TYRETECH '90

Papers from a two-day seminar
organised jointly by
European Rubber Journal
and
Rapra Technology Limited

5th-6th November 1990

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ROLAND NEWELL

Mr. Roland Newell is a principal scientist who joined the MRPRA - Malaysian Rubber Producers Research Association - in 1969. After obtaining his BSc in 1971, he spent three years in the chemistry group working on the development of urethane crosslinking systems.

In 1977 he transferred to the dry rubber technology group and is now project leader in charge of tyre research.

MARTIN J. RODEN

Martin J. Roden graduated from Imperial College, London University, with a degree in physics in 1964 and joined the research department of ICI Fibres at Pontypool in South Wales. Initially working on new nylon process development, but then spent many years on the fibre makers 'holy grail' - how to make wool from polyester!

In 1977 he transferred to what was then the industrial department - now technical products group - beginning his involvement with high tenacity yarns and the rubber industry. He worked for some years on developments for conveyor belting and then moved on to tyres. Becoming in 1987 Development Manager for rubber reinforcement responsible for a small team operating the development laboratory. This is currently located at ICI Fibres' Harrogate headquarters site but will shortly move to new facilities at our Doncaster factory where our heavy decitex nylon yarns for the rubber industry are produced.

THOMAS F. SCHULER

Thomas F. Schuler is a graduate of the University of Virginia, having a BS in Mechanical Engineering. During his 5 years employment at Du Pont he has gained experience in robotic development, for the past 3 years he has worked on manufacturing, coupled with research and development of Kevlar short fibres.

IMRE SIVÓ

Imre Sivo was born in Budapest, Hungary on 23rd February 1954, graduating from the Technical University Budapest as a chemical engineer having specialised in industrial engineering. He has now been working for Taurus for 12 years, his experience includes working as technical manager, chief engineer, plant manager in the tyre factory Budapest, head of tyre development for Taurus, technical director for Taurus tyre division.

Since 1989 he has held the position of vice president in charge of tyre division Taurus.

Taurus Tyre division manufactures and sells Taurus and other tyres in Hungary and worldwide. (Sales USD 180 M, 3500 employees, two factories).

He is a member of the corporate council, board of directors in Taurus and subsidiaries.

CHRISTOPHER R. STONE

Christopher R. Stone was born in Nottingham, England in 1940 and educated at Grammar School.

After two years as a trainee with Avon Rubber, he attended the National College of Rubber Technology obtaining an APRI in 1963.

He subsequently worked for a number of tyre and industrial rubber product producers in U.K. and in 1976 went to Iran as Technical Manager of Melli Caoutchouc Co., leaving there in November 1978 due to the somewhat unstable political situation.

Has worked for Monsanto Europe S.A. since April 1979 in the Marketing Technical Service Group of the Rubber Chemicals Division where his primary responsibility has been the East European Market.

ITSUO TANUMA

A graduate from the school of applied chemistry, Waseda University, Tokyo, Japan.
He obtained his Masters degree in Applied Chemistry in 1972. Since January 1990 he has become manager responsible for adhesion and surface treatment, at the Bridgestone Corporation, Technical Centre, Tokyo. His major accomplishments as a research chemist include R & D of structural adhesives, transparent adhesives and surface treatment of rubber surface for adhesion promotion.

GEORG TARGIEL

Georg Targiel studied at RWTH, Aachen, specialising in mechanical engineering and plastics technology.

From 1977 until 1982 he worked as an assistant at the Institut fur Kunststoffverarbeitung at Aachen, where he completed a dissertation on Thermodynamic-Rheological Design of Rubber Extruder. He then joined the department of process technology at Metzeler, Lindau in 1982, leaving in 1984 to become the Manager of the Development Department at Paul Troester Machinenfabrik, Hannover.

NORIAKI TATENO

Noriaki Tateno graduated from the faculty of Industrial Chemistry, Tokyo University in 1966. After entering into Yokohama Rubber Co., he has worked on research in rubber adhesion and development of PCR and TBS tyre compounds.

Over the last 2 years he has been resident engineer for tyre technical exchanges with Continental in Hannover, West Germany.

INTRODUCTION

The 1980's proved to be one of the most dramatic decades in the tyre industry's history. Mergers and takovers transformed the business scene, while improved materials and manufacturing techniques allowed unprecedented levels of production efficiency and quality.

The 1990's seem set to be another eventful decade. Many analysts predict that the series of changes in ownership is not yet complete and also that the business will be further transformed by unprecedented increases in production in Eastern Europe and in the developing nations of South East Asia and Africa.

New technology will also continue to come forward. This will be aimed at further improvements in productivity and quality and at meeting the growing challenges posed by more demanding customer requirements, stricter product liability legislation and the need for effective and economic methods for used tyre disposal.

All these trends show that, although the tyre-business is a mature industry, it is not a static one. Its structure, markets, materials and technology continue to change and develop. During the next two days this conference will review many of these changes, covering the opportunities offered by new materials and manufacturing processes and proposing solutions to the challenges the industry will need to address in the coming years.

