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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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The seminar on the establishment and Development of the Automotive Industry in Developing Countries

Karlovy Vary, CSSR, ~~14 October - 1 November 1968~~ 24 Feb - 14 March 1969

SIGNIFICANCE OF THE AUTOMOBILE IN THE NATIONAL ECONOMY: ITS INFLUENCE ON AND RELATION WITH OTHER INDUSTRY SECTORS 1/

by

Wilfred P. Ricart
Director General
Centro de Estudios Tecnicos de Automocion
Madrid, Spain

1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO.

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Wilfredo P. Ricart
General Director of "Centro de
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Spain

SUMMARY

1. This paper provides a brief description of the development of the automotive and ancillary industries in Spain since the Second World War, including areas in the technical and industrial fields where the influence of the automotive industry has been observed.

2. The difficult problem of promoting and forming a large and skilled professional labour force to meet the demands for the development of this new industry is discussed.

3. The paper examines the practical results of new techniques developed under foreign licences as well as with the original techniques.

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* This is a summary of a paper issued under the same title as ID/WG.13/2.

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4. The economic and political influences of the development of an automotive industry, e.g. import and customs duty problems, balance of payments, licensing and erection of assembly plants are indicated.

5. The effects observed in all sectors of the economy during the development of an automotive industry in a developing country are examined. Also discussed are the different effects which the proliferation of the automotive industries in a growing number of new nations will have on the economies of the traditional exporting and highly developed countries, and the means that science and technology place at their disposal to maintain their position.

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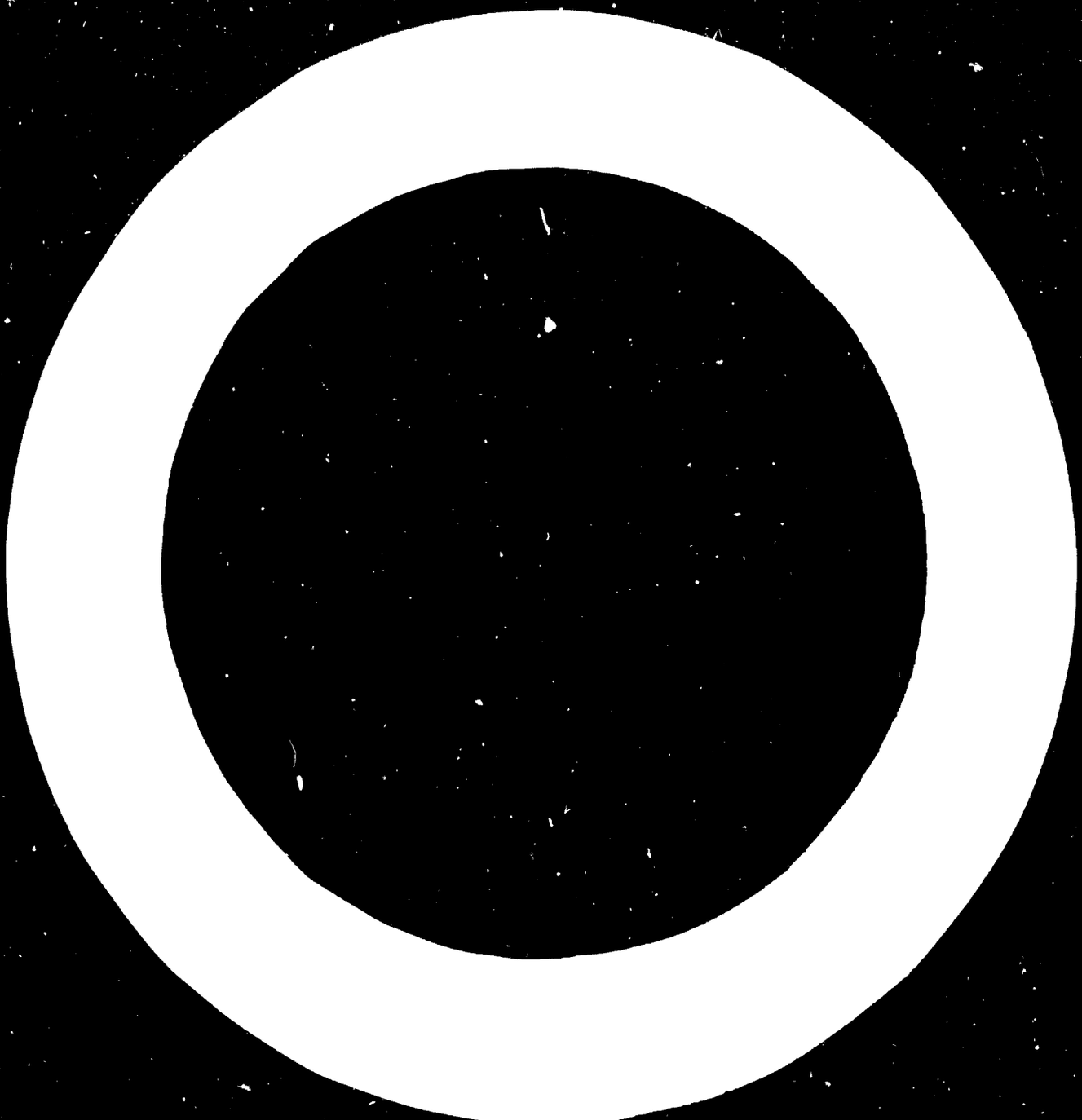

Introduction

1. The subject of this paper is fairly complex, as a number of factors and variables are involved. The introduction of the automobile, and, in general, of the automotive era, has far greater importance than a mere statistical review of the vehicles produced, the dollars spent and the millions of people who are supported by this industry would indicate.

