290.1
in %		100.0	95.4	83.2
Total traffic/employee in thous. (C)/(A+B)		478.8	402.5	369.5
in %		100.0	84.1	77.2

Number of Employees Engaged in Operating Freight Trains on the CMK Line

Category of task	No.
Traffic employee	200
Signal employee	50
Substation employee	60
Track employee	50
Gate keeper	30
Locomotive depot	900
Wagon depot	150
Total	1,430

Intercity Trains on Major Lines

Section	Distance time (1)			Speed in Km/h		Trains one way
	km	h,	m	Max.	Ave.	
Warsaw-Krakow	287	2	45	160	104.4	9
Warsaw-Katowice	293	2	40	160	109.9	13
Warsaw-Gdansk	329	3	30	120	94.0	15
Warsaw-Poznan	306	3	4	130	99.8	15
Warsaw-Lublin	175	2	16	120	77.2	9
Warsaw-Terespol (2)	210	2	30	120	84.0	12
Warszawa-Bydgoszcz	288	3	45	120	76.8	7
Warszawa-Wroclaw	385	5	0	120	77.0	11
Poznan-Szczecin	214	2	47	120	76.9	15
Poznan-Kunowice (3)	168	2	33	120	65.9	11
Poznan-Wroclaw	165	2	15	120	73.3	13
Krakow-Przemysl (2)	245	3	32	120	69.3	8
Krakow-Katowice	78	1	40	120	46.8	19
Katowice-Wroclaw	180	3	8	120	57.4	16
Wroclaw-Zgorzelec (3)	163	2	45	100	59.3	5

Note (1) "Time" indicates travelling time of the fastest train.
 (2) at Russian border
 (3) at German border

Source: Time-table PKP: April 1991

Shows current demand estimated by JICA for main inter-city trains.

	Domestic	International	Total
Warsaw-Katowice/Krakow	9,995	1,057	11,052
Warsaw-Gdansk	10,556	319	10,875
Warsaw-Pozan	4,967	1,285	6,252

Unit: person/day/oneway, average in April 1991. Source: JICA survey.

Number of Passengers at Border Crossings

Corridor	Number
Kuznica Bialostoka	1,988
Terespol	2,144
Dorohusk	1,326
Medyka	2,153
Muszyna	558
Zebrzydowice	1,540
Miedzylesie	1,248
Zgorzelec	267
Tuplice	45
Kunowice	1,795
Szczecin Gumience	144
Total	13,208

Number: Person/day/oneway,
Source: JICA survey, average of
Jan. - Feb. 1991.

Average Daily Volume of Export Goods

Export Gates	Volume
Terespol	3,220
Dorohusk	1,153
Hrubieszow (LWS)	1,045
Medyka	1,020
Marhowice	2,266
Muszyna	1,864
Zebrzydowice	3,490
Chalupki	3,688
Miedzylesie	6,544
Zasieki	4,362
Kunowice	2,097
Kostrzyn	3,237
Szczecin Gum.	3,119
Szczecin	10,890
Swinoujscie Port	12,416
Gdynia Port	11,671
Gdansk Port	14,242
Others	3,196
Total	89,520

Unit: ton/day.
Source: JICA survey, April, 1991.

PKP Investment over the Past 10 Years

(unit: million US\$)

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
US\$	320	408	474	518	580	503	520	308	312	324

The future annual PKP investment budget may be expected to surpass US\$ 300 million. Depreciation accounted for US\$ 240 million of the investment budget in 1988, 75 million in 1989 and 187 million in 1990.

**CHAPTER 5 ROADS AND ROAD
TRANSPORT PLAN**

CHAPTER 5 ROADS AND ROAD TRANSPORT PLAN

5.1 Major Issues of the Road Sector

The road sector has, like other modes of travel in Poland, been dramatically impacted by the transformation of the nation's economic restructuring. The road sector must, furthermore, cope with these changes in two broad areas, namely, type and extent of road infrastructure as well as road operations and operators. Key issues related to the road sector can be summarized as follows:

- (1) The rapid growth in motorization catalyzed by increasing popularity of the passenger car as well as shifts in cargo shipments toward the truck mode. The experiences of foreign countries infer that motorization will be furthered in the coming years in Poland as well.
- (2) The existing road network is extensive and generally perceived as being able to reasonably cope with existing traffic levels. However, rapid increase in vehicular traffic is expected in the future. Congestion is already appearing in urban areas and major demand corridors. More measures to solve the traffic bottlenecks need to be introduced.
- (3) Conditions of roads have been deteriorating due to the shortage of budget allocation to road maintenance and rehabilitation. This situation should be improved to avoid increasing costs to the society especially through increase of vehicle operating costs. At the same time, quality improvement of roads needs to be pursued to comply with quick and safe travelling of vehicles.
- (4) The ability of the Polish government to finance extensive upgrading of road infrastructure is in question. The formation of creative financing packages therefore seems prudent.
- (5) The transition from centrally controlled to free market economic structure implies a reduction in government's control over transport operators. The government needs to adopt appropriate policy measures to guide the orderly transition of the market.
- (6) The Polish trucking industry is inevitably transitioning from a single state owned entity to a conglomerate of multiple private operators in many cases without the benefit of administrative or regulatory guidance. In addition, the industry as a whole faces increasing challenges from foreign operators. The trucking industry needs to be rationalized and modernized for higher operational efficiency.
- (7) The Polish trucking industry needs to be prepared for higher quality of services by modernizing their truck fleet to comply with demand for containerization and special cargo transport by introducing suitable type of trucks.
- (8) The public transport (inter-city bus) sector features an extensive route network. However, patronage, and thus revenue, continue to decline even as costs steadily escalate. Requests for additional subsidies to a government which is increasingly less able to provide them can, therefore, be expected.
- (9) In accordance with the progress of motorization, environmental problems will become intensified and traffic accidents will increase. Measures to alleviate these problems need to be strengthened including the view point of harmonizing the Polish standards with those of the European Community.

- (10) Poland is moving toward full membership in the EC. Thus, a staged conformation to EC regulations, standards and guidelines will be required. Restructuring of the road transport administration is concurrently mandated.

The issues are explored in subsequent sections of this chapter, along with potential courses of action.

5.2 Policy for Road System Development

5.2.1 Road Standards and Classification

1) Administrative Strata for Road System

The road administration system in Poland consists of three levels: (1) national; (2) regional (voivodship); and (3) local (commune). At present, the Ministry of Physical Planning and Construction as well as the Central Planning Board are working for spatial and physical planning. The new act proposed to the Parliament by the Ministry of Physical Planning and Construction envisages changes of physical planning systems with a focus on land use and infrastructure planning.

The central government is entrusted with the task to make plans at the national and regional levels while local governments make plans at the local level (commune level). The central government assists local governments in technical and financial aspects. The technical assistance includes establishment of a planning methodology and an advisory office for planning. The financial assistance could include supplying funds to local governments for certain purposes of physical development. However, the physical plans of national and regional levels have not been developed since 1978. Also voivod offices have no specified functions bridging central with local governments. Therefore, there is a huge gap of road planning and administration between the central government and communes. National and regional road plans need to be developed as one of the most important guidance to coordinate central and local levels.

2) Establishment of Road Functional Class

The public road system in Poland is formed under the following four categories: (1) National Roads; (2) Voivod Roads; (3) Commune Roads; (4) Industrial Roads. This system is defined by their functions. In the road code there are no definitions of roads below voivodship road in the rural system and a complete lack of definitions of urban system.

The road classification by function is the indicator of importance of roads as well as the indispensable criteria for determination of administration and for planning/design purposes. It is also needed to separate urban and rural functional systems because these areas have completely different characteristics in terms of population density, type of land use, network densities, and travel patterns. Therefore, functional road classification needs to be introduced, for example artery, collector and local roads in rural and urban areas.

3) Geometric Design Standards

Poland is a signatory to the European Agreement on Main International Traffic Arteries (AGR) and is also a founder member of the Trans European North-South Motorway (TEM). The Poland geometric design standards of major roads, motorway, express road and inter-regional road, are basically satisfies the respective standards of TEM and

AGR. Polish motorways and express highways have a lane width of more than 3.5 m, a median width of more than 3.0 m and a shoulder width of more than 2.5 m for express road, and 3.0 m for motorway.

However, there are some problems regarding shoulders, median and frontage roads. Express highways have shoulder width of 2.0 m while inter-regional roads ("E" roads) have that of 1.5 m. These widths should be more than 2.5 m as a rule. This is particularly needed for safety purposes although benefit and cost analysis is required. The narrower width should be applied only for the severe terrain and limited right-of-way conditions. Otherwise, parking areas (stopping points) should be provided at intervals.