As ever, the organisers are happy to place on record their grateful thanks to all the speakers for the time and effort they have put into preparing and presenting their papers. We are confident that their contributions will be of value to all those involved in the tyre industry, whether as materials or equipment suppliers, manufacturers or users.

We would also like to thank all the delegates, many of whom have travelled considerable distances to participate in the conference. The response has been so positive that we now propose to organise the TyreTech conference on an annual basis.

We trust that you will find TyreTech 90 both enjoyable and informative and look forward to welcoming you to TyreTech 91 next Autumn.

Malcolm Copley
Peter Dickin
Kay Royle
Rapra Technology Limited

Bruce Davis
Babse Holmes
Paul Mitchell
European Rubber Journal

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Developments in the Tyre Industry of Eastern Europe

Imre Sivo and Dr. Laszlo Palotas

Taurus Hungarian Rubber Works,
H-1440 Budapest P.O.B. 25, Budapest VIII, Kerepesi ut 17-19, Hungary

In reply to the kind invitation to give a keynote lecture at TyreTech 90 which I was very pleased to accept, I'll try to use this unique opportunity to give you some information on the so-called Eastern-European tyre market from the point of view of a participant.

I believe this is a unique opportunity, indeed, because we can only take a snapshot on an area that is rapidly changing both from the political and the economic point of view.

I'm putting down my reflections on paper in August, 1990 and I expect that by the time the conference takes place this November, there will have been a great deal more interesting and important changes in Eastern Europe. Then, I'll have to report on these developments as well.

Getting my thoughts together, I would like to speak about three main issues:

1. Eastern-Europe in general.
2. Tyre market in Eastern-Europe.
3. Development of the Eastern-European tyre industry based on the pattern of Taurus Hungarian Rubber Works

1. EASTERN-EUROPE: SCENE OF EXPLOSIVE POLITICAL AND ECONOMIC CHANGES

Since 1985 everybody has spoken of economic and political changes in Eastern-Europe. However, the effective structural changes have only happened during the past year and a half.

Following bloody battles or peaceful transition, monolithic structures of despotic regimes have been overthrown one after the other, and the countries of the area have turned towards the Western democracies. Instead of top-down controlled economies people in the area are working on establishing decentralised and, in part, privatised market economies.

Eastern-Europe is not a homogeneous area, but the particular nations have been developing individually beyond general tendencies

The specific development of the Eastern countries reflects a number of common features after the 2nd World War. The strong Soviet power imposed identical economic and political methods to the Eastern countries. Except for the past forty years, the history, the course of development and the traditions of each nation in the area are specific. That's why I would like you to refrain from generalisation. We can only come to the right conclusions about the different industries with full knowledge of the particular countries. Because of strong national feelings, we also have to consider the nature of each nation.

We can hardly predict or estimate the speed of economic development in Eastern-Europe

Following silent and violent revolutions and [illegible] over of power, Eastern countries will start or continue to restructure their economies. Immense energies have been released there, yet, the rate of development and changes will be different.

The fortune of Eastern Europe is not solely in the hands of Eastern nations; the area can only develop into a strong market economy with the help of developed countries and, above all, with the help of Western Europe

I am convinced that the most exciting market development can be observed in Eastern Europe. If the healthy and irreversible progress is to be ensured, the particular countries and nations need allies. We can then expect the natural internal development to be accelerated and integrated into the economic system of the Western World.

From this point of view, your industries and companies have great opportunities but many responsibilities as well. Let me show you some figures to summarise Eastern Europe:

- 427.5 million people live there that is nearly 140 million even without the Soviet Union (see Figure 1).
- The per capita GDP (General Domestic Product) of particular countries show a great variance both in absolute value and the rate of progress (see Figures 2 and 3).
- Indebtedness is characteristic of the whole area. The total and the per capita rate of indebtedness

