LIMA DISASTER PREPAREDNESS REPORT

VOLUME V:

Heavy Equipment Rehabilitation and Maintenance

by

Robert Gersony

in collaboration with

Raymond Lynch
Tony Jackson

for

Office of U. S. Foreign Disaster Assistance

Agency for International Development

June 1982
The Lima Disaster Preparedness Report has 15 sections:

Volume I: Methodology Employed
Volume II: Port of Callao Infrastructure Security and Emergency Evacuation Needs
Volume III: Electricity
Volume IV: Water and Sewerage
Volume V: Heavy Equipment Rehabilitation and Maintenance
Volume VI: Airport and Aircraft Resources
Volume VII: Education
Volume VIII: Food
Volume IX: Housing
Volume X: Health
Volume XI: International Donor Coordination
Volume XII: Critical Abstracts from the Literature: A field perspective on major earthquakes:

Peru, 5-31-70
Nicaragua, 12-23-72
Guatemala, 2-4-76

Volume XIII: Review of Earthquake Prediction by Brian Brady
Volume XIV: Other Issues
Volume XV: Summary
FOREWORD

This is one section of a fifteen volume report concerning disaster preparedness in Lima, Peru. It was researched in Lima by a team of disaster specialists during the period July—November, 1981, for the Agency for International Development's Office of U. S. Foreign Disaster Assistance and USAID Mission in Peru. The report is supplemented by a considerable number of maps, charts and resource documents which are located in the USAID/Peru Disaster Preparedness Resource Library in Lima.

June 1982

This work was done under Contract #PDC-0018-0-00-2075-00 by Robert Gersony, Raymond Lynch and Tony Jackson.
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NOTE TO READER

This part of the overall Lima Disaster Preparedness Report consists of a principal volume, including nine charts and three appendices.

It is supported by five additional supplementary books: one provides detailed background on an emergency spare parts, maintenance and heavy equipment program conducted in Guatemala after the 1976 earthquake; three are inventories of Ministry of Transport heavy equipment, trucks, and departmental distribution of them; the final volume consists of lists of spare parts most frequently required to repair and maintain the type and brand equipment described in this report.
EXECUTIVE SUMMARY

After an earthquake of magnitude, the City of Lima could find its main roads, to the north, south and east, are blocked by landslides and mass failures; that its streets are filled with rubble; that critical city infrastructure has suffered breakdowns. Buildings which threaten life and safety will require demolition, adding to the rubble and to the demand for the heavy equipment needed to carry out these jobs. Clearing land for new resettlement areas will further tax Government and private sector tractors, bulldozers, front-end loaders, and dumptrucks.

This report describes the organization and resources of the Government of Peru's fleet of such equipment; reviews the post-disaster experience of Guatemala (1976) in this sector; and proposes some post-disaster options for international donors in the event of a major earthquake.

Management of the Government's US$100 million equipment fleet, including its 2,000 pieces of heavy equipment distributed in 25 departments, and the 2,400 employees who are machine operators and mechanics, was, until recently, conducted by the Ministry of Transport and Communication's "SEM" office. From September, 1981, operation and maintenance of the fleet was transferred to the Dirección General de Caminos within the Ministry. Major overhaul, purchase of spare parts, and technical inspection remain with SEM.

Only about 40% of the fleet is operational at any time. The balance is either under repair or inoperable. A significant part of the fleet is concentrated in only a few manufacturers' brands, and
usually concentrated again in specific production years.

After the 1976 earthquake, the Government of Guatemala, faced with an incalculable amount of earth and rubble moving work, but a finite amount of operational equipment, adopted a program which might be useful in Peru should a similar disaster occur. In short, under a USAID grant, private sector firms were contracted to conduct emergency rehabilitation of heavy equipment which was in the repair shop or which had been considered inoperable because of lack of spare parts. Another private sector contract provided for regular weekly maintenance in the field of the equipment, to insure its continued service. Finally, a small amount was set aside for procurement of U.S. Government surplus equipment at extremely reduced prices.

Improvement of on-going maintenance programs for the Government fleet does not fall within the purview of this report. However, as a post-disaster option, a crash maintenance and rehabilitation program, such as that conducted in Guatemala, is suggested. The resumés of two potential liaison/technical resource experts are provided.

The report contains numerous charts illustrating the composition of the Government equipment fleet by manufacturers' brand, age and location. These charts were developed by the disaster preparedness team from lengthy inventory documents, which are available in the USAID disaster preparedness resource library in Lima. At the report's conclusion, a list of contacts current at the time of the field research is provided; because of the recent organizational changes, the list may well have changed substantially in the interim.

