KEYNOTE ADDRESS

LOCAL ROAD AND WORLD DEVELOPMENT

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Contents and Summary

Nations spend a fairly constant proportion of their resources for transportation. In the competition for these resources, transportation for cities and for intercity facilities are winning out over the less visible needs of low-volume rural roads, which generally get what is left over.

This situation, if allowed to continue, may find the world without adequate supply lines to the cities and without the necessary rural access to make possible the production of food and other resources needed for the economic survival of both city and country.

Solutions lie in viewing the world's transportation as an integrated system, in which the solutions to rural road problems are addressed not only by improvements in design, construction and management practices that relate directly to rural roads but in changes affecting the way city and intercity transportation systems are provided. Much of the help needed for local roads will have to come from remedies affecting the other parts of the global network.

Making the necessary changes in policy calls for new approaches to financing and a more effective organization of the world's transportation research and development.

In this conference technical solutions are the principal focus, but key policy issues will have to be resolved if sound engineering and management practices are to be effectively applied.

Low volume roads, although they represent 90 percent of the world's highway mileage, are losing out in the competition for attention and support. Cities and intercity routes are everywhere absorbing a major part of the resources available for transport. Yet the economic prospects of the globe depend increasingly on local roads for raising the incomes and purchasing power of the rural poor, supplying more adequate diets, providing easier access to industrial raw materials, supporting the cities and expanding the levels of world output and trade.

The ability to view the world from outer space has furthered our understanding of the transportation system and its functions. Remote-sensing satellites can detect conditions on earth with such precision that trends in transportation and related conditions are visible from space that often go unnoticed by people on the ground. The most important of these observations concern the shrinking size of the earth, the great gap in transport capabilities between the rich countries and the poor, the increasingly integrated global economy, and the growing challenge of mounting world population. Each of these conditions being highlighted by space imagery will be having a major impact on the world transportation agenda for the 1980's and beyond, and on the importance of rural roads.

A Shrinking Planet

Pictures from Apollo 11 show the small size of the earth as it appears to astronauts 100,000 miles from home. The earth has also become small for those whose travels are confined to inner space. Until very recently people could travel long distances only on the power of the wind. Not much more than 100 years ago Jules Verne could only imagine a trip Around the World in Eighty Days. In the late 1800's the sailing ship Nellie Bly finally made the journey in 72 days. But as recently as 1924 two U.S. Army planes had only cut the Nellie Bly's record time in half. Now, with the speed of jets, there is hardly a place on earth that cannot be reached in a day. And with earth-orbiting space shuttles, the time around the world has gone from eighty days to ninety minutes.

An Integrated Global Economy

A world rapidly shrinking in size has become increasingly interdependent. Today one-fourth of everything the world produces is traded across international borders. Forty percent of everything America exports goes to developing countries. World trade continues to increase twice as fast as gross world product. We have become so dependent on outside sources of supply that an American automobile consists of parts and components from 32 countries. By the time a 1983 model reaches the buyer, it has already traveled more miles that it will ever be driven.

In Tokyo more hamburgers are sold in the Ginza than at any other McDonald's in the world. In Osaka the makers of Japanese Scotch whisky have taken over control of the Encyclopaedia Britanica. On our closely integrated planet an average of 400,000 passengers a day are riding on international airlines and international telephone calls have increased from a million in 1955 to over 200 million in 1982.

The spotlight is now shifting from travel and trade to the international integration of industry. Japan makes transmissions for General Motors plants in Australia and Brazil. Europe's A-300 Airbus is assembled in Toulouse, gets its engines from the United States, is supported by wings from England, and is flown from a cockpit made in France. Ford uses parts and components from six European countries for assembly in Spain and Germany. France's Renault owns part of American Motors, General Motors owns part of

Japan's Isuzu Motors, and everywhere joint ventures have been made feasible by international transport and communications.

The Challenge of World Growth

Landsat completes fourteen trips around the earth every 24 hours. By the time it finishes its fourteenth daily orbit there are 200,000 more people in the world than there were when the day's first trip began.

The population of the Earth is expected to increase from 4.7 billion in 1983 to over 6 billion early in the 21st century. Eventually 10 billion people may have to be supported before a stationary level of population is reached.

Most of the world's growing population will be living at considerably higher levels of consumption by the year 2000 if anything like current growth rates can be maintained. It is estimated that the world economy was producing $9.5 trillion of goods and services in 1978. It took an estimated 25 trillion ton-kilometers of freight hauling to reach that level--about 2.5 ton-kilometers per dollar of gross world product. A large additional increment of freight that cannot be measured was moving on the backs of men and animals and in carts and wagons.

If gross world product in the year 2000 reaches the anticipated level of $20 trillion in 1979 dollars, this doubling of the output of goods and services will have to be supported by as much as a doubling of both freight and passenger movement.

The movement away from rural areas to the cities is increasing the importance of suppyling large quantities of materials from rural sources to city consumers. The world was 20 percent urban in 1950, it is 40 percent urban today, and by the year 2000 the planet may be 50 percent urbanized.