4) Road Facilities

There are many road sections with less provision of frontage roads although they have considerable slow moving local traffic (horse drawn, agricultural vehicles, pedestrian, etc.) on the shoulders. The need is great in many rural areas because the high speed and general lack of adequate lighting make them risky to use the shoulder. The frontage road should be provided for such locations from both traffic safety and through traffic efficiency view points. There are no provisions for safety fence and glare screens in some medians in case of the width of less than 6 m, and these should be provided for safety purposes.

5.2.2 Road System Development

1) Objectives of Road System Development

Main objectives of road system development are: (a) to cope with increasing vehicular traffic; (b) to encourage the integration of Poland with the international community; (c) to encourage balanced development of regions; and (d) to improve traffic safety.

- (a) **Coping with Increasing Traffic:** Vehicle registration in Poland continued to increase rapidly from 5.5 million in 1980 to 9.8 million in 1991 with an annual growth rate of 5.4%. Car ownership rate in 1991 reached almost 160 cars per thousand population as the national average and almost 300 cars for Warsaw. Due to this rapid increase of vehicles, coupled with higher dependence on road transport, traffic congestion is often observed in urban areas and in their vicinity. Car ownership rate is estimated to increase further toward 2005 (to about 300 per thousand). Road capacity needs to be increased to cope with the advancing motorization.
- (b) **Encouragement of the Polish Integration with International Community:** Poland is located at the crossroads of east - west and north - south international transport corridors. Road development is vitally important to strengthen Polish international interactions with neighboring countries through providing better accessibility. Road development in Poland is also of great interest to these countries for travelling across the country, particularly between the EC countries and CIS, and between the Baltic League nations and central/southern European countries. Motorways of international standards are needed to this end.
- (c) **Encouragement of Balanced Development of Regions:** Main urban centers are evenly distributed to every part of Poland. Due to the absence of extreme concentration of urban functions to the capital city, each urban

center has their own regional entity with neighboring domestic as well as foreign cities. In this context, development of inter-regional roads is important for encouraging regional economy.

- (d) Improvement of Traffic Safety: The statistics between 1988 and 1991 showed a 44.0% increase in accidents, a 62.9% rise in total casualties, and 49.5% increase in injuries. However, the increasing trend was changed to a decreasing or leveling trend in the latest months. Comparing the 4th quarters of 1990 and 1991, traffic accidents decreased an 8% in the number of accidents, a 9% in fatal casualties and a 7% in other injuries. For the first quarters of 1991 and 1992 these figures were plus 1%, minus 10% and plus 2.6%, respectively. The decline of traffic accidents could be attributable to the strengthened enforcement of seat belt wearing, lighting and maximum speed limit introduced recently.

2) Policies for Developing Road System

Development of a roadway network is, in its most basic sense, driven by a need to accommodate vehicle trip demand. However, additional benefits to be gained through an enhanced road network are the stimulus to economic growth, reduced transport cost, and enhanced regional development. Furthermore, trade with neighboring nations will be facilitated, an important consideration in Poland's case given the economic importance of its Western neighbor Germany and the European Community.

Thus, a series of topical policies which govern development of the road network include:

- (a) Define an inter-urban road network which promotes regional development, caters to increasing traffic demands, and integrates the Polish road system into the international road network. This policy is to be pursued through progressive upgrading of the existing road network at a rate which is dependent upon available financial resources.
- (b) The inter-regional transport corridors involving urban agglomerations with high development potential should be stressed. Especially in case of the corridors which must cater to international traffic, they should be prioritized in the road development program to promote EC, etc. integration.
- (c) Inter-regional transport corridors with high development potential should be developed to promote economic integration between regions. For this purpose various bottlenecks on existing roads should be improved and the existing roads should be well maintained to make the best use of the existing facilities.
- (d) Segregate through traffic from local traffic in major urban areas via the construction of by-passes and the alleviation of local traffic bottlenecks such as bridges and low capacity junctions.
- (e) Improve traffic safety.
- (f) Mitigate adverse environmental impacts.
- (g) Rely on a road financing scheme which meets the balanced needs of investment, rehabilitation and maintenance. These policies carry several important implications which should be noted.