Rubble-removal in low-income and other housing areas must be
approached with sensitivity to the salvage, psychological, land-demarcation and other needs of occupants. Policies governing such activity are discussed elsewhere.
INTRODUCTION

MANAGEMENT OF HEAVY EQUIPMENT AND TRUCKS
REQUIRED TO OPEN AND REPAIR ROADS, REMOVE
RUBBLE, AND PERFORM OTHER CRITICAL TASKS

After an earthquake of severe magnitude, the City of Lima could find its main roads, to the north, south and east, are blocked by landslides and mass failures; that its streets are filled with rubble which impedes emergency and mid-term recovery efforts; that critical city infrastructure -- such as the Atarjea Water Treatment Plant or the Rimac River itself -- have suffered breakdowns. Buildings which are so seriously damaged that they represent a threat to life and local security will have to be demolished, adding to the rubble and to the demand for the heavy equipment needed to carry out the job. Clearing land for possible new resettlement areas will also require much of the same equipment:

The heavy equipment capacity of many Governments is stretched to capacity during normal times with the rather simpler demands of normal road construction, maintenance, and other tasks. In order to meet the demand created by a severe disaster, a Government would examine its fleet and determine how the available units requiring relatively simple maintenance can be most quickly placed into working condition and maintained.

The purpose of this section of the report will be to describe the organization and resources of the Government of Peru's fleet of heavy equipment and trucks; to review the experience of another country, Guatemala, which found itself in approximately the same situation when it
was struck by an earthquake; to examine a program undertaken in Guatemala by USAID which yielded significant positive results; and to propose some options for post-disaster support activities in this sector which AID/Peru could consider.
DESCRIPTION OF CURRENT ORGANIZATION AND RESOURCES

Within the Government of Peru, the Servicio de Equipo Mecánico -- known commonly by its acronym, SEM -- is the agency responsible for the management of the great majority of heavy equipment and trucks owned by the Government. Its fleet, whose estimated value is US$100 million, consists of approximately 2,000 pieces of equipment distributed in 25 departments. SEM has 2,400 employees, of which most are machine operators and about 400 are mechanics.

Until recently, SEM was responsible for a broad range of management functions in connection with this fleet: it handled operations, repair and maintenance. SEM rented its equipment to other Ministry agencies which required it. In theory, the rental income covered SEM's operating expenses. In practice, however, the Government of Peru subsidized the operation directly for up to 80% of its operating expenses.

World Bank experts suggest that SEM is spending about US$600,000 per year on spare parts and that the balance of the budget is dedicated to other operating costs. In all, they argue that this is only about 10% of the budget actually required to maintain Peru's fleet.

In part to alleviate that problem, the World Bank has included an allocation set aside of US$10 million for SEM of its US$80 million omnibus package with the Ministry of Transport and Communications. Of the US$10 million, $4.2 million is reserved for spare parts over a two-year period.

On September 1, 1981, the organization of heavy equipment-related functions was changed: from that date, Operation and Maintenance of the fleet became the responsibility of the Dirección General de Caminos.

(9)
SEM remained with the following responsibilities:

Major overhauls
Purchase of equipment and spare parts
Technical inspections
Establishment of norms and standards

Undoubtedly, there will be changes in the management structure as well. Thus, should this report be reviewed in a future disaster, it is likely that the officials currently included in the List of Contacts has changed completely.

There is a considerable inventory of spare parts in Lima — about 55,000 items according to one estimate. Estimates of the number of spare parts outside Lima range from 5,000 to 55,000. It has been recommended by World Bank consultants that a computerized management system be provided to SEM so that more accurate figures and detailed breakdowns can be produced.

At the moment, it takes an average piece of heavy equipment about four months to be repaired by SEM. Several pieces of equipment considered under repair, however, are virtually irreparable and no "through-put" time can be calculated for them.

After a major earthquake, some of the equipment which would be most critically required are bulldozers, front-end loaders, dump trucks, graders, compressors and cranes. This study has focused on the first four types of equipment.

SEM has a rather limited supply of fuel on hand at any time: their own tank holds 4,000 - 5,000 gallons. Thus, SEM is dependent on PETRO-PERU, the national petrol company, for fuel.
INVENTORY OF KEY EQUIPMENT

The charts which appear on the following four pages analyze the SEM fleet for four particular types of equipment:

Chart I describes the inventory of tractors. As can be seen, about 40% of SEM’s 465 tractors were operational when this study was undertaken. Of these 181 operational units, about 75% were CATERPILLAR brand (CATERPILLAR comprises 62% of the total tractor fleet).

Of the CATERPILLAR tractors, 136 were operational and 115 were under repair. Of the total 251, 62 are D6C’s, 24 are D7F’s, and 41 are D8H’s. A breakdown by age show that 70 of the total number of 251 units were purchased in 1972.