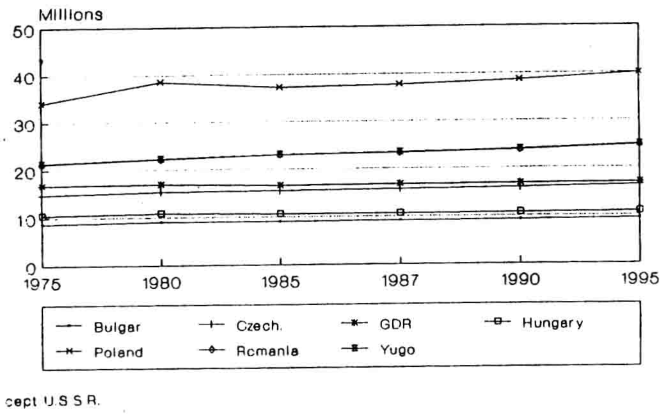


Figure 1 Population, Eastern Europe

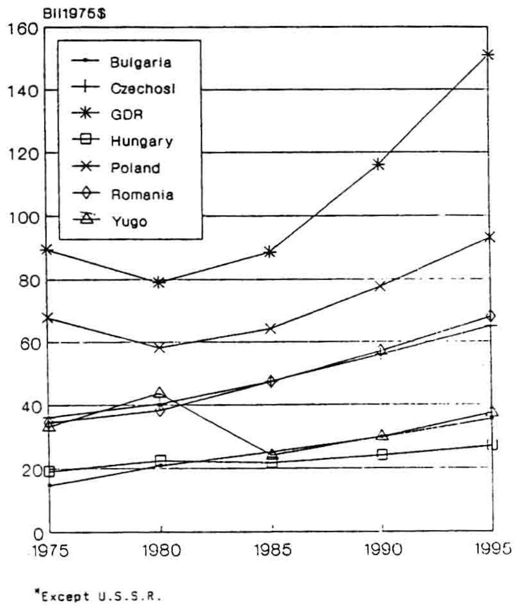


Figure 2 GDP, Eastern Europe

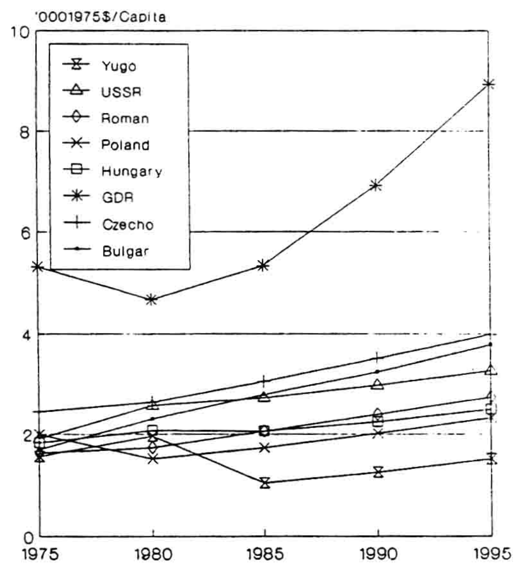


Figure 3 GDP per capita, Eastern Europe

of the particular countries reflects overall problems (see Figures 4a and 4b).

– From the point of view of tyre demand, vehicles park is of great importance (see Figures 5a and 5b).