The production of more food will be critical. Even now one-fourth of the world's people have too little to eat, and hundreds of millions suffer from disease and infirmity resulting from malnutrition. While the world has the potential for feeding itself, it will take a marked increase in the amount of land under cultivation and multiple cropping. That will multiply the need for all-weather transportation to and from the farm. Low volume roads are the high-priority network.

The Four Transportation Systems

As we trace the traffic movements of the world over the surface of the globe it is apparent that there are four fairly distinct transportation networks.

The Intercontinental Routes

These are visible only in the wake of ocean liners and the vapor trails of jet planes. In a world 70 percent water and surrounded by air, intercontinental rights of way are supplied cost-free by nature. Modern technology permits those rights of way to be used effectively for the first time in history, which explains how we have so suddenly become one world.

The other three networks are more costly. They include the urban transport systems, the intercity networks, and a vast web of local rural roads. What is evident from space is that city and intercity systems are carrying the heaviest burdens and that rural roads are less visible and less traveled. But they are generally the only means of access to the approximately two-thirds of the world in forests, crops and pasture.

Rural Systems

Landsat spacecraft transmit an impressive picture of the part that local roads are playing in agricultural and rural development. In the United States, two and a half million farms are connected to the rest of the country by a network of roads that provides two miles for every square mile of cultivated land, 80 percent of the mileage surfaced. All-weather access means on-time delivery of seed and fertilizer and the speedy marketing of farm produce. Two million miles of local roads are the end and the beginning of the urban-rural links that can take much of the credit for high levels of productivity in agriculture and for the enormous surpluses available for export.

Local roads in the United States not only get things moved but have completely changed the way farming is organized. Many farms now specialize in doing one thing on a large scale--raising hogs, producing eggs, growing fruit or concentrating on wheat, corn and soybeans. Many farmers join with others in the same business in order to increase the benefits of large-scale operations. In the mid-west one such joint venture involves 27 farms in four different states that are producing half a million eggs a day, combining their purchases of feed and other inputs and jointly marketing their output. Reliable all-weather roads make such joint ventures feasible in spite of the wide spatial separation of the producers. In the state of Georgia chicken farmers have gotten together to make use of a central hatchery that is affiliated with a network of 200 farms and a central processing plant that dresses and packages 30,000 broilers a day. The roads are the integrating network.

Rural transportation is justified not only because it facilitates the movement of materials and crops. Much of the benefit accrues from improvements in personal mobility, including education made possible by ease of travel. American history reveals the obstacles imposed by poor transportation to education dispensed through the one-room schoolhouse. Lack of mobility made it necessary to provide instruction within walking distance of widely dispersed farm houses. But the motor bus and all-weather road made it possible after 1920 to consolidate many small schools into one larger and better school. The one-room schoolhouse with one teacher for eight grades began to disappear at the rate of 4,000 a year in the twenties and thirties. Consolidated schools, well staffed and equipped, have been a direct

consequence of better local road transport, and today in the United States a third of a million buses carry 22 million students to school each day, with heavy reliance on local roads.

As Landsat speeds across the vast stretches of land in the developing world, dirt tracks and footpaths present a different picture. Lack of rural roads and their poor condition are primary reasons for low productivity, lack of trade, inadequate incomes, food deficiencies and shortages of everything needed for a better life. Often the reasons given for the poor state of agriculture is the absence of wells, the short supply of fertilizers, and the lack of technical assistance and credit facilities. But the underlying difficulty that contributes to these problems is often the lack of mobility due to bad roads, or the complete absence of any means of access to farm land and other resources. Seven out of every ten villages in India are without all-weather approach roads and thus isolated from the rest of the economy. Hundreds of millions of people in developing countries are making no contribution to the economy other than meeting their own minimal needs, and urban industries find few rural customers for the goods and services they produce.

But where roads are passable, their limited capacity is put to good use. Notable success has been achieved in India through a nationwide scheme for collecting and processing milk and dairy products. Every day 2 million producers transport their milk over local roads to collection points where trucks make their daily pick-ups for delivery to central dairies. There the milk is pasteurized and shipped to outlets in Delhi, Bombay and other cities. Supplies are collected from 10,000 villages, where even the landless poor with one or two cows can participate in the national milk cooperative.1/

A vital role has also been played by local roads in India's satellite instructional television experiment (SITE). NASA was responsible for stationing the satellite over the subcontinent, while Indian technicians turned to the task of riding the rural roads to select 2,400 villages out of India's 600,000 rural settlements that would be included in the experiment. The final choices had to be villages with road connections good enough to have electricity supplied and sufficiently reliable to get the equipment in to allow maintenance and repairmen to reach the scene when needed. Satellite television depended on advanced telecommunications technology, but local roads established the limits as to how the new technology could be applied.

Urban Systems

Less than one percent of the earth is urban, but understandably the transport networks in cities attract major funding and attention. They contain 40 percent of the world's people and most of its industrial activity. These growing concentrations have an almost insatiable appetite for additional transport capacity supplied at extremely high cost. Urban expressways, railways, buses, subways, airports, harbors and other terminal facilities have become an enormous drain on available transport funds. Intercity rail and highway connections that carry much of a nation's traffic and add to the demand for greater capacity and modernization.