2. The automotive age ranks in historical significance with the Industrial Revolution for its material consequences, and may have even greater social and political significance than the French Revolution in that, it has ushered in a new era of colossal material transformation for mankind, and has been the key to a radical change in human life. It has opened the road to outer space and to a number of as yet unforeseen transformations.

3. The automobile has invaded the entire world so swiftly and violently that modern philosophy and culture may have had too little time to appreciate its value and fundamental importance. In a sense, the automobile has made a great conquest of man through its successful and explosive development. Civilization depends primarily upon the transport of persons and goods. The automotive industry represents the source of 90 per cent of the total means of transport and has direct derivatives in the many forms on land and sea and in the air.

4. To bring about the revolution in transport the automobile mobilized tremendous amounts of human intelligence and effort. It has used fabulous amounts of capital and has produced innovations and changes in economics, social customs, urban planning and revaluation of areas and activities; it has reduced the psychic pressures on the inhabitants of great cities, facilitating their escape to the country and has in general affected our entire way of life.

5. The automobile is an essential factor in the transformation of the developing countries, which, while at present often give us cause for concern, also give us hope for newly evolving human values. Furthermore, the automotive industry has given rise to new techniques such as mass production and the instalment purchase system, and it has created vast new markets by increasing individual purchasing power.

6. This paper is restricted to an examination of the relation of the automotive industry to other industrial sectors and to national economies. It

could have been simply a statistical study, with a few supplementary observations on the economies of various developed and developing countries, but the needed treasury of reliable data that would permit us to arrive at some definite conclusions or to formulate definite rules, however complicated, does not exist. The existing partial and probably inaccurate figures cannot be relied upon; therefore only the more essential statistics are used. Effort has been made, however, to explain the events observed and to present, objectively, the consequences of actions that have been taken, the lessons that have been learned, and some predictions for the future.

POLITICAL INFLUENCES ON THE DEVELOPMENT OF THE AUTOMOTIVE INDUSTRY

7. The automotive industry is now proliferating in many countries that had produced no motor vehicles previously. It is useful to understand clearly the impetus to this progress and to examine the probable consequences. The phenomena currently observed in relation to the automotive industry in developing countries, present various aspects and factors in different parts of the world, although they can be reduced to a general philosophy applicable to all of them.

8. The technological improvements and the tremendous progress experienced in industry, added to the marked differences in protective policies (customs and fiscal duties applied in different countries), complicate the circumstances surrounding these events. The wide variations in individual income between some developing countries is a fundamental influence in the market for consumer goods. The progressing economic activity of the people of any country produces a consequent increase in the rate of currency circulation and in the exchange of goods. All of this creates a desire and a necessity for automobiles, which are then imported from the principal industrial nations.

9. The initial stages of such development are always viewed with curiosity and satisfaction by responsible economists of each country. Once motorization has commenced, there generally follows a surprisingly rapid development, or there is a strong pressure on the economic authorities by the importers and the diplomatic representatives of the exporting countries to increase imports. Usually a marked disturbance in the import-export balance of payments follows these imports, because an automobile, apart from its initial purchase price, requires continuous expenditure for fuel, lubricants, replacement parts and the like which are expensive for non-producing regions. The automobile also affects many aspects of the living standards of the people indirectly.

10. After a time, when that upward trend reaches a certain level (which is determined by the circumstances of each country) automobile imports are often restricted by customs and fiscal duties, import quotas, and by requirements that certain vehicle parts be finished in the receiving country by local labour and by restricting the value of the parts imported by a certain percentage. All this gives rise to the need for creating assembly plants.

11. Once the process described above has begun, and unless a crisis or economic recession arises, its progress is inevitably encouraged by the unequal rivalry promoted by these market conditions, since the firms which have not yet installed assembly plants because of an insufficient local market, find themselves frozen out of it entirely. When they judge that developments are favourable, they try to enter the market by offering to form a new industry that would be nationalized to a greater degree than that of their rivals already in operation.

