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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

Distr.
LIMITED
ID/WG. 282/96
16 October 1978
ENGLISH

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

INTERNATIONAL FORUM ON APPROPRIATE INDUSTRIAL TECHNOLOGY

New Delhi/Anand, India 20–30 November 1978

WORKING GROUP No. 12

APPROPRIATE TECHNOLOGY FOR RURAL TRANSPORT

APPROPRIATE RURAL TRANSPORTATION FACILITIES IN DEVELOPING COUNTRIES.

Discussion Paper.

Appropriate Rural Transportation Facilities in Developing Countries*

Issues and Considerations

Note prepared by the secretariat of UNIDO

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Appropriate Rural Transportation Facilities in Developing Countries*

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* This Note has been largely based on the background documentation on the subject, which is attached.

INTRODUCTION

1. The growth of modern transportation facilities has been marked by significant technological developments, and complex and sophisticated systems have been evolved in respect of land, sea and air transport. Such developments have been extended in the international movement of goods and materials not only between industrially-advanced economies but also with most developing countries, to varying degrees. Internally within several developing countries also, there has been considerable resource allocation for transport, particularly for urban transportation including urban road networks and the needs of motorised transport, following the conventional pattern of developed economies. Expenditure on the transport sector in many of these countries has largely concentrated on the construction of roads for conventional motorised transport and greater use of such vehicles, together with the growth of automotive capacity based on the phased manufacture of conventional motor vehicles such as automobiles and trucks. In some countries, there has been significant extension of the railway network, though the heavy capital outlay on rail-lines and equipment has constituted a major constraint. By and large, however, the needs of rural transportation in developing countries have received comparatively little attention and rural areas continue to be largely dependent on modes of transport prevalent over several past decades. Since most of these countries are primarily agricultural economies, the inadequate growth of this basic infrastructure, together with energy, has been an important contributory factor in the growing imbalance between the rural and urban sectors in these countries.

2. The provision of suitable transportation facilities in the rural areas of developing countries constitutes an essential infrastructure prerequisite for rural economic development. Such transport facilities need necessarily to be designed both for the adequate movement of human beings and materials in the rural areas and at prices that the rural population in these countries can afford. With the high proportion of rural production in the GDP of these countries and with the majority of the population, mostly the poorer sections, concentrated in rural areas,

the provision of adequate rural transport facilities constitutes a basic socio-economic need.

3. While there has been increasing recognition, in recent years, of the need for evolving an appropriate strategy for rural transportation, emphasis has largely been given to the construction of roads of varying standards and specifications to meet rural needs. Some attempts have also been made to bring about greater standardization in the designs and construction of rural roads, adjusted to meet local availability of construction materials and movement requirements. Comparatively little attention has, however, been given to the design and manufacture of alternative and appropriate modes of transport, both non-motorised and motorised, specifically to meet rural requirements. Such needs consequently continue to be met either by traditional modes of transportation utilized in these countries for past several decades, with marginal improvements effected in certain countries or on conventional motorised transport based on models and production techniques from developed economies.

4. With increased emphasis on agriculture and with programmes for integrated rural development being undertaken in most developing countries — including the development of agro-industries and production of a wide range of rural consumption goods and inputs for the agricultural sector, including light engineering goods and repair and maintenance facilities — the movement of goods and materials to and from rural areas is likely to increase significantly during the next few years. Unless appropriate facilities for transport of such goods and materials is provided, programmes for integrated rural development and economic improvement of the poorer sections of the rural population may be severely affected. It is consequently essential for developing countries to give necessary emphasis to the design, production and use of appropriate modes of transport which would be within the economic capacity of average agriculturists in these countries. The consideration of appropriate modes of rural transport will need to take into account the pattern and construction of rural roads, including standards and specifications, and construction and maintenance costs and appropriate technological alternatives and developments in respect of (i) muscle-powered transport (ii) animal-drawn vehicles and

(iii) various forms of motorised transport. To meet the needs of countries where water transport, both fluvial and by sea, is of particular importance, consideration has also to be given to boat construction and mechanization of such transport. At the same time, various policy measures and implications have to be considered, which would enable appropriate rural transport facilities to develop to an adequate extent.