Passing over Chicago, Landsat reveals what it takes to keep the metropolis moving. In this second-largest city in the United States the transportation net carries the incoming and outgoing freight of 14,000 manufacturing plants, 113,000 wholesale establishments, and 57,000 retail outlets. Total outbound freight in a single year exceeds 50 million tons. The port of Chicago accommodates 14 overseas shipping lines that move locally manufactured goods to 47 ports in 24 countries. At O'Hare International Airport, the busiest in the world, 40 million people come and go by plane during the course of a year. Two million workers have to be transported to and from their jobs every day, while a labyrinth of railroads and 300,000 trucks supply a never-ending replenishment of meats and poultry, fruits and vegetables and millions of tons of other goods to assure three meals a day for eight million people.

The concentration of people, income and automobile ownership in cities has received major outlays for urban streets, expressways, traffic control, parking and underground rapid transit. A high percentage of transportation funds are used within city limits and on intercity connections.

Intercity Systems

Along with urban transport, intercity systems have received much of the emphasis in transport development and in the modernization of facilities. Satellite pictures show clearly the lines of America's coast-to-coast Interstate Highway network, as well as the ribbons of steel that comprise its railway freight system. Europe has invested heavily in its international highway routes and Trans-Europe express trains, and the toll roads and bullet train network of Japan are sharply defined in color composites from space. While intercoastal and river transport provide low-cost movement of materials and manufactured products in many areas of the world, most of the intercity freight and passenger movements of the globe take place on road and rail facilities built and maintained at heavy cost.

The combination of facilities and services to meet the needs of the cities and the elaborate networks that carry traffic between cities have absorbed a large part of the resources and ingenuity available for transport development throughout the world. The significance of this point for rural roads is that while all four systems of transport are in reality one global network, each is separately administered and financed and competes for attention and resources. These resources, however, are limited, and rural transportation facilities that are least visible and only

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1/ World Bank, World Development Report, 1982, "The Milk Revolution in India," p. 83

lightly traveled are least likely to be given the emphasis they require.

The Allocation of Resources

Every country allocates a fairly constant percentage of its national product or of its development budget to the transportation sector. In the United States about one to one and a half percent of gross national product generally goes for highways. In developing countries, the percentage of development funds allocated to transportation varies from 14 percent in Indonesia to 17 and 18 percent in Pakistan and India. While the figures vary, they are a reminder that only so much is available for transport as a whole. Local roads generally operate on the residual, after other needs are met. This is no longer a satisfactory arrangement in a world increasingly dependent on rural resources to keep the urban-industrial sectors alive.

The prosperity of the cities is closely tied to the economic fortunes of the countryside. Rural consumers are the customers for city-made products. Rural roads deliver the food and raw materials for cities. A total system view of transportation, therefore, suggests measures to bring about a better balance between outlays for transportation in city and country in order to assure the construction and maintenance of essential rural roads.

Savings in urban transport outlays are possible by applying low-cost system management techniques that make use of traffic engineering and pricing policies rather than relying exclusively on more expressways and more rapid transit. The cost of one 20-mile underground rail rapid transit line is enough to build at least 10,000 miles of rural roads.

The revenues that are collectible in the cities by charging motorists the marginal social costs of rush hour driving could help support the rural roads that are feeding the cities and providing markets for their industry. These are logical system solutions that could contribute to the effective operation of the total network.

In the cities, too, there are good prospects for raising more transportation revenues. Hong Kong is experimenting with electronic billing of motorists for their use of city streets in rush hours. This approach, now being tested with 15,000 government-owned vehicles, is made possible by vehicle identification plates and circuits in the pavement that transmit information to a central computer, identifying the vehicle and time of passage. Monthly charges will be tallied and road bills mailed monthly like electric bills.

A further means of increasing financial support for urban transportation is suggested by European experience with infrastructure banks. In Germany last year 600 savings banks chartered by local govenments have outstanding loans of $32 billion for the financing of public works. Part of the annual profits of the banks is turned over to municipal governments to subsidize infrastructure projects. Belgium finances 60 percent of all local public works through municipal banks and in Norway the combination of community banks and pension funds underwrites half of all municipal debt. New Jersey may be first in the United States to try this 100-year old European approach. 2/

Other types of solutions include guiding of metropolitan growth outward into pre-planned satellite cites located away from center city congestion. A mix of living, working and services in the satellites cuts down on costly commuting. Examples are numerous and suggest that such changes in urban form, aided by telecommunications, may be the major means of decongesting urban transport in future years. A look at the world from space shows how Stockholm, Paris, Tokyo, Osaka, Singapore and Seoul and other cities are beginning to manage their own space problems by dispersing population in pre-planned urban regions.

Projections of populations in the world's big cities by the year 2000 stress the urgency of these types of planned dispersal if the simultaneous need for financing rural parts of the transport system is to stand any chance of being met. Mexico City is expected to have a population of 31 million by the end of this century, Sao Paulo 26 million, Rio 19 million. In 1950, each of these cites had only 3 million people.