12. It must be admitted that this chain of events has variations that depend on local factors. The case of a developing country with no steel industry but rich in oil that it sells to industrially developed and automobile-manufacturing countries is totally different, for example, from that of another developing country with some steel and metallurgical industries but with no oil or rubber resources. In the first case, there is probably no need for limiting the demand for imported automobiles as this country can be paid in manufactured goods for its exports of oil. For regions in the second group, the situation is far more critical, since automobile importation can quickly provoke an unfavourable balance in import-export payments, and a country cannot check for long its own development or the growing public demand for motor vehicles. The easiest solution is to channel certain development projects towards producing at home the desired foreign goods that have given rise to the crisis, and the fastest way to do this is by means of patents, licences and the know-how of foreign engineering firms. It was done this way in Spain, which is used in the following pages as an example.

THE CASE OF SPAIN

13. In Spain a pioneer automobile tradition had existed since 1900. Hispano-Suiza, of Barcelona produced greatly appreciated vehicles and in 1915 created the famous Hispano aircraft engine.

14. The effects of the two World Wars and, even more so, of the Spanish Civil War (1936-1939) and of industrial progress in many other countries impaired the position of the Spanish automotive industry, which had been competitive only through intelligence and craftsmanship. There only remained the willingness and determination of the people to make up for lost time. The railways were in bad condition and by-passed large areas that thus could not be developed for lack of communications. The few motor vehicles were old and in poor condition. No foreign currency was available to buy new ones and no possibilities for credit from abroad because Spain was under a political boycott.

15. In 1946 the author returned to Spain after having been Director of Research and Design in an automotive industry abroad and was entrusted with the mission of preparing the plans that later formed the basis for the current development of the automobile industry in Spain.

16. In 1946 the total Spanish steel production was under 600,000 tons a year for 26 million people: that is to say, around 23 kg (50 lb) per capita, which meant there were tremendous difficulties for producing alloy steels. There were almost no auxiliary industries and no possibilities of obtaining ball or roller bearings or other necessary materials in sufficient quantity to commence an automotive programme. In 1946 the Spanish automotive industry produced less than 800 vehicles (including motorcycles) with a total labour force of 3,000.

17. In 1946 the Instituto Nacional de Industria (INI) appointed the author to create the Centro de Estudios Técnicos de Automoción (an automotive research centre). Later, several factories and companies were formed, among them the ball-bearing factory Empresa Nacional de Rodamientos (ENR) with Svenska Kullager Fabrik (SKF) partnership. Then Empresa Nacional de Autocamiones, S.A. (ENASA) was organized for industrial vehicles and is now well known for its trucks and buses under the trade mark PEGASO. With the technical assistance of the Italian FIAT organization, the SEAT factories for touring cars were founded two years later. The old Elizalde Works were modernized by the INI, and its modest activities in aircraft engines were redirected into diesel engine production. An

important and complete steel industry was created in Aviles with modern steel furnaces, production facilities for sheet and rolled steel and so on. Other steel works then in existence were modernized and enlarged, and new lines of activity were initiated.

18. All of this is easier to recount today than it was to accomplish during the last twenty years. As has been noted there was no foreign currency or credit with which to purchase the needed equipment and supplies. It was difficult to plan rationally because basic materials were not forthcoming on the stipulated dates. The technological level was low, although the human element is intelligent and intuitive. There were almost no workers in the intermediate scale of foremen. Spain jumped without continuity from a few good mathematicians with university training to a mass of quick thinking workers with little or no training. There was, however, a small number of artisan mechanics who could be retrained for the modern production methods that were being introduced.

19. During the past twenty years of intense work the position has changed as a result of both official and private initiative. From 800 motor vehicles manufactured in Spain in 1946, production had increased ten years later (in 1957) to 21,900 automobiles and more than 6,500 industrial vehicles. In 1965 the total output reached 179,670 touring cars, 72,987 industrial vehicles and 38,000 other types of automotive vehicles. The rate increased according to plan in 1966, so that 453,000 touring cars and 108,000 industrial vehicles were anticipated for 1967. To these figures should be added those of the motorcycle industry, which produced 295 units in 1948 and 193,000 units in 1958. At that time, owing to the continuous increase in the standard of living and some fiscal influences and digressions, the motorcycle industry experienced a marked crisis from 1959 to 1962. It later recovered, and production has been stabilized at approximately 180,000 units per year, with an increasing percentage for export. Some of the younger customers now purchase low-priced four-wheeled vehicles.

20. Within the limitations and economic standards of Spain, the growth of the Spanish automotive industry is spectacular and greatly exceeds the coefficient assigned to it by the National Economic and Social Development Plan. This demonstrates that the available data upon which even the more acute and studious planners can base their conclusions do not always correspond to reality.

21. In Spain, the situation of under-development in 1946 was due principally to its Civil War which had devastated the country for three years. Its end coincided with the outbreak of the Second World War, and the resultant boycott by the victors strangled the national economy. However, the basic condition of the country was rather more developed than seemed apparent from its temporary acute impoverishment. As soon as conditions became normal, an internal period of peace and toil produced swift expansion and development with diverse consequences that were reflected in the production figures of the automotive industry that have been mentioned. This has been called "the Spanish miracle" by some observers. However, it is a miracle that has an explanation.