5. The above aspects have assumed much greater significance, not only because of greater dependance on movement by road or by boats for rural transportation but because of rising costs of road construction and maintenance and the greatly-increased cost of production and maintenance of conventional motor vehicles and other alternative transportation facilities. The alternative types and patterns of rural road construction must necessarily be related to factor conditions and resources of each country and are under examination at national level. These have not, therefore, been discussed in detail in this paper and attention has been concentrated on alternative modes of transportation in rural areas and the categories and types of vehicles that can be used.

I. OBJECTIVES

6. An appropriate strategy for rural transportation must be primarily geared to provide adequate and cheap means of transport to and from rural areas. The objectives of such a strategy should be to (i) highlight the principal issues and alternatives in the determination and selection of appropriate modes and types of non-motorised and motorised transport for the rural sector in developing countries, (ii) define the various policy measures that may need to be adopted, (iii) identify the main areas of research and development on which attention needs to be concentrated and (iv) evolve an overall programme of action that can be considered at national and international levels.

II. CONSIDERATION OF TECHNOLOGICAL ALTERNATIVES

7. The various alternatives to be considered must be related to the distance over which goods and materials have to be transported. By and large, rural transportation should aim to cover short-distance movements

either on the farm or between farms and markets and vice versa. Short-distance transport can take place through various means, ranging from human portage and animal transportation to muscle-powered transport such as bicycles etc. and to motorised equipment of different degrees of sophistication. . Since primarily short-distance transport is involved, rail movement need not be taken into consideration, though such transportation may well be most appropriate and economic where rail links to rural areas exist or are developed as part of the railway network. The economics of production and use of alternative types of rural transport, other than human portage, also need to be taken into account.

8. The range of alternatives in respect of land transportation in rural areas can be broadly considered under the following headings[1/] (i) human portage; (ii) hand carts and wheel-barrows; (iii) pedal-powered equipment such as bicycles and tricycles, with various attachments; (iv) animal-drawn vehicles; (v) light-motorised vehicles such as mopeds, motor cycles with attachments, motorised tri-wheelers and the like; and (vi) medium and heavy motorised vehicles of different types. For water transport, various types of boats and attachments have to be considered.

Human portage:

9. This continues to be a common form of transport in poorer rural areas and where rural roads do not exist and is utilized primarily for bringing smal quantities of agricultural and other rural products to village and semi-urban markets. Better alternatives need to be evolved for reducing the burden of such portage, whether loads are carried on the head, shoulder or back. Carrying methods have hitherto largely been dictated by local customs in different areas and only marginal improvement has been made in some countries. Reference has been made in the background paper[2/] to the Korean Chee-ke, where an improved frame for back-loading has been designed which can easily be converted to a wheeled carrier.

1/ More detailed information on each of these categories is contained in the background paper Appropriate Transport Facilities for the Rural Sector - ID/WG.282/40.

2/ Ibid.

Hand carts and wheel-barrows:

10. Hand carts continue to be commonly used in several developing countries for short-distance transport in both urban and rural areas. Such hand carts are usually of traditional design, though steel-spokes and bicycle and used automobile tyres have been introduced in some countries. Wheel-barrows are also commonly used in several countries but have mostly followed traditional Western designs, except in China, where a larger-diameter wheel (about 700 mm.) is used.

11. While hand carts, wheel-barrows and the like will continue to be extensively used by poorer sections, greater local research and adaptation would be necessary by way of improved designs, lighter materials and better components. The production of handcarts, wheel-barrows and similar items is usually undertaken in semi-urban and rural areas. If Rural Workshops/Industrial Centres (RWICs) are set up, improved types could be constructed. Designs and supply of materials not locally available would, however, have to be ensured.