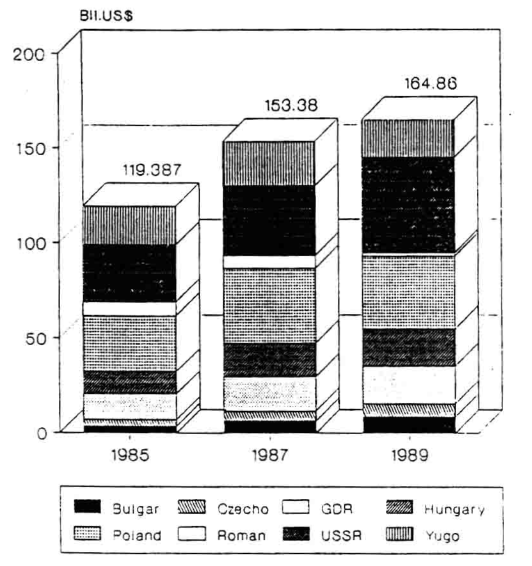


Figure 4a Gross debt 1985-1989, Eastern Europe

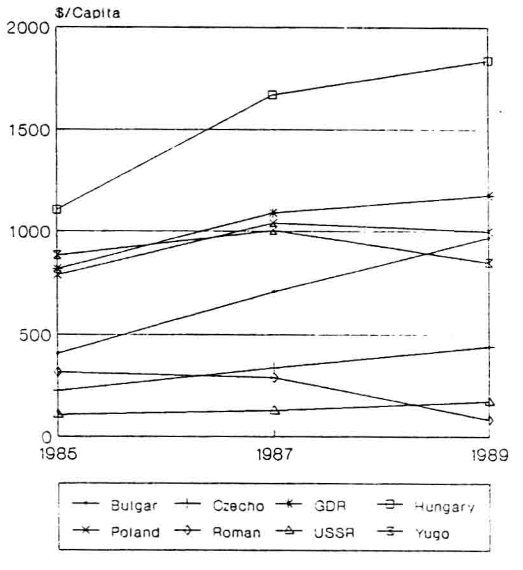


Figure 4b Debt per capita, Eastern Europe

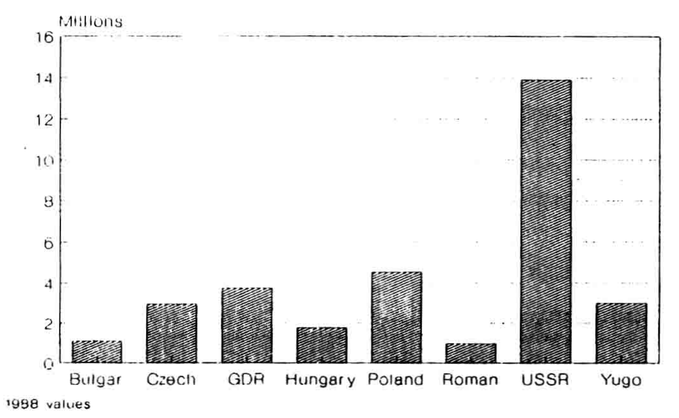


Figure 5a Vehicle park, Eastern Europe

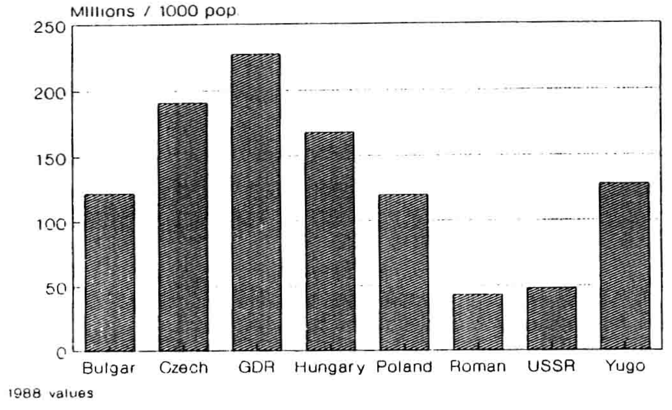


Figure 5b Vehicle park/population, Eastern Europe

standardisation have been harmonised on COMECON level. Bilateral relations between enterprises and institutions have been much more typical during the past ten years.

Old and new factories at quite a different level

Many enterprises that had been entitled to be recognised worldwide between the World Wars are still in existance, for instance Matador and Bata in Slovakia, the Polish factories in Poznan and Debica and the Hungarian Cordatic. The development of socialist industrialisation was, however, charged with contradictions after the 2nd World War. In factories of different ages mainly self-developed