More money could be allocated to rural roads by changes in intercity transport policies. The conflicts among various methods of intercity transportation need to be resolved by intermodal systems that provide a complete service under one management. The container and the computer have accelerated the growth of integrated multi-modal networks and it should be possible to overcome much of the waste and duplication that results from each method of transportation going it alone. In the United States deregulation is leading to the creation of effective road-rail coordination and to the successful combination of air cargo and trucking services for priority shipments.

In the highway field, the high cost of intercity road systems such as America's Interstate Highways has drained funds away from other needed projects, including the maintenance and improvement of rural bridges and low-volume roads. Assurance of necessary maintenance and replacement of the Interstate System that carries 20 percent of the nation's traffic may require supplementary charges to avoid neglecting this major investment and to prevent the depreciation of lesser primary roads and bridges. Tolls are already charged on 2,000 miles of interstate highways and have been used to finance Japan's national system of expressways as well as those of Italy and Korea. Special toll charges would make it possible to allocate more motor vehicle tax revenues to local roads.

For many low-income countries, however, the cost of needed maintenance and extension of rural roads is so great that outside assistance

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2/ "Community Controlled Banks" in Transatlantic Perspectives The German Marshall Fund of the United States, May 1983, p. 13

is required for any major progress. Just as the United States relied heavily on foreign technical and financial assistance in the 19th century to help build its transport network, much of the developing world is now urgently in need of a global program to help create the basic rural systems on which an integrated global economy will be increasingly dependent.

Global Disparities

In spite of the fact that the earth has been compressed by modern transport into one world physically, it is two very different worlds economically, and this is apparent in what Landsat imagery transmits to the earth. Remote sensing reflects the fact the side of the globe with most of the people is the side with the least transportation. The roads that appear so prominently in the North are less frequently detected in the South. The United States and Europe own 80 percent of the world's motor vehicles. The Soviet Union alone accounts for half of all the world's railway freight. Half the world's airline passengers are riding on domestic flights in the United States.

At the other end of the spectrum, Africa, Asia and South America have 75 percent of the world's people and 61 percent of the area, but only 9 percent of the motor vehicles (excluding Japan) and 10 percent of the highways. A dozen countries containing half the population of the world own fewer than 2 percent of the world's motor vehicles. An outstanding characteristic of the globe visible from outer space is the inaccessibility of much of the land and therefore the resources of the planet.

Satellite pictures show how the world's road networks often dead-end beyond the major cities. At that point much of the population of the planet and much of its resource wealth remain inaccessible. In a world that has suddenly been compressed in size, prosperity may be unattainable when half the globe is immobile and stagnating. There can be no effective program of food production, job creation and income promotion if the basic transportation means are not available. To meet the rapidly growing demand for transportation in the last years of the century, it will be necessary to assure the maintenance and extension of the millions of miles of roads needed for agriculture and rural development. That calls for an international effort to improve the construction and maintenance capabilities and the management and budgeting efforts of local road administrators in Third World countries.

An International Cooperative Effort

Current programs of international financing for road transport show some basic flaws. In any given year only a few countries can be helped, and help is neither substantial nor continuing. An accelerated program and a sustained effort are needed to provide a basis for long-term plans, for building a competent road organization, and for creating the necessary maintenance capabilities. The lessons of federal aid in the United States suggest possible changes in aid for Third World countries.

The federal government initiated an aid program for getting America out of the mud that began in 1916 and has since demonstrated a number of relevant lessons. The United States did not grant aid on a project basis, but laid the groundwork for a system-wide program through annual appropriations distributed among the states on the basis of population, area and road mileage. Income per capita would certainly be an added factor in any revisions of financial aid to developing countries today.

Federal assistance in the United States was made contingent on the designation by each state of a road system comprising 7 percent of total mileage. Grants had to be matched on a 50-50 basis, design standards had to be adhered to, and maintenance of federally aided roads had to be to acceptable levels if aid were to be continued. Federal commitment to a continuing program made it possible for state highway departments to plan their construction programs with the assurance that funding would be sustained, permitting them to carry out advance land acquisition and draw up preliminary long range plans.

Developing countries willing to enter into an agreement with an international financing agency could benefit substantially from the introduction of similar programs for local roads, contingent on certain assurances. It would be necessary to establish competent roadbuilding agencies and to carry out prescribed maintenance operations. Matching provisions would have to be tailored to individual country finances, and funds would need to be granted for maintenance as well as construction. Rural roads would also need to be designated in close cooperation with agriculture departments and rural development agencies. There might also be a parallel need in some countries to assist business and public agencies or cooperatives in the purchase of farm trucks and other vehicles.

A roadbuilding program for world agriculture and rural development would benefit nearly every one: the one-half of the world living in rural poverty and in need of adequate nutrition at affordable cost; the urban industries that need rural customers; and the roadbuilding and automotive equipment industries whose major markets in the future will be in developing countries. Underwriting the program might now be possible through an automatically collected international tax on some aspect of global transport operations--a tax on international trade, on internationally traded oil, or on the value of world motor vehicle production. Funds collected would be credited to the World Bank's International Development Association. It takes neither imagery nor imagination to sense that this could be an effective long-run program to reduce rural isolation and to further the rate of global economic development.