22. At present the Spanish automotive industry employs about 50,000 people, to whom must be added those of the ancillary industries, which in Spain are developing continuously. The iron and light metals castings industries, as well as forging and stamping, have been developed to the degree that 95 per cent of the demand is supplied domestically. Also, practically all of the electrical equipment for ignition, lighting, starting and ventilation, as well as injection units for diesel engines, fuel pumps and the like are produced completely within the country. The same applies to tires, piping and all rubber and synthetic accessories; friction materials and hydraulic or compressed-air equipment for brakes and anti-freeze mixtures for radiators. A large production of spare parts for popular automobile models is strenuously attempting to recapture the national market.

23. The Spanish market has reached a point of internal competition that has forced the authorities to stop or limit the initiatives of foreign industries, since the market is still insufficient for many different models. Their introduction would have produced a great deal of confusion among industries already established and in the course of consolidation. The next stage will probably be one of concentration among these industries so as to form substantial groups with ample means for production. However, this will not be easy because of the conflicting interests of the licensing associates.

AUTOMATION AND MASS PRODUCTION

24. Because of the multiplicity of the techniques involved in it, the variety and complexity of the know-how necessary for it, the great number of the auxiliary industries that are related to it and, more generally, the high level of executive competence and experience that are required to harmonize all of these intricacies, the automotive industry may be considered as the type specimen of highly developed industrialization. No other industry utilizes so great a portion of man's technological knowledge and skill.

25. To produce motor vehicles, iron and steel and metallurgical techniques are needed; also knowledge of chemicals, fuel, lubricants, rubber; electrical, textile, painting, polishing and anti-corrosive know-how; knowledge of light and heat, glass, plastics; and principally, the manufacturing techniques of mass production, inspection, control, finishing and testing, as well as modern techniques of sales, service and maintenance. With the great expansion of automobile manufacture that took place after the First World War and which culminated in the present powerful companies of the automotive industry (the greatest industrial complexes of our time), it became an extraordinary and almost mythical world to the minds of most people - a world in which life converged and boiled; a world that concentrated a tremendous degree of knowledge affecting all human activities and produced goods which were needed or desired by all.

26. The influence and pressure of the automotive industry on all this range of activities have introduced wide and profound changes and transformations. A typical example is in the machine tool industry whose biggest and richest customers are the automobile factories. Intense competition has obliged it to accelerate its development and progress, which have been great. It should be remembered that it was the automobile industry which gave rise to automatic machines and programmed operations. The first copying machines were designed and produced in Detroit as were transfer machines, somewhat later. Special and complicated machines were designed for the production of certain parts. The trend, however, has been toward machines composed of standard elements within mechanical, hydraulic or electric groups. At present electronic devices with numerical control machines employing cards or tapes are being introduced. These developments are of immediate benefit to many other industrial activities which lack the economic power to generate them themselves.

27. Paradoxically it leads to a new perspective of the automotive industry all over the world. The aura of prestige surrounding the great automobile manufacturers is perhaps beginning to dim, because, although no developing country can possess all of the techniques and know-how that have been described, it is quite possible today to import, in the initial stages of development of a national automotive industry, the complicated cast and forged parts as well as the accessories, and to mount an automobile manufacturing plant in a developing area. This does not apply only to assembly plants. It must be recognized that modern techniques make it possible to obtain good precision and mass production and assembly in such places.

28. Work can now be programmed and finished with all needed accuracy by push-button techniques, not only as regards the mechanical phase, but also in assembly, inspection and control. The proportion of competent technicians to be sent to a new factory for the care and maintenance of the automatic installations need be only 5 to 7 per cent of the total labour force. If this is to be achieved, it is essential to establish sound techniques under licence from an experienced and reliable producer. However, automobile manufacturers are often willing to participate in such projects, if only for competitive reasons.

29. An economic study must prove that a new automobile factory in a developing region must count on a protected market in its early stages to absorb its production capacity. It is much more difficult at first, however, to create the necessary specialized auxiliary industries for such items as electrical and injection equipment, ball bearings and so on. The Government, as a rule, grants the necessary permission to import such equipment and accessories. As automotive production increases in the course of subsequent years, the auxiliary industries can also be developed.

30. The fact that this process has been repeated in so many parts of the world, proves that the automobile industry is losing its exclusive character. It should be remembered, however, that there are always two very different categories of importance and prestige in the automobile market: those firms or factories that create their own models with proper techniques, and those that depend upon the patents and know-how of others. This is a very important point.

31. The process described has evident consequences. First the automotive industry primarily, caused the propagation and progress of technology in the world and influenced economic development. Second, it may be expected that,

in time, some of these new industri- that rely on foreign patents and licences will produce technicians capable of emancipating themselves from this tutelage. This will mean a certain form of progress for the community and reveal new human values. Finally, this continuous expansion of local new industries will affect the production programmes of the traditionally great industrial powers, although they are compensated by reaping rich rewards from their subsidiary units in their countries or from their royalties.