Muscle-powered and pedal-driven vehicles:

12. While bicycles have become fairly common in the rural areas of several developing countries and are manufactured in many of these countries, these are still primarily used for the transport of persons rather than goods and materials, except for light agricultural products such as milk, dairy products and the like. It is necessary, however, to consider whether more robust designs of bicycles could be evolved for rural areas, rather than existing models, which are mostly based on earlier Western designs. It is also necessary to consider whether a rigid frame permitting both personal transport and movement of goods can be devised, together with special attachments for carriage of rural products, including metal or wood products, besides agricultural products such as fruits, vegetables etc. Various types of attachments used in different countries for carriage of goods and materials can be considered, together with wheeled carts which can be attached to cycle frames. An alternative form of pedal power is that of the tricycle, which is commonly used in Asian cities in the form of a cycle rickshaw. The use of such vehicles, with

or without carrying attachments, in rural areas has, however, been rather limited because the light-weight body is often not suitable to rural conditions. Reference has been made in the background paper[1/] to the "Oxtrike" which could be considered as a possible improvement.

13. The use of pedal-driven equipment can be significantly extended. Appropriate designs for the basic frame and attachments could be drawn up by national R+D institutions and manufacturers, and prototypes must be tested in field conditions. While basic frames may need to be manufactured on a larger scale, various attachments and accessories could be produced in Rural Workshops / Industrial Centres and by rural units and artisans, provided designs, common service facilities and supply of materials can be ensured. With appropriate designs and local production facilities, purchase loans on easy terms will need to be provided to facilitate extensive use of such equipment.

Animal-powered transport:

14. Apart from pack animals, which will continue to be used in difficult terrain, animal-drawn carts constitute a common form of rural transport in several developing countries. In India, it is estimated that over 60% of goods transported from farms to markets are moved by bullock-carts. While improvements have been made in bullock-cart designs over the years, considerable improvement still appears to be necessary. Such improvements may relate to (a) replacement of wooden wheels having steel rims with rubber tyres, already in use in several urban and semi-urban areas; (b) devising a new frame to reduce the weight of carts, either through redesigning or use of other materials; (c) redesigning the yoke to reduce the pressure on the neck of animals; (d) evolving a light roofing structure of tarpaulin or local materials; and the like. It should also be possible to design special types of carts for certain types of agricultural products. Though considerable research has been done in this regard, there appears to be need for more effective dissemination of information regarding new designs and their implications in techno-economic terms.

15. The use of animal-drawn carts is less in the case of African countries where draught-animals are still extensively used. Donkey carts are, however, fairly common in several African countries and improved designs

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1/ Appropr[illegible]e Transport Facilities for the Rural Sector - ID/WG.282/40.

have been and are being evolved in several countries. Such improved designs, however, have been put into practical effect only to a limited extent and traditional cart designs continue to be used.

16. With the high price of petroleum products and consequential impact on costs of motorized transport, the role of animal-drawn vehicles in rural transport will continue to be very significant. Greater emphasis is, therefore, necessary on improvement in designs and ensuring that such designs are tested and then utilized in production. Since production is normally undertaken in semi-urban and rural areas, the results of research in the form of appropriate designs and technical instructions should be transmitted to local units engaged in such production. A specific programme of financial and other assistance, including supply of materials and components which may not be locally available, should also be provided to such production units, often in the form of single households, so that design improvements can be applied in actual practice. Together with financial assistance to production units, credit on easy terms should also be provided for purchase of carts of improved designs. It should be possible for field financial units to provide purchase credit on a hire-purchase basis in certain areas where purchasing power is very low, so that the production and use of carts of improved designs and utility could be significantly extended.

Motorised rural transport:

17. The alternatives in respect of motorised transport for rural areas range from motorcycles and motorised bicycles with various attachments to multi-purpose vehicles used both for transport and agricultural operations and modified designs and bodies of conventional motor vehicles.