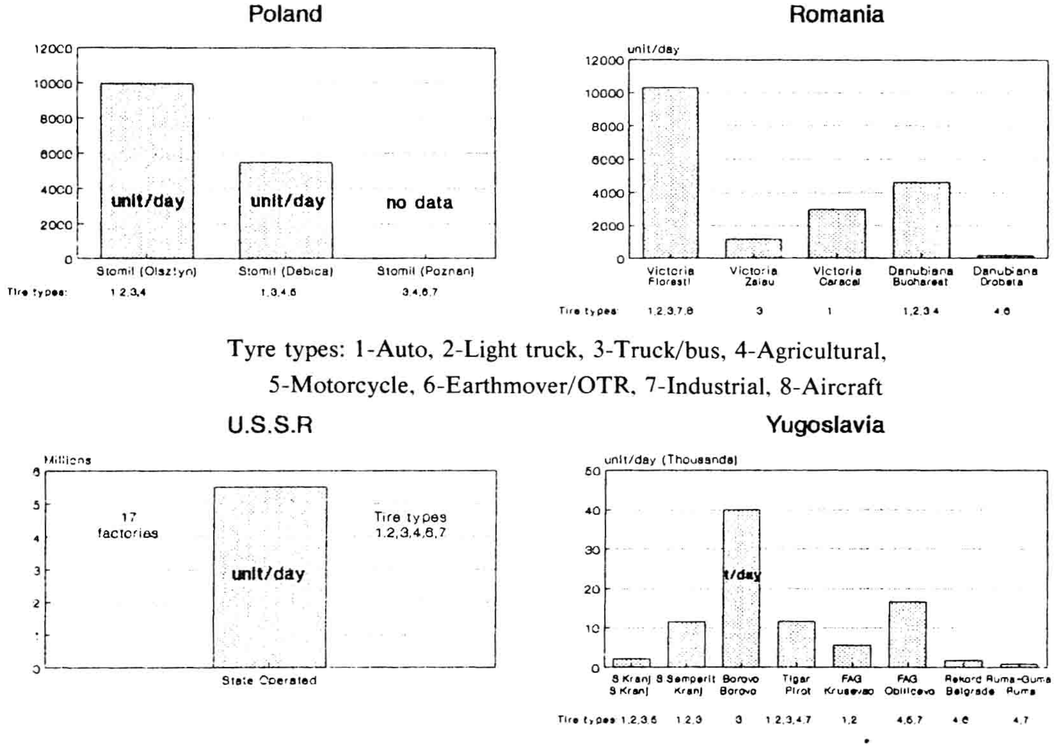


Figure 6a Production units

2. TYRE MARKET IN EASTERN EUROPE

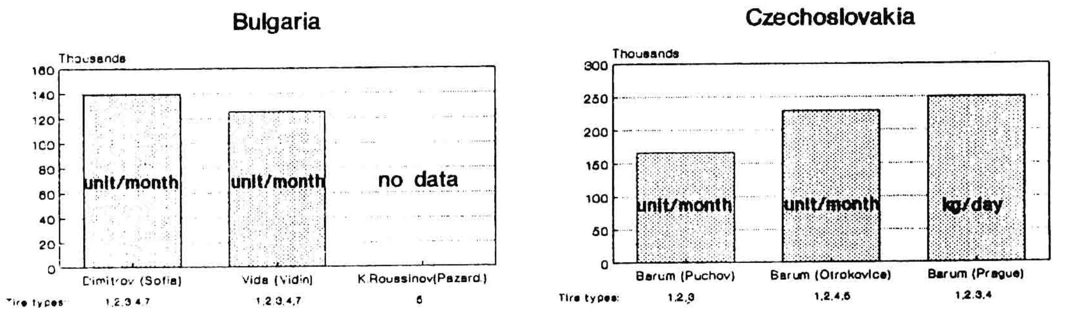
Introduction - some common features

Until 1989, tyre makers in the area were state enterprises. From among 440 tyre factories throughout the world, there are 40 in Eastern countries with a world market share of 15 per cent (see Figures 6a, 6b, and 6c).

Until the late eighties COMECON played a decisive role, having great influence on the production structure and raw materials base.

The exchange of technical-scientific results and technologies based on Eastern raw materials and equipment were developed.

The development of the tyre industry has been determined by that of background markets, especially the automotive industry, traffic and transportation as well as site facilities. Let me refer to the open question of motor-car production, and the agreements on specialisation of truck and bus production, as well as the road network differences.



Tyre types: 1-Auto, 2-Light truck, 3-Truck/bus, 4-Agricultural,

5-Motorcycle, 6-Earthmover/OTR, 7-Industrial, 8-Aircraft

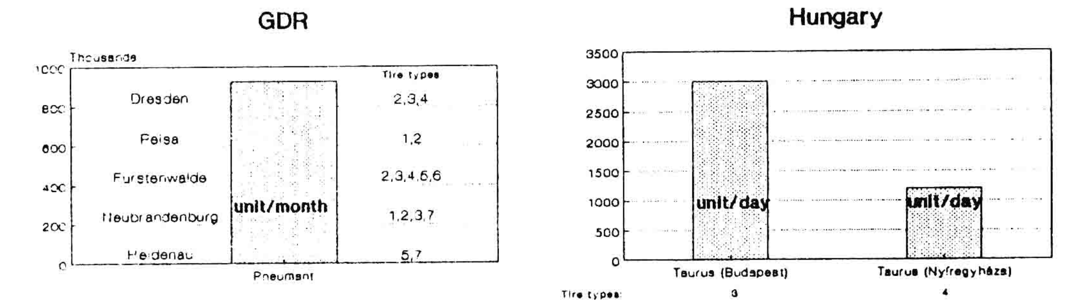


Figure 6b Production units

COUNTRY	ESTIMATED CAPATICY	TIRE TYPES
BULGARIA	264 000 unit/month	1,2,3,4,7
CZECHOSLOVAKIA	395 600 unit/month 250 t/day	1,2,3,4,5
GDR	925 000 unit/month	1,2,3,4,5,6,7
HUNGARY	4 200 unit/day	3,4
POLAND	15 450 unit/day	1,2,3,4,5,6,7
ROMANIA	19 231 unit/day	1,2,3,4,6,7,8
U.S.S.R	5 500 000 unit/month	1,2,3,4,6,7
YUGOSLAVIA	50 640 unit/day 40 000 t/month	1,2,3,4,5,6,7

Tyre types:
1. Auto
2. Light truck
3. Truck/bus
4. Agricultural
5. Motorcycle
6. Earthmover
7. Industrial
8. Aircraft

Figure 6c Production units, Eastern Europe

- Both the level of quality in industry as well as that of production management, and productivity is behind the level of Western competitors.
- As regards raw-material structure, the raw materials of the area are dominated. The rate of synthetic rubber use exceeds that in Western countries, see Figure 7.
- As a result of particular developments, local scientific research centres have achieved world standard results in theory.

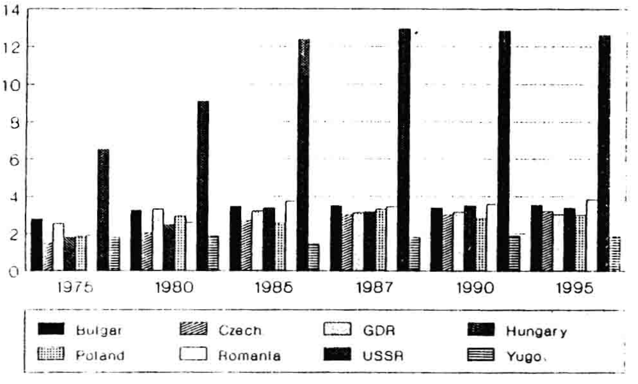


Figure 7 Synthetic rubber/natural rubber usage, Eastern Europe

How is the tyre industry in Eastern-Europe developing?

Before entering into fundamental and overall features, I would like to point out again that this problem should be examined by countries or even by enterprises, yet, there are some common features.