. Perhaps the moment has arrived for the economic authorities to examine with care all aspects of this problem, because it is known that in every process of development, such as that of the great expansion and multiplication of the automotive industries, there would be a certain optimum beyond which it would damage the well-being of the community. This condition varies continuously with the standard or cost of living, so that, as the developing countries progress, they will need greater efforts and more powerful and complex industrial installations to achieve results in their possible markets.

. It is still doubtful what political and economic trends humanity will follow. If the idea of forming supranational economic groups such as the European Economic Community and the European Free Trade Association prospers, this would constitute a check to the excessive fragmentation of the world's automotive industry, since in such areas only the strongest and most intelligently managed producers would survive. When existing artificial trade barriers and other economic obstacles are at last cleared away, only manufacturers that can continuously offer attractive and technically sound motor vehicles at competitive prices will be viable. That this will be so is shown by the fact that the vast motor vehicle market of the United States is now dominated by only four gigantic manufacturing groups. In Spain, on the other hand, where the market is still small and the industry in the developing stage, there are no fewer than seven manufacturers of passenger automobiles. The need to manufacture locally, under licences, motor vehicles of foreign design, merely because political and economic considerations prevent their direct importation, will some day cease to justify the existence of local automotive industries. It is certain that, in a world that is anxious to extricate itself from its presently unstable political situation, only scientific and technological superiority can supply the solid basis for a sound industrial effort that will yield genuine economic rewards.

EDUCATION FOR MASS PRODUCTION

34. To satisfy market demands for its more popular models the automotive industry reached large production volumes. To achieve this, it has been forced to transform the technical methods of the entire mechanical industry. Complicated operations and entire processes are now performed with complete automation. It is the automotive industry that has pushed us so rapidly into the surprising automatic and cybernetic era.

35. To arrive at this point, it has been necessary to transform not only the technical procedures and methods, but also the basic training of the men responsible for the development of production systems. Rational and scientific organization, the study of methods and production cycles, cost analysis, statistic control and continuous market investigation were first introduced and developed by the automobile industry. The extent of this new knowledge and its accomplishments, though not always profitable, have been the basis for the system of management and co-ordination of the remarkable industrial concerns that are the greatest productive enterprises of our time.

36. For this reason, those of us who are no longer young have had to develop or at least to adapt ourselves to all of these new circumstances. In very recent times electronics has also invaded the automotive industry. Data processing systems are today relied upon for all problems in accounts, stores and payrolls. Payrolls in particular have constant complications in different countries, with the great variety of laws on wages for overtime, charges for medical insurance, old age pensions and social welfare benefits.

37. Computers are penetrating even further into the industrial structure. A research and development department cannot now survive and compete without having at its disposal a large data processing library to resolve rapidly routine and special or future calculations. The director of such a design department knows well that the work which can be done by a computer should not be given for calculation to men who are liable to human mistakes, and the senior research technician, even if he deals only with applied testing for the designers in an automotive industry, knows the advantages he can obtain from his digital computer and usually asks for more complete equipment. For programmes of research and for exploring situations or phenomena expressed with

multiple variables commonly represented by systems of equations, he needs an analogical analyser, or a hybrid analogical digital computer, with which he can explore in a short time the laws of variations in any problem that would otherwise take days or months to resolve by a team of physicists and mathematicians.

38. Today, there is extensive use of numerically controlled machines; automatic controls for machining, including inspection, and even for a complete and complex assembly programme are being considered.

39. These facts, so well known to every modern engineer or economist, are repeated only in order to emphasize the great progress achieved by the automobile industry in the education and high level of technical knowledge of the men employed in modern factories. Not so long ago, skilled mechanics and the good fitters were in great demand: in today's mass production, the automated groups of machines do all of their jobs and do them better. Very highly trained technicians in electronics, computers and programming are now needed. The result is however, that, in spite of the present higher cost of labour, resulting from the continuous rise in living standards and purchasing power of the workers in every industrial country, more elaborate and refined vehicles are being produced with a labour cost less than that needed for much cruder products only a few years ago.

INFLUENCE OF THE AUTOMOTIVE AUXILIARY INDUSTRY

40. To establish a general philosophy of the importance of the automotive industry in the national economy and its influence on other industrial sectors, it becomes necessary to observe carefully the history, motives and course of all these activities in different countries. The common and major factors present must be discovered in order to obtain a logical basis for the study of cause and effect for future development.

41. The influence of the automobile industry, from a strictly technical point of view, on the development of the technical and professional education in a country, and its influence on progress in other sectors, follows a very important and nearly always similar evolution in different regions. Within certain limits, the influence on economic progress attributable to the technical development in the automotive industry, is generally the same. However, the economy of each country is also the result of other factors influenced in different ways by other industrial sectors. These local peculiarities make it difficult to formulate sufficiently the precise economic laws applicable to individual countries.