Organizing a Global Approach

How could such a program be gotten underway? In today's world one has little trouble in finding out the conditions and trends in world agriculture, health, housing, labor, trade,

environment or monetary affairs. World centers of responsibility have been established where one can gain a fairly accurate picture of how humanity is faring in a wide variety of activities, and what the needs and prospects for the future may be. Strangely, however, the transportation that has helped make possible these global approaches is itself lacking a global approach. There is no place to turn for a world view of transportation and for a reliable assessment of the volumes and types of traffic to be moved in the future. We do not know how much transport will be needed to feed a world of six billion people, to support the great urban concentrations now projected, or to support the trends in industrial production and trade.

The United States, which has so clearly demonstrated the importance of transportation to development, should take the lead, through the National Research Council and the Department of Transportation, to begin the process of establishing a global network of organizations in the transport field that would focus responsibility for extending and improving the world's transport capabilities. The American agency with primary interest is the Transportation Research Board.

The function of a global network of public and private agencies in the transport sector would include the furthering of international cooperation in the conduct of research and developemnt, in education, and in the analysis and exchange of relevant experience. A center somewhere in the network would serve as a focal point of responsibility to help assure the transportation needed to support the increasing population, urbanization and industrialization of the planet. Taking a world view of transportation would put the necessary emphasis on rural roads as the essential means of access to the resources of the globe in which all nations have a stake.

PROBLEM SOLVING DISCUSSION
3RD INTERNATIONAL CONFERENCE ON LOW VOLUME ROADS
MONDAY, JULY 25, 1983

The Monday evening session on Problem Solving was moderated by E. J. Huffington, Clark County Illinois, County Superintendent of Highways, and Melvin Larsen, Illinois Department of Transportation, Chairman of the Low Volume Roads Committee. Mr. Larsen opened the session by stating that there were more problems than solutions. The discussion of problems lead to awareness of the problem; there is a sharing of effort at solution; it leads to innovative solutions; and it points out the need for further studies. Professor Lynne Irwin of Cornell University stated earlier that we have solutions which do work but have not been communicated to others. This is called "technology transfer." The Rural Technical Assistance Program, "RTAP," is a program through which the Federal Highway Administration is attempting to accomplish technology transfer to local agencies throughout the United States.

Mr. Larsen pointed out that maintenance is a prime discussion subject yet it ranked very low in a survey by the American Road and Transportation Builders Association. This may not be unusual. It was pointed out in an editorial in the Engineering News Record in June of 1983 that maintenance is too often given very little attention. In fact, deferred maintenance seems to be the means by which we are coping with funding shortfalls today. The editorial pointed out that a major handbook on civil engineering treats the subject of maintenance under life cycle costs in three paragraphs including this commentary, "Post construction costs are permitted to be high so that initial costs can be kept within the owner's construction budget; otherwise the project will not be built. The client hopes to have sufficient capital later to pay for the higher operation and maintenance costs."

Mr. Larsen also pointed out some dichotomies such as the desire for a national set of design standards or criteria and yet a desire by local agencies for individuality in order to comply with situations that are local in nature.

He also pointed out some of the similarities and differences of developing countries and those in the United States. For instance, the effect of local roads on economic and social aspects of a community or area is similar in both instances. However, differences lie in the fact that in developing countries very little has been done to establish badly needed roads in some areas, while in the United States there may be a need to eliminate some roads so that others may be better maintained.

He challenged the group with a query from Clark Oglesby, Professor Emeritus of Stanford University, "Is there progress being made in making people and engineers aware that low volume roads are unique compared to the rest of our highway system?"

Dr. Louis Berger, of Berger and Associates, pointed out the concern about the amount of investment that can be spent in order to receive a return from economic, agricultural and social points of view. He felt that if you determined the relevance of a road on the basis of expected returns, it would put a whole new light on the subject of roads in developing countries. He stated that low volume roads must be low cost roads as well. He stated it might be necessary to spend as little as $200 per kilometer for a road carrying five vehicles per day. He expressed the opinion that our experience with county roads is far more relevant to developing countries than our expertise in building modern superhighways.

Mr. Madonia, of Illinois, asked whether certain roads could receive less maintenance than others by designating these roads as primitive roads. Mr. Schornhorst, of Iowa, pointed out that Iowa has a law which permits a county board of supervisors to provide two levels of service which might relate to the primitive road mentioned. The board may designate which roads are to be maintained at the higher or lower level and may set the standards for the lower level. There is reluctance to employ this approach for safety reasons. Although low volume county roads are

built and maintained for the use of local residents who may not find a lower level of maintenance troublesome, even the most lightly traveled road will occasionally be used by strangers. Alcohol is also a problem. Any road hazard is magnified by the intoxicated driver. The issue of county liability in accidents on such "primitive" roads has not been tested.

Further reluctance stems from possible adverse public reaction to an intentional effort on the part of a county board of supervisors to lower maintenance standards.