- Following political changes, forms of ownership have been changing as well. State-owned enterprises will be privately run.
- Among new owners, we shall also find the biggest international tyre makers who are, as a matter of fact, interested in penetrating into these markets.
- The structure of national tyre companies will be changed. Tyre enterprises set up to compete with each other will be separated and then merged in new alliances.
- Technical development will progress in accordance with the requirements of the global tyre market: new units of high efficiency and technical levels will be established in order to adapt to the international manufacturing integration.
- Eastern European manufacturers will adopt Western technical standards.
- Tyre industry in Eastern Europe should become nature friendly and should not pollute the environment any longer.
- How quickly industry can be restructured will be basically determined by people, besides political and economic conditions. It is a gigantic task for management and the whole administration to change such a way of thinking and culture in accordance with market conditions.

3. DEVELOPMENT OF TYRE INDUSTRY IN EASTERN-EUROPE BASED ON THE PATTERN OF TAURUS HUNGARIAN RUBBER WORKS

Traditions

Tyre production in Hungary dates back to the end of

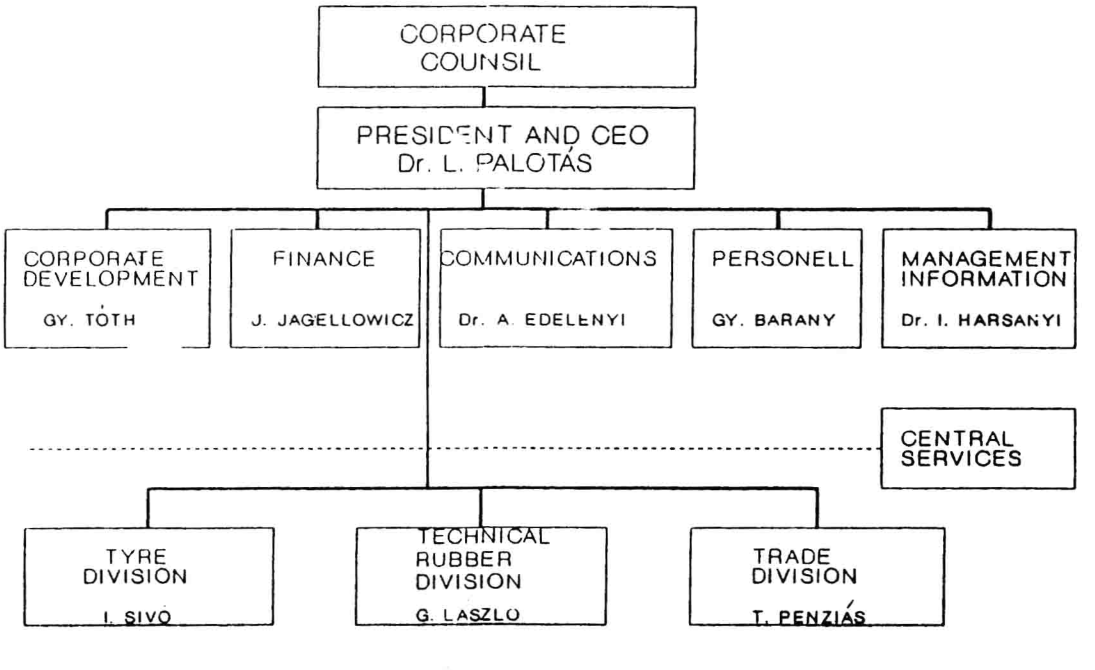


Figure 8a Taurus Hungarian Rubber Works, Corporate Structure

Sales	20,66 Bill HUF	333,2 MUSD
Profit befor tax	1,13 Bill HUF	18,2 MUSD
Profit after tax	640 Mill HUF	10,3 MUSD
Gross value of fixed assets	9,4 Bill HUF	151,6 MUSD
Total assets	12,9 Bill HUF	208,1 MUSD

1 USD = 62 HUF

Figure 8b Taurus Hungarian Rubber Works, Selected Data

the last century. Erno Schottola founded the ancient factory of Taurus in 1882 where Cordatic tyres were manufactured from 1912. In the twenties, the factory became world-famous for several patents and its international activities. Its leading shareholder had been the English company Dunlop. Even under difficulties during the 2nd World War, production could be maintained and loyal employees saved machinery as well. The factory was nationalised in 1948. By the sixties the factory had become a big public enterprise with three factories in the country. Since 1974 the company has been called Taurus with an individual strategy that has, to date, been followed. The history of more than a hundred years shows that the Hungarian rubber industry can call upon considerable tradition and experience.

Individual strategy and image

Taurus had the good fortune to be managed by pioneers creating and experiencing Hungarian corporate strategies.

Our internationally recognised CEO (Chief Executive Office), Laszlo Horvath established the strategy of Taurus in the early seventies. Then Ilona Tatai was President for fifteen years until she retired in the spring of 1990.