42. The industries auxiliary to the automotive industry have developed primarily in proportion to the demands of their customers. As a result of the large volume of supplies necessary, some companies have been absorbed, new ones have been created directly by their customers and others have fallen within the financial orbits of the major automobile industries. In all such cases, the automobile industry has been the powerful catalyst that has promoted the natural development of ancillary industries to satisfy the promising and growing demands. However, the economic incentive, although always the principal one, has not been the only one. The rapid technological progress characteristic of automobile production is also an influence, as it gives rise to beneficial contacts and constant improvement of the training and professional level of an increasing number of specialists.

43. The influence of the automotive industry is so widely acknowledged that today the degree of progress in any given part of the world can be judged by observing the development of its industrial activities related to the production of motor vehicles. Following are some comments on the influence of the automotive industry on other sectors directly or indirectly related to it.

44. The importance of the relationship of the automotive industry to iron and steel is obvious. In particular, the large-scale production of highly resistant and resilient steels, the progress and extension of induction, nitrification and sulphating methods for hardening and extending fatigue limits and the development of quality steels for springs to avoid brittleness indicate the importance of these industries to one another.

45. In conjunction with scientific and technical developments, the enormous volume of special steels required for the manufacture of automobiles is significant. Since the automotive industry requires great regularity in the materials supplied to it, it has given rise to the large-scale production of homogeneous materials without defects. A similar progress is observed in castings and forgings, since the production of parts in great numbers has introduced the development of new methods for precision forging, and casting and cold pressing with minimum tolerances.

46. The automotive industry has been the reason for the tremendous advance experienced by the light metals industry and its application, on a large scale, to castings and pressed parts. The different requirements in the use of these materials has led to a useful standardization of light metals.

47. Solid bearings have advanced principally on account of the demands of the automotive industry (for example, copper-lead bearings and thin bearings), and great activity is observed in solid lubrication and in sintered metals.

48. The rubber industry has been a major example of vast development, owing to the demand for tires and tubes. Great activity and competition exist in this market, resulting in continuous progress. The production of metal rubber components to eliminate vibrations and noise has progressed in the shadow of the rubber industry, as has temperature-resistant rubber piping.

49. New types of plastics of different colours and special fibres for upholstery have been introduced. In this field there now are vinyl components that are useful for certain types of gears that have favourable characteristics for silent transmissions and reduced vibrations.

50. The glass industry has produced new safety and splinterproof glasses for windshields and windows. Progress is being made also in the production of polarized glass in large sheets.

51. The automotive industry has made a great impact in the field of machine tools. Automobile manufacturers became exacting and critical, and all the great developments during these past years, both in precision and in transforming speeds as well as in automation, have been introduced to satisfy them. Simple techniques have advanced to amazing degrees of perfection; for example, gear cutting and finishing, lapping machines and super-finish of friction surfaces, superficial induction hardening processes that can be easily introduced into production lines. Copying and transfer machines, unknown before the inception of the automotive industry, financed their development with the volume of orders and the competition in the automotive field. The same is true in the field of presses for forming sheet steel and in electric welding. Both of these have made possible complex transfer installations that make it economically possible to maintain the rhythm and precision essential in large-scale production. Already mentioned in this paper are machines with numerical controls and the introduction of automatic and multiple-function control systems. It can be assumed that the progress of machine tool techniques and the great development of its market are overwhelmingly due to the presence of the automotive industry.

52. When the automotive industry reaches a certain degree of development, it becomes necessary to establish investigation, research and design organizations with their own laboratories and calculation centres. After this stage is reached, it can be said that the automobile has been a promoter of tremendous change in a country, opening the door to progress and position in the modern world. In a rudimentary way in some cases, and in a highly developed form in others, this advance in scientific and technical knowledge is observed in every part of the world where the automotive industry has been consolidated.

53. The importance of the automotive industry in the more advanced countries has created quality standards. Only a great customer such as the automotive industry can require good quality from its suppliers. Related industries are the first to benefit from the credit granted to companies where quality is well controlled. This example and relationship with other sectors extends benefits to all the industrial production in the same field.

54. Through the scientific methods of production and control introduced by the automotive industry, substantial economies have been obtained in the services

service stations, maintenance and repair shops, satellite towns removed from urban centres, transport corporations and, as an important corollary, the development of tourism with its agencies, hotels, motels and so on.

63. It is evident that the automobile has spurred the economy of many countries to a fast pace that the economists must maintain under control. However, they should not fall into the error common in many countries, in which the public administration regards the automobile as an inexhaustible gold mine out of which it can obtain tax benefits of every kind. Also, the automobile has confronted these administrations with important problems that are new to bureaucratic traditions.

RELATION OF THE AUTOMOTIVE INDUSTRY TO ADVANCES IN OTHER HUMAN ACTIVITIES

64. The automobile in itself is a blessing and not an evil. It is one of the most valuable tools ever invented by man. It has proved to be an adaptable and efficient servant in the movement of goods and people. The highways constructed for motor transport are among the most profitable investments in the development of any country, since they place extensive regions that were formerly isolated within the reach of economic development.