It was also brought out that road density and level of maintenance depends greatly upon the productivity of the land. In Montana, for instance, there may be a road for 3,000 or 4,000 acres whereas in Illinois there is a road for perhaps 300 acres. Also there is the problem of urban dwellers who like the rural life but then demand services which are beyond those that can be provided within the economics available in rural areas.

Mr. Pelzner, of the Forest Service, pointed out that our roads are becoming multi-purpose roads. He described roads which are made essentially for the purpose of moving timber out of the National Forests; these roads are being built as a part of the sale of that timber. This approach might be used in the development of oil, coal and agriculture as a means of providing financing for such roads.

In the USA, the dispersal of urban populations to the hinterland has put pressure on the rural low volume roads. In developing countries there is a greater need to develop rural transportation networks. Otherwise people in rural areas will migrate to the cities which then become overcrowded, with increased social and economic problems for the Nation. If there were a concentration on rural transportation then we could hopefully eliminate some of the social and economic ills which are associated with crowded urban areas as well as neglected rural areas. In addition, the development of highways stimulates the development of the rural areas which become productive assets rather than just liabilities. Wilfred Owen, of Brookings Institution, mentioned in his opening remarks that roads provide social amenities to rural areas. Transportation provides ways of correcting social ills and reducing spending on social programs.

Mr. Ring, of the FHWA, questioned whether studies have been done on the effect of the improvement of roads on the economy of the area. It was pointed out that, at least in the U.S., there is a higher tax rate if the land has good access. With improved access, the sale price of the land increases which effects the taxable valuation of the land.

Just keeping the road in sufficient repair to keep it as a road is one of the biggest problems in developing countries. One of the main problems is finding funds that will be used in the future for these roads. They depend upon aid from other agencies for construction. They sometimes depend upon a private system of highways built by private investment.

It was pointed out that not only do we need low cost but low standards where there are no roads. Peter Thompson of South Africa mentioned that communities without any roads would be helped very much by a low standard highway. The main requirement for a road such as that is that it is well drained. He suggested that we put a maxmium on the standard that would be built rather than a minimum. He recommended the use of stage construction recognizing that there will be weak points in these highways which can be improved over time rather than building a road that will not need any maintenance in the future.

The consensus was that the papers at this conference were much more specifically oriented toward low volume roads than the Second International Conference in Ames, Iowa. Dr. Mathew Betz, of Arizona State University, pointed out that the discussion on problem solving had dealt more with the appropriateness of situations to low volume roads and the land that they serve than it had at previous discussions and conferences. Mr. Huffington pointed out that if this was so we need to take it on ourselves not only to be good engineers but also good salesmen and let our legislators know of the need for keeping the rural roads in the condition that will keep this country vital.

Mr. Larsen summed up the session by stating that just as in developing countries, there is a lack of funds in the U.S. and this is measured by what we have had in the past. It appears that we will need to go back to basics and ingenuity to solve some of our problems. There must be a recognition that in the developing world as well as in the United States there are great opportunities for seeing that transportation can and will affect the social and economic welfare of great groups of people. It was emphasized that our county engineers are ingenious in providing low cost roads and they have become very adept at keeping the criteria appropriate for the type of road that is needed as well as keeping the quality at a level that can be justified.

FINDINGS OF THE SPECIAL PANEL ON RESEARCH

Introduction

A major task completed at the Third International Conference on Low Volume Roads was the identification of those facets of low volume road engineering and management where additional research would yield major benefits. To accomplish this goal, a special task group of 35 engineers, officials and researchers met during the conference. The aim of this group was not a simple discussion of research needs, although such discussions were conducted. The real objective was to delineate those areas where commonality of need and interest would maximize the ultimate benefits of research.

The task group was led in its discussion by Sam Silberman of the Arizona Department of Transportation, aided by Dr. Mathew Betz of Arizona State University. The membership of the task group was evenly split between those whose

primary concern was the maintenance and development of low volume roads outside the United States and those principally concerned with local roads within the United States. There were several participants whose interest could truly be described as global. A roster of the task group is appended.

Method

To achieve the stated goal, the task group moved from the specific to the general. The first order of business was to assemble a list of specific research needs statements. Such statements, proposed by task group members, cited specific problems whose solutions might be derived from research. Seventy-four specific needs statements were proposed.

These statements were discussed and any bases of commonality among statements were identified. By this process, "topic areas" where research was needed were identified. In some cases five or six of the specific statements might belong to a common area. In other cases, the specific statement might address a problem so unique that no direct relationship to other problems could be discerned. It must be realized that this uniqueness is relative only to the other research needs identified and not to the significance or insignificance of the specific problem. For example, the need to develop a synthesis of case law relative to low volume roads managment was a specific need statement that was judged significant enough to be a "topic area."

Once the areas of needed research were identified, the task group members were asked to assess those topics where research is likely to yield the greatest benefits.

Polls were conducted in four separate categories. The categories were:

1. economic and/or administrative topics globally significant.
2. technological topics globally important.
3. topics important to local jurisdicitions in the U.S.
4. topics important to state and federal jurisdictions in the U.S.