The extent of the needed year 2005 road system, even if culled to its most needed elements, is nevertheless likely to be extensive relative to the 1990 system. The ability of the Polish Government to finance a road building program of such a large scope is questionable given the current economic outlook and competing national non-transport interests.

These policies and issues therefore underline the testing and development of the road network under analyses of future road system.

3) Analysis of Future Road System

(1) Overview

Road traffic is expected to increase sharply within the study's planning horizon toward 2005. This increase will apply to both passenger and goods traffic and to both travel within Poland and across its borders. The scale of these increases has been estimated and it is on this basis that road network modelling is accomplished. Because of the strategic nature of the model, it is only possible to predict future traffic volumes on the inter-regional route network. Shorter distance intra-urban / intra-voivod trips do not reach the network, consequently, sections of the system, particularly roads in major urban areas, are likely to carry higher traffic volumes than predicted.

Poland is strategically located astride major North-South and East-West European transport corridors. Poland is a signatory to the European Agreement on Main International Traffic Arteries (AGR) and a network of "E" routes is already established throughout the country. In addition, Poland is a founder member of the Trans-European North-South Motorway (TEM) Project.

International roads are therefore fairly well established along Poland's Western and Southern borders although the standard of Polish roads currently falls below those of West European nations. The future strategic road networks to the East in Russia, Belorus, Ukraine and the Baltic states are not well defined at present. Whilst the demand for road transport is also expected to increase rapidly in these countries, the scale and the timing of this increase is more difficult to forecast as is the extent of potential road improvement projects. Furthermore, a new system of international border crossings is still developing. Consequently, the future standard and location of international corridors within Eastern Poland is uncertain.

(2) Analytical Framework

The analysis proceeded in a step wise manner, during which alternative networks were subjected to existing and future vehicle trip demand. The initial network tested was the 1990 highway network, which encompasses almost 11,600 road kilometers including 1,100 kilometers 2-lane regional roads, 9,520 kilometers 2-lane inter-regional roads, 730 kilometers 4-lane inter-regional roads, and 230 kilometers 4-lane motorway (Fig. 5.2.1).

The second network represents the 2005 development which is likely to be required at the conclusion of the current planning program. It is, from a transport perspective, more correct to indicate that future year demand projections and requisite road improvements reflect the achievement of a stated socio-economic condition, which may or may not occur precisely in the year 2005.