65. Characteristic of the automotive industry is its decentralization, which gives rise to many ancillary industries and this becomes the principal factor in creating the background and means for subsequent development in other industrial sectors.

66. The progress, at professional and technical levels, of education of the great mass of people involved in the automotive industry is reflected in the whole population. Initially this educational effort prepares and uses a labour force previously dedicated to less profitable occupations, and it increases living standards for them and their families. At the same time, it creates a human reserve from which flow initiatives for ancillary industries and other diverse activities that use the co-operation of technicians educated in the automotive industry.

INFLUENCE OF NATURAL RESOURCES AND THE GEOPOLITICAL POSITION OF A COUNTRY IN THE DEVELOPMENT OF THE AUTOMOTIVE INDUSTRY.

67 The extension of the automotive industry all over the world depends upon the natural wealth of each region, as well as on the geopolitical situation These factors produce the initial indications of the need for developing automotive production. The current situation in the world, with the relatively closer proximinity between different regions resulting from modern systems of communication and from rapid diffusion of technical knowledge, has created a favourable climate for industrial progress and the first impulses for anti-colonial feelings. In a parallel manner, the desire and need for automobiles is continuously increasing, following the progress of economic and social development.

68. It must be repeated that the course - and even the possibility - of attempts to create an automotive industry in even the most unlikely regions of the world depends in great part upon local conditions. It is clear that Japan - a country that has long been a very important and developed producer of iron and steel with a large potential home market, an important commercial zone and a high level of technical knowledge - had all of the characteristics necessary for a favourable and intense automotive development. However, this did not occur until the last fifteen years, but in that period it has expanded with explosive rapidity. In other regions with less favourable conditions, development will be slower but not essentially different.

69. The delicate economic situations that appear in a country when a market for motor vehicles develops within a short space of time bear heavily upon import-export balances, creating problems that are difficult to solve in many cases. While it is easy to understand the desire to produce locally, in any way possible, goods that cause such disturbances, such autarkic policies lead to the fragmentation of industrial production and to increases in the cost of living that could be avoided with other solutions. However, such considerations do not depend entirely upon motor vehicle production techniques or even directly upon the automotive industry, which is the subject of the present study, but fall within the province of the political sciences.

THE PROLIFERATION OF THE AUTOMOTIVE INDUSTRY IN DEVELOPING COUNTRIES

70. The present study has examined various aspects of the trend toward the proliferation of automotive industries as it affects the course of industrialization in developing countries that are attempting to raise the living standards of their peoples. However, it appears that a stage in this process is being reached at which striking changes in existing market conditions will occur. Drawing from the experience of the present exporting and importing countries, economists and political leaders should investigate the probable effects of these changes on the economies of the developing countries.

71. If it is to be able to compete successfully in the mass market for passenger cars, an automotive industry must have financial resources that will permit it to set up and maintain modern facilities that can produce between 250,000 and 1,000,000 units annually, according to local conditions and the types and classes of vehicles that are in demand. Only such large-scale production can keep per-vehicle costs at competitive levels. However, in the new automotive industries now sprouting in countries undergoing industrial development, capital available for investment is in short supply, the initial production is usually much more modest, and the per-vehicle cost is consequently high. Such negative circumstances are in some way compensated on the local market by official protective measures that allow new industries to survive, like delicate plants in a hot-house, against competition from abroad. However, as the new industry progresses and consolidates its position and the national market increases in volume, the necessity to expand production creates the desire to enlarge the limits of the original market.

72. All newly industrialized countries have the dream of exporting. When starting new industries, they accept foreign collaboration under licences and agreements for the acquisition of foreign technical know-how, with clauses limiting or prohibiting exports. In the course of development, these clauses become generally unacceptable and must be revised. If this new desire for commercial freedom meets too great resistance from the organizations that originally granted the licences, economic pressure is increased in order to free the local producers from this tutelage.

73. The last decade has seen both Japan and Canada become major producers of motor vehicles, and in the same period Argentina, Australia, Brazil, Poland, Spain and Sweden have made good beginnings. The Union of Soviet Socialist

Republics has developed a strong automotive industry, and China (mainland) now produces industrial motor vehicles and transfer machine tools. Each of these countries anticipates expansion into new markets, but the industrialisation of some of these areas may well curtail these hoped-for outlets for exports.

74. At present, the increase of consumer purchasing power in most parts of the world has largely offset the loss of traditional export markets. However, because of the requirements of economic balance, it appears probable that trends toward regional self-sufficiency will provoke a crisis. The division of the great world-wide automobile market into a number of more or less modest regional ones (some of which are now profitable), could affect the world economy adversely, since this situation will tend to raise the average manufacturing cost and selling price of the product. The same considerations hold true for most large-scale industrial production and investment.