Although categories one and two indicate global importance, the vast majority of the topics and the discussions concerned the role of low volume roads in economically developing countries, many of which are expanding their transport infrastructure. The inclusion of category four reflects the fact that many states administer low volume roads systems and that the U.S. Department of Agriculture and Interior as well as other federal agencies administer still larger low volume road systems.

Results

Table 1, on page 11, indicates the ranking and identification of those topics which were voted to be most important by the participants.

It is significant, comparing the differences in categories and the fact that over 30 topic areas were considered, that less than 12 individual topic areas appear in the rankings. In light of the diversity of the participants' backgrounds, interest, and responsibilities, this result would lead one to believe that the major research agenda for low volume roads transcends geographic or economic boundaries. Even more startling may be the fact that the top three ranked subjects in three of the categories are exactly the same. In at least one of the categories these three far outranked the fourth-ranked issue.

The evidence of non-jurisdictional bias is also reflected in the technical subjects reviewed in that those areas of most concern to the local jurisdictions within the United States include one technical problem of concern globally, and those issues identified as of state or federal interest include not only the top three ranked economic and administrative factors, but also the third and fifth-ranked technical problems of global concern.

Summary

The repetition among these lists of topics is striking.

The need to create better systems of information exchange was cited in each category. This is more than the fear that every educated man or woman has of ignorance. Low volume road engineers and administrators most often practice their crafts far removed from research and training institutions. Without mechanisms of information exchange that actively seek out these individuals, they will continue to feel isolated from progress. Conversely, their colleagues and the engineering community at large will remain ignorant of the experience and needs of this dedicated group.

As indicated in Wilfred Owen's Conference Keynote Address, local low volume roads are the least visible of the world's major transportation networks. "Local roads generally operate on the residual, after other needs are met." Low volume roads administrators throughout the world agree with Dr. Owen that "this is no longer a satisfactory arrangement." Hence, the common assessment, both globally and domestically in the U.S., that new sources of funds must be identified, and, innovative funding and allocation methods must be developed.

Correlative to funding problems is the general consensus that program management systems must be developed that will maximize the benefits of available funding. It is most important that such systems are specific to low volume roads and are not simply downsized versions of programs applicable to urban and intercity expressways and other high volume networks.

The repeated need for more research on marginal or nonstandard materials and the development of "risk analysis" alternative design concepts that allow for the incorporation of marginal material on a rational basis also reflect, in part, the scarce funding given to low volume roads. These topics also are a reminder that the "common" construction materials of North America and Western Europe

are not necessarily common elsewhere and that the empirically derived standards for construction used in North America and Europe may not apply to materials in different geologic and climatic environments.

The interrelationship of user costs and alternative designs was cited as both a global and American domestic topic for research. This was echoed in Dr. Clarkson Oglesby's summary address. Dr. Oglesby offered the opinion that practical user cost data are essential to demonstrate the actual value of design options and to demonstrate the true impact of underfunding to legislative bodies or other funding agencies.

A major topic of "classical" technical research cited both in the global technical category and the U.S. state and federal category is the study of damage mechanisms in low volume roads. The mechanisms by which earthen, aggregate or lightly surfaced roads deteriorate under traffic and/or environmental conditions are not well understood. Indeed, there seems to be no consensus definition of "failure." Only a thorough understanding of the mechanisms of deterioration in the light of the special traffic, materials and design considerations of low volume roads, will enable engineers to effectively combat the problem.

One topic appropriately had greater significance globally than to the United States. This was research into the cause and effect relationship of physical accessibility and social and economic developments. We still have little rational information on the ability of roads to promote development. This necessarily hinders the decision-making process for low volume roads administrators.

In the U.S. there is a heightened awareness of the legal aspects of low volume roads administration. This awareness is most keenly felt at the local level and a need to synthesize a legal "casebook" for the use of local engineers and managers is now necessary.

In all, the task group identified 11 topic areas where research and development efforts can produce major benefits for the engineering and administration of low volume roads. The enumeration of these topic areas or goals is, however, only the first, and easiest, step toward the reaping of those benefits. Now that these goals have been clearly established, TRB and other transportation and research agencies must develop concrete proposals for research and development projects aimed at their achievement. Funding for actual conduct of such research must be generated and prompt and extensive reporting of research results must be undertaken.

Table 1. Low Volume Roads Research Needs

Rank	Global Economic and Administrative Topics	Global Technical Topics	Local Jurisdications U.S.A.	State and Federal U.S.A.
1st	A	D	A	B
2nd	B	H	B	A
3rd	C	I	C	C
4th	F	A	D	I
5th	G	E	J	E & K

A -- The development of more effective methods to correlate and disseminate information and the results of previous research.

B -- The development of program management systems in design, maintenance, and construction, which will maximize the benefits of available funding and utilize standards appropriate to low volume roads.

C -- Development of innovative funding mechanisms. This includes identification of new funding sources and research into equitable distribution of funding responsibilities.

D -- Research into the characteristics of marginal, substandard, and unconventional materials and development of guidelines for selection and standards for their use.