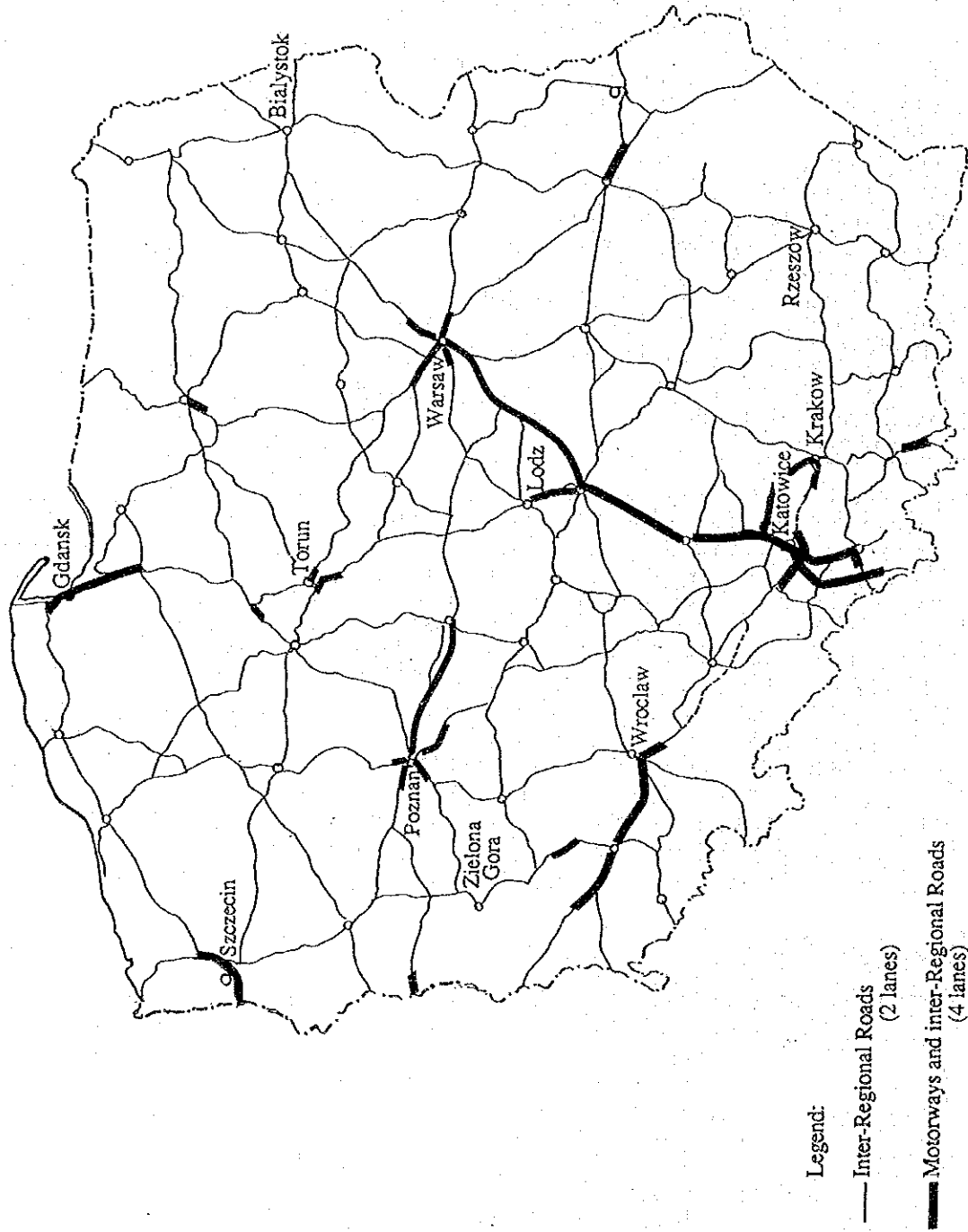


Fig. 5.2.1 1990 Highway Network

The designated strategic network is made up of various roadway categories / definitions employed by the Polish Roads Authority. It includes the entire E-road system, almost all inter-regional roads and some of the more important portions of the regional road net.

(3) Sufficiency Analysis

The assignment of 1990 demand on the 1990 network confirms that there are no significant problems resulting from a lack of capacity on the inter-regional road system. The volume to capacity ratio, for the systems as a whole, suggests that about one-third of available capacity is, on average, being utilized (Table 5.2.1, Case I). Observed 1990 traffic flows confirm this with only very isolated instances where flows exceed 10,000 vehicles per day on a single carriageway inter-regional link. Problems associated with traffic capacity are generally found in or near major urban areas which points to a need for by-passes of those areas.

There are several major cities (with more than 100,000 population) in Poland where traffic using international routes still passes through the heart of the urban area because of the lack of an effective by-pass. These include:

- Route 1 (E 75): Gdansk, Torun, Wloclawek, Lodz.
- Route 2 (E 30): Poznan, Warsaw.
- Route 3 (E 65): Gorzow Wielkopolski, Zielona Gora.
- Route 4 (E 40): Opole, Katowice (upper Silesian Region), Krakow, Tarnow, Rzeszow.
- Route 5 (E261): Bydgoszcz, Poznan, Wroclaw.
- Route 6 (E 28): Koszali.
- Route 7 (E 77): Gdansk, Warsaw, Radom, Krakow.
- Route 8 (E 67): Wroclaw.
- Route 9 (E371): Rzeszow, Radom
- Route 96 (E462): Bielsko Biala.

The assignment of future demand onto the 1990 network results in rapid increases in passenger car unit (pcu) kilometers, pcu hours and system-wide volume-capacity ratios. It is clear that the current network may not be able to cope with the 2000 demand, certainly not with the 2005 demand (Table 5.2.1, Case II, III, IV). The assignment of 1995 demand onto the 1990 network over 90 percent of which consists of two-lane roads, reveals that the capacity of several links has been exceeded. These include:

- Route 1: Lodz Route 2
- Route 2: Konin to Route 1
- Route 3: Through Zielona Gora and south towards Lubin
- Route 5: Poznan to Leszno
- Route 7: Kielce to Jedrzejow and Zakroczyn to Plonsk
- Route 10: Torun to Bydgoszcz
- Route 14: Sieradz to Lask