75. The desire for rapid industrialization appears in the developing countries as a consequence of the higher living standard maintained for nearly two centuries by the people of industrial countries as compared with that of the inhabitants of agricultural regions, especially those situated far from the centres of production. With today's facilities for the interchange of information and with the movement of ever greater human masses, it was to be predicted that immediate comparisons in labour prices would be made, and the logical and natural desire to engage in the activities that provide better living standards in the more highly developed regions would arise. It seems evident for the moment that this trend will promote immediate and positive economic progress until a higher standard of living is reached. Beyond that, the position is delicate and the danger exists that it can become harmful for the world collectively. It is a direct consequence of an unjust economic position, maintained by a strong difference in the average income from different activities all of which are necessary to mankind. Instability must be expected until this situation is corrected.

76. An important result of the rapid evolution of the automotive industry is the continuous up-grading of the qualifications of its scientific and technological personnel. This development favours the more developed regions, since the scientific and technological escalation that it represents can be sustained

only in countries that can mount and continue strong programmes of research and development. Only thus can they remain in the vanguard of progress. By the same token, regions that cannot conduct such programmes cannot expect to move forward.

7. Intelligent and rapid application of discoveries in industrial activities and manufacturing is the best way to offer advanced and attractive commodities to the world. The myth of the automotive industry has perhaps already passed its maximum splendour. Although it continues to be a decisive economic and labour factor in human societies, it will no longer be exclusive to a few centres of the industrial aristocracy of the richest countries, as it spreads increasingly to more countries of the world. Its future success will depend primarily on the relative levels reached by the science and technology applied in each particular case.

CONCLUSIONS

79. The automotive industry may be said to be one of the most characteristic and important human creations. It has promoted an extraordinary industrial development, unprecedented as regards economic volume, technical training and progress, owing to the immense volume reached and the methods used.

79. Its ancillary industries have experienced similar development. They have introduced mass-production methods that demand precision and quality standards from other industrial activities in each automotive manufacturing region, thus promoting general progress in all fields.

80. The automotive industry has been a decisive factor in the current increase of scientific and technical research centres sponsored directly or indirectly by the industry and is the mainspring of the present rapid scientific and technical progress and developments. In general terms, it is possible to measure the progress reached in the technical and industrial development of a community by the importance of its automotive industry.

81. The automobile, as well as being a necessary instrument in the normal lives and activities of millions, provides the means for people submerged in over-populated areas to escape occasionally to healthier and quieter localities. Consequently, it is a great factor for maintaining the necessary psychic and physical balance and becomes a very positive factor in the increase of general productivity and well-being.

82. The widespread use of automobiles gives rise to greater investments and expenditures in every country as living standards increase. There are direct investments in industrial installations, expenditures for buying the vehicle and continuous expenses for its use and maintenance. It also influences the needs and habits of the population, promoting the desire for improved living conditions in the form of longer holidays, tourism and so on. To obtain this objective, general productivity must be increased to reach the necessary balance to limit inflation.

83. Automobile development introduces new factors into the economy that affect the normal balance of payments in each country. The traditionally powerful industrial and exporting nations have obtained great advantages from their automotive industries and a large volume of credit and foreign currency. On the other hand in those countries that import vehicles the position has

generally deteriorated. These circumstances lead countries that import vehicles and that cannot support the resulting unfavourable balance of payments to establish (or at least to try to establish), automotive industries locally.

34. Another influential factor is the difference between the wage paid in industrial regions compared to the more modest income obtained by workers engaged in work on the land. Present-day communications, the migration of great masses of people and tourism have spread a natural desire to engage in the same activities as those people who live better. The growth of industrial automation continually promotes better industrial knowledge and technical education.

35. A process of multiplication cannot continue indefinitely since it leads to autarkic theories opposed to those of great common markets. An increasing fragmentation of the automotive industry in the developing parts of the world follows a trend opposite to that of the great industrial concentrations in the more developed regions where the largest markets exist. The time has perhaps arrived for an international conference of specialists and economists to determine the basic lines for an optimum development from a world-wide point of view.

36. A gradual upward revision of colonial-type wages which will raise the prices of local products in the international market is in diametric opposition to the small industrial autarkies that are now developing. However, either way will lead to increased costs. In all probability it will not be possible to apply any single solution in a general way to every region in the world, but some attempt should be made to avoid exceeding the optimum economic limits. The ideal theoretical solution tends towards a universal standard based on sound economics rather than on politics and anticolonialism, but such a solution would be difficult to achieve. To reach this point, the world community must be educated towards acceptance of this optimum solution and prepared for the necessary adjustments. No one can suppose that the present state of the world, with two revolutions - one industrial, due to mass-production and automation, and the other political due to anticolonial feelings and the desire for freedom - could have produced anything but a general readjustment of values.

37. The automotive industry has had enormous influence and has become one of the most important factors in promoting this analysis of human thought and conduct, and it will continue to be the principal element in fomenting it. In this is the great historical interest of the automotive industry. It would seem that the time has arrived for an honest and calm examination of markets, production and the economic situation from every viewpoint in every part of the world, so as to be able to reach conclusions and recommendations useful for the best development and economic progress for humanity in the immediate future.

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