E -- Development of greater understanding of the mechanisms of damage to low volume roads. This includes both traffic and environmental damage. Problems associated with heavy loads were cited, as well as damage due to unique traffic found on low volume roads, such as damage caused by hardened steel horseshoes.

F -- Research into the measurement of the cause-and-effect relationship among physical accessibility (roads) and economic and social development, including the effect of road construction, or lack of it, on population migration patterns.

G -- Continued development of methods to utilize user cost predictions in the analysis of alternative designs for low volume roads. This includes the need to correlate data generated by different user cost models currently in use.

Table 1. cont'd.

H -- The need for improved maintenance/management techniques that are flexible enough to be adapted to specific low volume road situations. This should incorporate risk analysis in maintenance determination and should recognize the special, and radically differing, traffic characteristics of low volume roads.

I -- Development of risk-based design concepts that recognize the problems of materials quality and availability. Although similar to Item D, this topic calls for the development of rational design methods that use such materials.

J -- The development of a national case law synthesis for managers of low volume road systems. This synthesis should deal with tort liability and the legal ramifications of engineering decisions related to low volume roads.

K -- Development of guidelines for the acceptance of alternative designs and methodologies and to assess the impacts of such alternate designs on user costs as well as capital costs.

APPENDIX A - SPECIFIC RESEARCH TOPICS SUGGESTED BY THE PANEL

1. Adopt electronic equipment to measure, monitor and characterize low volume road traffic.
2. Improve traffic flow estimation and traffic characterization techniques.
3. Identify innovative funding sources and methods.
4. Research into use of unconventional or substandard materials.
5. Develop low volume road specific traffic safety engineering criteria.
6. Improve methods of information exchange.
7. Develop methods to analyze the economics of alternative design and maintenance standards.
8. Develop new approaches to remedial drainage works for low volume roads.
9. Improve the organizational efficiency of existing highway agencies.
10. Define low volume roads in terms of function and special requirements.
11. Improve low volume roadway design to optimize the use of corridor by broadly mixed traffic types.
12. Develop unified rapid methods for stabilization mix design.
13. Develop a method to evaluate base course performance using observed field strengths.
14. Develop new maintenance standards that reflect the possible as well as desirable level of achievement.
15. Develop environmental protection standards for sensitive areas.
16. Develop applications of small computers to design problems at the field level.
17. Risk based design methods that utilize material variability and availability concepts.
18. Identify lower cost alternatives to asphalt surfacing.
19. Develop a synthesis of case law relative to management of low volume road systems.
20. Develop methods to measure the relationship between socioeconomic development and physical accessibility.
21. Develop better methods to manage the allocation of funds throughout low volume road networks.
22. Design equipment modifications for multiple uses.
23. Develop training methods, manuals and other aids for non-professional personnel.
24. Develop low cost drainage structures.
25. Develop procedures for identifying natural materials sources with inexpensive aerial photography.
26. Develop a greater understanding of roadway damage and mechanisms.
27. Develop rapid, non-destructive, structural testing techniques for unpaved roads.
28. Develop procedures that use vehicle operating costs to support levels of financing.
29. Improve or develop standards for the use of local materials and labor resources.
30. Optimize methods for field control of construction and maintenance costs.
31. Define parameters influencing loss of surface aggregate.

APPENDIX B - MEMBERSHIP OF SPECIAL PANEL

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SUMMARY ADDRESS: A DOMESTIC VIEW

Dr. Clarkson Oglesby, Stanford University

When I asked what I was supposed to do in these closing remarks, I was told to give you my personal impressions of the conference. That is what I am going to do. I realize that what I will say will reflect my personal biases, and I hope you will understand.

For me, this conference has been a tremendous learning experience, both technically and in talking to people. It was a pleasure to feel the high level of enthusiasm that everyone here had in talking about and learning about low-volume road problems. I hope we can keep it when we go back home and get buried in all the things that are waiting for us there. Also, I was personally pleased to find a strong level of agreement in this group on the fact that low-volume roads are different. Fifteen years ago that would not have been the case even among individuals who were dealing with low-volume roads. Today we accept that concept, although there are many other highway people who do not buy the notion that low volume roads are different and therefore need special attention.

In looking at the conference activities, I found them to deal with five distinct activities, three of which fall under my assignment. These three were:

1. Lessons we in the developed world must learn about and can learn from the developing world.
2. An assessment of the subjects covered by the formal papers.
3. The problems bugging low-volume road people in the United States and the need for research to aid in solving those problems.

I first want to go over very quickly what I learned about and from the people representing the developing nations. Among the lessons are:

1. Most of the population is in that part of the world, a fact that most of us have not faced up to. These people have expectations and needs and we on the small side had better be on notice.
2. The changes in the developing nations are taking place very fast. They are moving rapidly from transporting goods on human heads to trucks and moving people by walking, pedicabs, and bicycles to buses and private automobiles.
3. Progress in transportation in those nations comes through enlisting the people and getting them involved in providing the things they feel they need rather than expecting them to accept something someone else says they need. This concept should be helpful to us. Too often, we in the USA say "We're the engineers, we know what you need." This