The essence of the strategy has been to develop only competitive industries, to select and then to develop products that conform to our strategy. Taurus should envisage individual directions of development and work without governmental subsidies. The strategy should rely upon employees who are loyal to the company. With international alliances in view, corporate structure should be developed in compliance with strategic targets. The management of our company follows this line as well.

Tyre business strategy

Considering the development of the domestic vehicles industry and transportation, as well as the potentials in specialisation, Taurus has chosen two segments:

heavy truck tyres and agricultural tyres.

Since 1974 we have been manufacturing all-steel-cord radial truck tyres as well as the traditional crossply truck tyres, thus we may have had the most experience in this field in Eastern Europe.

In 1979, a modern tyre factory was set up in Nyiregyhaza where we began to manufacture agricultural tyres. We set as an aim, the need to meet home demands for these tyres including those of original equipment manufacturers, to make use of the advantages of raw materials and products supply between COMECON countries. We also had in view, to capture part of the world market and to establish our brand name internationally.

Technical strategy

Having appraised its experiences, human and technical resources, the Taurus management came to the conclusion that its targets can be best realised with the best licence agreements achievable.

At that time we could hardly think of more than technical agreements and limited trade connections.

Between 1970 and 1985, we had a licence agreement with the Austrian company, Semperit. We managed to take over and adapt the technology of all-steel-cord radial truck tyre production. In 1987, we purchased a new technology from Firestone, at that time an American enterprise. From 1976 till 1986, we had a contract in force with B.F. Goodrich on agricultural tyre production. Having adapted the new technique in Nyiregyhaza, we trained a talented staff prepared also for technical developments of its own. Our technical progress has been characterised by a comprehensive outlook both at home and abroad. We have had good relations among others with the Soviet tyre research institute, the American Smithers and the German TUV or ERTRO.

Management and organisation

With our idea in mind that is based on the interactions of the resources of development, production and trade, we have steadily developed our organisation. For over ten years we have had a matrix-type functional structure based on the co-ordination of product manager. In the mid eighties we felt we had to decide on the future of our product lines and we had to improve various marketing methods.

New challenges

In the late eighties, we had to face a whole series of challenges and possibilities. We appraised the positions of Taurus in international comparison in cooperation with Boston C.G. and A.T. Kearney. We recognised the need for quick mobilisation of the industry, the keen competition of prices and marketing policy, as well as that of cost and technology and we refreshed our strategy.

- With regard to the characteristics of the Eastern European market, we have improved our market organisation, promoted our sales into Western markets with the endeavour to strengthen our market position.
- We entered into investments to improve our competitiveness in the mix of product lines, as well as in quality and efficiency, while our main business remained in truck and agricultural tyres.
- The organisational structure was broken down into divisions. The tyre division has been an individual profit centre and we tried to separate the results of the particular product lines in order to refine our market policy (see Figures 8a and 8b).

As a result of slow progress for many years we found ourselves amid the rush of political and economic changes of regime during the last two years.

Even amid such an embarrassing situation we shall make every effort to find the right way in order to accomplish the Taurus mission that is:

'Our company's whole activity should be internationally competitive satisfying all our customers and colleagues and establishing a prospering future'.

I am very pleased that your kind invitation made it possible for me to report on the exciting events of an exciting era which I have witnessed.

Biography of a Tyre

Eric Holroyd

Holroyd Associates Ltd.

INTRODUCTION

The pneumatic tyre was invented some one hundred years ago.

It's purpose then was to cushion the bumps, and speed the movement of transportation machines over uneven road surfaces.

This purpose has remained throughout the years, but the tyre's role has changed in many ways, and mainly in sympathy with the development of transportation devices. Perhaps the most significant of these changes has been for the tyre to become a safe and efficient transmitter of forward thrust and a safe and efficient controller of braking forces - a change which it's inventor could not have foreseen in 1888 when motive horse-power was just that!

What has altered the tyre specification most dramatically is the development of higher speed transportation vehicles, and the improved road surface over which these 'tyre-driven', and 'tyre-supported', vehicles move. These effects coupled with the rate of change of vehicle suspension design, the vehicle's high volume output, and the need for reduced cost components has placed high demands on the tyre - demands so high that the tyre in it's struggle to meet these demands has often lost it's way.

Tyre technologists, engineers and innovators have striven over many years to create, design and build into the tyre, strength, durability, performance, accuracy and the low production costs which can be so readily achieved with the majority of engineered components of a motor vehicle. – But today the tyre still remains the only high cost major multiple component of a motor vehicle which is mostly manufactured according to the laws of chance, and which, for some of that reason, requires that a high cost spare be carried. – If there should be any doubt, this fact surely proves the point that the tyre is a very unique and curious product.

To further demonstrate this oddness, consider that initially a tyre is designed and specified as it is required to be in the finally cured state. This final design specification is then attempted to be met by almost unbelievably loose and un-controlled stages of manufacture.

Only the beads are wound and assembled as a complete inspectable component at the uncured tyre building stage.

All other open ended uncured components are not completed for inspection until they have been wrapped and joined at the uncured tyre assembly stage.