18. While medium and heavy trucks will continue to be used for longer-distance transport, other alternatives need to be considered and developed for short-haul movements by individual farmers or small groups. The pattern of import substitution in respect of transport vehicles has resulted, in most cases, in the assembly and semi-assembly of conventional motor vehicles, particularly of cars and trucks of various models. This has often resulted neither in the growth of integrated domestic production

of automotive vehicles and their principal components and spares nor in the local production of vehicles suited to rural conditions. Some successful local adaptations have undoubtedly taken place such as the 'jeepney' in the Philippines but, by and large, there has been little development primarily suited to local rural conditions. A major constraint has of course been the high cost and consequently low demand for such vehicles and this aspect has to be kept in mind in considering possible alternatives.

Motor cycles and attachments:

19. The use of motor cycles in rural areas of developing countries is very low at present and such limited domestic production as takes place in these countries is utilized principally in urban areas. Interesting urban adaptations, which can have varying degrees of rural application are the auto-rickshaw in India and the 'bermo' in Indonesia. Greater use in rural areas of such equipment or motorised bicycles with attachments can take place if simpler and cheaper vehicles can be designed, together with simple attachments in the form of trailors, side-cars etc. Such production could be encouraged through financial incentives to manufacturers, including differential taxes and duties.

Multi-purpose motorised farm vehicles:

20. There appears to be considerable potential for the design and production of simple, multi-purpose motorised vehicles, which can be used both in agricultural operations and for rural transport. In some agricultural communities, light conventional tractors are already being utilized to pull trailers carrying rural products to local markets. The use of conventional tractors for this purpose is expensive and would be beyond the reach of the average agriculturist. Other alternatives that have been developed are the two-wheeled tractors used extensively in China; single-axle tractors with petrol engines developed by the IRRI in the Philippines, which is particularly suitable for wet-rice agriculture areas; a self-propelled cart also developed by the IRRI and other similar vehicles in use in different countries. A number of other alternatives have been

designed for carrying ½ton loads under difficult ground conditions[1/] While these have not been specifically designed for developing countries, they examplify the possibilities that exist for designing and producing such multi-purpose vehicles.

21. The use of multi-purpose vehicles for farming, together with short-distance transport, can provide a challenging solution to rural transport needs, particularly in areas with greater purchasing power. Obviously, such production will need to be related to demand that can be generated, particularly by groups of farmers operating on the basis of joint ownership through co-operatives or similar units. Production of such vehicles will also necessitate extensive testing of prototypes in field conditions, acquisition of technology on suitable terms and conditions and a programme of financial and other incentives to both producers and users of such equipment.

Modifications of conventional vehicle designs:

22. In some instances, conventional vehicles can be suitably re-designed to meet rural needs. These include vehicles such as modified jeeps or the Asian Utility Vehicles (AUVs) presently produced and used in the Philippines and other South-Asian countries. Another possible alternative that can be considered is the Trantor[2/] which can also be assembled economically in small numbers, as group technology production could ensure the production of a large number of common parts and components.

23. Rural Workshops / Industrial Centres could play an important role in repairs and maintenance of motorised vehicles utilized for rural transport and also for production of simple parts and components over a period of time. The use of such vehicles would also greatly accelerate the pace of technological growth and the use of modern tools and equipment in rural areas.

1/ Reference is invited to the World Bank document Appropriate Technology in Rural Development: Vehicles for On and Off Farm Operations *

2/ Reference is invited to the background paper Appropriate Transport Facilities for the Rural Sector- ID/WG.282/40.

* This document will be distributed at the meeting.

24. It would appear, from the above resumé that there is considerable potential for the design and development of appropriate motorised vehicles for rural regions, either in the form of multi-purpose vehicles or modifications of existing conventional vehicles using common basic parts and components. The selection of the appropriate type of vehicles would necessarily be related to factor conditions, resources and needs of each country. Obviously, initial internal demand for motorised vehicles would be limited in view of low purchasing capability and it may be necessary to take up joint production of particular vehicles for groups of countries in case national internal markets are not adequate. Nevertheless, considerable scope does exist for choosing appropriate alternatives and for initiating programmes of production and distribution of such vehicles.