Table 5.2.1 Network Sufficiency Evaluation of 1990 Highway Network

Case I: 1990 Demand on 1990 Network

Road Type (1)	Road Kilometers		MILLION PCU Kilometers		PCU Hours (0000)		Volume to Capacity (2)
	Number	Percent	Number	Percent	Number	Percent	
1	1,095.0	9.5	4.124	85.4	6.126	5.8	0.25
2	9,520.5	82.3	58.946	77.3	83.378	79.0	0.34
3	729.0	6.3	10.746	14.1	13.545	12.8	0.34
4	225.1	1.9	2.446	3.2	2.575	2.4	0.21
Total	11,569.6	100.0	76.261	100.0	105.624	100.0	0.33

Case II: 1995 Demand on 1990 Network

Road Type (1)	PCU Km (Mln)	PCU Hrs (0000)	Volume to Capacity
1	7.176	10.855	0.44
2	92.383	135.688	0.54
3	16.084	21.192	0.50
4	4.367	4.616	0.37
Total	120.010	172.351	0.52

Ratio to Case I		
PCU Km	PCU Hr	Vol/Cap.
1.74	1.77	1.76
1.57	1.63	1.59
1.50	1.57	1.47
1.79	1.79	1.76
1.57	1.63	1.58

Case III: 2000 Demand on 1990 Network

Road Type (1)	PCU Km (Mln)	PCU Hrs (0000)	Volume to Capacity
1	11.848	18.623	0.72
2	129.965	200.391	0.76
3	21.652	29.554	0.68
4	7.158	7.658	0.61
Total	170.623	256.226	0.74

Ratio to Case I		
PCU Km	PCU Hr	Vol/Cap.
2.87	3.04	2.88
2.20	2.40	2.24
2.01	2.18	2.00
2.93	2.97	2.90
2.24	2.43	2.24

Case IV: 2005 Demand on 1990 Network

Road Type (1)	PCU Km (Mln)	PCU Hrs (0000)	Volume to Capacity
1	19.265	32.794	1.17
2	205.215	345.973	1.20
3	29.515	43.472	0.92
4	10.822	12.274	0.92
Total	264.817	434.513	1.14

Ratio to Case I		
PCU Km	PCU Hr	Vol/Cap.
4.67	5.35	4.68
3.48	4.15	3.53
2.74	3.21	2.71
4.42	4.77	4.38
3.47	4.11	3.45

- (1) Road Type 1 = regional road (2 lanes);
Type 2 = inter-regional road (2 lanes);
Type 3 = inter-regional road (4 lanes);
Type 4 = motorway (4 lanes).
- (2) Average system-wide (all links included) volume to capacity ratio at Level of Service C/D.

The assignment of 2000 and 2005 volumes on the 1990 highway network which assumes that no improvements take place, results in increasing demands on available capacity. Significant portions of the network in the Western part of Poland come under stress reflecting overall increase of domestic traffic as well as the sharp increase in cross-border trips between Germany and Poland predicted during that period. By 2005 a large increase in trips across Poland's Eastern border are also predicted but it is less certain to which border crossings these will channel.

(4) Implications of Analyses on Road Systems

The analysis leads to several conclusions regarding sufficiency of the roadway network. It is appropriate to surmise that upgrading of road facilities emerges as a critical priority given anticipated future domestic and international trends in vehicle ownership, person travel and truck cargo transport.

- (a) Superimposition of year 1995, 2000 and 2005 demand onto the 1990 network reveals that sizable portions of the road system will no longer be able to operate at an acceptable level of service.
- (b) An 2005 road scheme which is commensurate with the year 2005 demand is required. This concept should embrace the judicious provision of motorway and multi-lane, rural highway-class facilities in key corridors of demand. An implementation and staging program is required to reflect uncertainties in likely levels of available funding.
- (c) It is anticipated that four-lane cross-sections are appropriate for higher order road facilities in order to meet the projected year 2005 demand. However, some motorway sections may, in the longer future term, require a six-lane cross-section. It may well be prudent that, as a general rule, all motorway right-of-way acquisitions reflect this eventuality, as should design criteria for key facilities such as bridges.
- (d) Motorways and inter-regional roads within Poland are expected to link with similar facilities provided in neighboring countries, particularly Germany. Currently, crossing Poland's borders by road can be a time-consuming effort. It is therefore vitally necessary that border facilities and legal formalities be improved to the highest degree possible in order to optimize the vehicle throughput of each border crossing and to maximize the capacity and speed advantages realized through the implementation of higher-order road facilities.