- There is a specification for uncured tyre components which are assembled on a tyre building former.
- There is a specification for these components to meet when they have been inflation shaped into an uncured tyre form.
- Finally there is the initial cured state design specification which has to be met when the tyre has been moulded and cured.

Three stages of specification
Three chances of component movement error
Three stages of inspection?

To check what has happened to tyre components during manufacture, sections are cut out of a sample tyre to compare reality with design. – Amongst all of this activity throughout the years the tyre product development and it's material formulation have attracted and absorbed vast amounts of research and development capital. – But how little capital, in comparison, has been afforded to improve production methods to the standards of today, – which when viewed in this high technology age have a distinctly 'antique' image?

There is room for doubt in the tyre's concept, its composition and its manufactured precision. These aspects, and many more, are researched at continuing high cost – but the factors so often missing are imagination, innovation and the recognition that all is far from well.

There is no doubt about the high cost of a tyre, and that it is a necessity which is largely ignored and neglected when in use. In the motor vehicle, for example, petrol, oil and water conditions are signalled for the driver's attention – but air pressure in tyres, which is crucial to their performance and for the support and safety of the vehicle, is left to the imagination!

Despite this doubt and neglect, the laws of chance have, so far, been kind to the tyre. As a composite product which suffers much design compromise – a product having 'finished' components which can go through three stages of process change before completion – the tyre remains a product to admire for it's ability to defend itself. It is a product whose performance is a credit to those who have developed it to the needs of today but it is also a product which surely has to be considered worthy of even more study, more development and more care for its future life.

So let us look a little closer at the creation of a tyre. Let us examine its design, materials preparation, component forming, assembly and finally moulding which gives the tyre its identity for use in our modern world. As this story unfolds let me try to convince you, as I have been convinced, that manufacturing methods for tyre production never were correct from the start, – and are still wrong today.

THE TYRE DESIGN

In the beginning, tyres were of simple design – they were not air pressure containers in themselves but relied upon an inflated tube to maintain their vehicle supporting role. From this unsophisticated start point there were some exciting tyre developments and innovations, mainly brought about by the evolution of the motor car. At that point in time the motor industry accepted tyres with the design and performance specification as offered by the tyre manufacturer – and was probably grateful that the properties available in a tyre could iron out some of the inadequacies of motor vehicle suspensions at that stage of their development.

Today that situation has been reversed, with the motor industry specifying tight tyre quality standards – and even issuing awards to those manufacturing plants most able to meet them. The best of today is expected to be the average for tomorrow.

In short the powerful production engineering arm of the motor industry has embraced the tyre as it would an engineered component, and can be expected to drive the search for quality and low cost into the Twenty First Century.

Commercially a tyre must meet an agreed performance specification, it must have durability for long life, be safe and cost as little as possible to produce.

It is a fact, however that the design requirements and material specifications to meet this market demand are all too often more easily set down than the production means can be established to achieve the accompanying low cost need. In reality, academic design of a tyre has never quite worked in concert with academic or innovative production engineering, and the two disciplines have rarely coincided for the true benefit of the tyre.

Perhaps it is the motor industry with it's high specification and low cost demands on the tyre which will spur changes to this long lived pattern of events and put the future into the hands of a new breed of entrepreneurs who will employ drastically less capital and resources to produce superior products.

It is my belief that there is no aspect of a tyre design which does not offer possibilities for radical improvement. From compounding materials to curing the tyre the long accepted and 'antique' systems of production inhibit important lines of investigation by the tyre designer – because his mind is closed to more innovative methods. Demonstration of the possibilities, even in the simplest form, is the key to releasing a vast reservoir of ideas and innovations related to the tyre and it's manufacture, – which could then reach forward to attain levels of improvement presently considered unobtainable for almost all of the performance parameters of a tyre.

Tyre design and tyre specification define the principal processes which are used to create a tyre.

These principal processes which are used to produce the compound, the ply fabrics and all other components of the tyre have been long established and cautiously developed to the stage at which we find them today – I will briefly describe these processes as I know them to be, in order to identify those long accepted process practices which may well be in need of serious review.

TYRE COMPOUND MIXING

In early times open mill mixing of rubber compound was the norm. – In some instances this method is still in use, but in the main, this method gave way to the Banbury Batch Mixing Machine invention around the year 1917.

The weight ratio of such a mixing machine to the weight of batch mixed is about an inefficient 160:1, and the floor space taken up by such a mixing system in relation to the batch size is equally inefficient. However these machines, and others like them, are still in use today – having been developed over the years for increased speed and consequently tremendously increased energy input.

Typically a compound mixing machine weights 40 tonnes, and together with dump mills, cooling lines, batch offs and other associated facilities absorbs massive applied horse power.

In operation an average size compound mixer processes 250 kilo batches of compound twenty times an hour. Once dumped these batches lie around for differing periods of time, supposedly to allow the compound to recover it's nerve.

In fact there is no option. The compound cannot readily be used as it is made – hence the cynical view