Boats and outboard engines:

25. In many developing countries, water transport is of considerable significance. In Bangladesh for example, a considerable portion of rural produce is still carried to markets by boats. It is necessary, as in the case of non-motorised and motorised alternatives on land, to evolve design improvements for boats and vessels, including attachments such as light outboard engines. Such engines will also need to be simple to manufacture and repair in view of the limited facilities in rural areas. An alternative that can be considered in this context is ferro-cement boats in respect of which a study has been conducted by UNIDO.[1/] The issue of low-cost boats both for water transport, as well as for fishing, needs to be considered and design improvements identified and disseminated for use and application in developing countries where such transport will continue to be of considerable significance.

III. PROGRAMME OF ACTION

26. It will be seen from the above brief survey, supported by the background documentation, that several alternatives exist and can be further

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1/ "Boats from Ferro-cement". United Nations publication ID/85. October 1972. Sales No: E.72.II B.23.

developed for providing appropriate rural transport of various categories. The studies and research made in this regard are by no means comprehensive and considerable additional research and development efforts are necessary, together with the production of prototypes which can be intensively tested in actual field conditions. Nevertheless, there is considerable potential for an effective and realistic programme of action to be undertaken in this regard.

(i) It is essential that adequate emphasis be given to rural transportation at national policy level and an overall programme be drawn up regarding the economic and technological needs and implications of development of an appropriate rural transport sytem.

(ii) It is necessary that national agencies must devote greater research and development efforts to identify the issues relating to domestic rural transportation, coordinate the results of R+D that may already have taken place and define specific fields for further study and research in respect of different categories of vehicles to particular institutions on items such as designs; substitution of lighter and durable components in existing common modes of transport; use of better materials and components; application of group technology in manufacture of appropriate motorised vehicles and the like. Similar R+D efforts can be undertaken in institutions and by manufacturers in developed countries, particularly in respect of alternative designs for motorised rural transport of various types and categories.

(iii) National agencies should evaluate alternative designs for various categories of rural transport from a techno-economic viewpoint; assist in the production of prototypes and disseminate information and provide technical guidance regarding appropriate alternatives and production techniques to existing and potential production units.

(iv) National agencies should compile information on alternative types of vehicles, and improvements and modifications of such vehicles, together with experience of operations. Such information could be compiled both on national and regional levels and be disseminated to other developing countries through international agencies such as UNIDO.

(v) A specific programme of financial assistance should be undertaken to encourage commercial production of the non-motorised and motorised vehicles

considered appropriate in particular countries. Such incentives can take the form of long-term loans on easy terms or provision of capital grants for undertaking manufacture of approved types and categories, together with differential rates of taxes and excise duties to production units. Financial assistance will also need to be provided to users of such non-motorised and motorised vehicles and suitable hire-purchase facilities should be provided at the field level, to individual and groups of farmers.

(vi) Rural Workshops/Industrial Centres and similar production units in semi-urban and rural regions should undertake maintenance activities, together with production of products, parts and components to the extent feasible and on a phased basis, with the growth of local skills and capability. In respect of simpler transport equipment such as improved carts, fishing boats and the like, RWICs and similar production units can effectively undertake production programmes, provided technical guidance, designs and necessary materials can be supplied by national agencies and the 'organized-urban' sector, and necessary financial arrangements can be made.

28. The role of international co-operation in rural transportation can be very significant, both in research and development of alternative designs, production of prototypes etc. and in the phased manufacture of appropriate vehicles for rural areas in developing countries, particularly modified motorised vehicles and their attachments.

In preparing this Note, the following documents were referred to:

Appropriate Transport for the Rural Sector - ID/WG.282/40.

Boats from Ferro-Cement - ID/85.

The Manufacture of Low-Cost Vehicles in Developing Countries, Development and Transfer of Technology Series No. 3 - ID/193.

Appropriate Technology in Rural Development: Vehicles for On and Off Farm Operations (this document will be available at the meeting).

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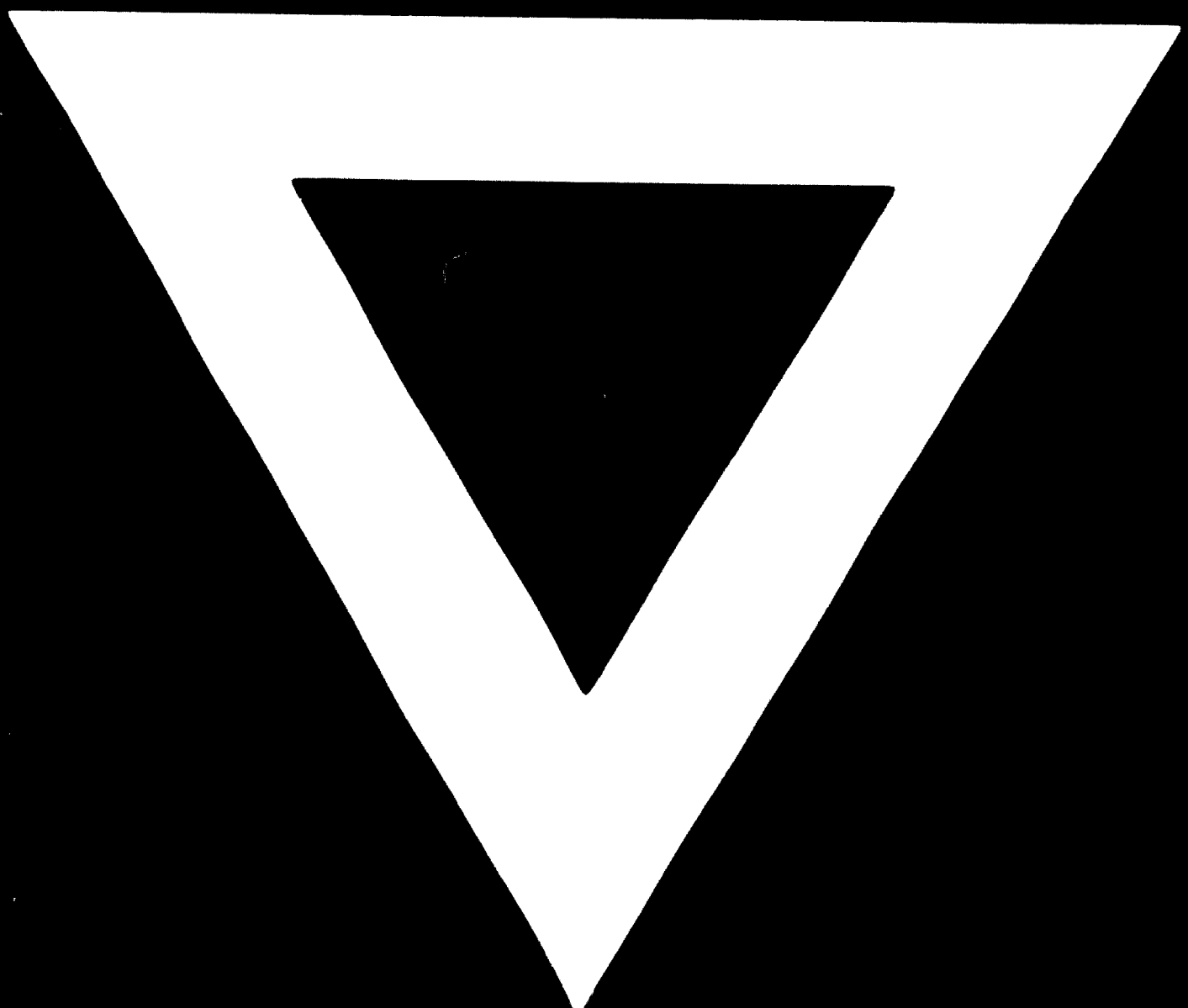

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