Chart II describes the inventory of front-end loaders. About 48% of the 170 loaders were operational at the time of the survey. Of these 81 operational units, about 88% were CATERPILLAR brand (CATERPILLAR comprises 68% of the total front-end loader fleet).

Of the CATERPILLAR front-end loaders, 71 were operational and 35 were under repair. Of the total 106, 64 are Model 930’s and 27 are 950’s, most of which were procured in 1972 and 1979.

Chart III describes the inventory of dump trucks. About 36% of the 542 trucks were operational at the time of the survey. No single brand has a majority of the number of units, but SISU and FORD are the most numerous.

Chart IV describes the inventory of graders. Forty-two percent (42%) of the units which are operational or under repair are CATERPILLAR brand. Of these 61 are 120G’s procured in 1978 and 1979.
## SEM National Heavy Equipment Inventory

### Bulldozers

<table>
<thead>
<tr>
<th>Producer</th>
<th>Operational</th>
<th>% of All Operational</th>
<th>Under Repair</th>
<th>% of All Under Rep.</th>
<th>Subtotal</th>
<th>% of All Subtotals</th>
<th>Out of Service</th>
<th>% of All Out</th>
<th>Total</th>
<th>% of Grand Total</th>
</tr>
</thead>
<tbody>
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<td>136</td>
<td>75%</td>
<td>115</td>
<td>59%</td>
<td>251</td>
<td>67%</td>
<td>38</td>
<td>43%</td>
<td>289</td>
<td>62%</td>
</tr>
<tr>
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<td>17</td>
<td>9%</td>
<td>46</td>
<td>23%</td>
<td>63</td>
<td>17%</td>
<td>21</td>
<td>21%</td>
<td>84</td>
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<tr>
<td>KOMATSU</td>
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<td>26</td>
<td>13%</td>
<td>47</td>
<td>12%</td>
<td>14</td>
<td>16%</td>
<td>61</td>
<td>13%</td>
</tr>
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<td>4%</td>
<td>9</td>
<td>5%</td>
<td>16</td>
<td>4%</td>
<td>15</td>
<td>17%</td>
<td>31</td>
<td>7%</td>
</tr>
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<td><strong>Total</strong></td>
<td><strong>181</strong></td>
<td><strong>100%</strong></td>
<td><strong>196</strong></td>
<td><strong>100%</strong></td>
<td><strong>377</strong></td>
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<td><strong>88</strong></td>
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<td><strong>465</strong></td>
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<td>KOMATSU</td>
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### Caterpillar Bulldozers Breakdown

(Three types account for 72% of units under repair).

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</tr>
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</tr>
<tr>
<td>D6C</td>
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<td>D7E</td>
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</tr>
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<td>D7F</td>
<td>9</td>
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<td>D7G</td>
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</tr>
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<td>D8H</td>
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<td>36</td>
<td>D7H</td>
</tr>
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<td>D8K</td>
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<td>113</td>
<td><strong>Repair</strong></td>
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<td>1966</td>
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<td>1970</td>
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**Source:** Situación del Equipo Mecánico - SEM (HAQUIMAS) Lima, Julio de 1981

Pages: 58 & 59 (attached) and 60/70 (not attached).
### SEM National Heavy Equipment Inventory

#### FRONT-END LOADERS

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<th>Operational</th>
<th>% of All Operational</th>
<th>Under Repair</th>
<th>% of All Under Rep.</th>
<th>Subtotal</th>
<th>% of All Subtotals</th>
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<th>% of All Out</th>
<th>Total</th>
<th>% of All Total</th>
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<td>CATERPILLAR</td>
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<td>73%</td>
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<td><strong>TOTAL</strong></td>
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#### CATERPILLAR Front-End Loaders

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<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>11</strong></td>
<td><strong>15</strong></td>
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</table>

**Source:** Situación del Equipo Mecánico - SEM (MAQUINAS) Lima, Julio de 1980

Page 003 (attached) and 4-7 (not attached)
### SEM National Heavy Equipment Inventory

**Dump-Trucks**
**Camiones Volquete**

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<th>% of All Operational</th>
<th>Under Repair</th>
<th>% of All Under Ref.</th>
<th>Subtotal</th>
<th>% of All Subtotals</th>
<th>Out of Service</th>
<th>% of All Out</th>
<th>Total</th>
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<td>6%</td>
<td>125</td>
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<td>18</td>
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<td>59</td>
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<tr>
<td>Others (Nine)</td>
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<td>24</td>
<td>14%</td>
<td>63</td>
<td>17%</td>
<td>46</td>
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<td>109</td>
<td>20%</td>
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<td><strong>Total</strong></td>
<td><strong>193</strong></td>
<td><strong>100%</strong></td>
<td><strong>170</strong></td>
<td><strong>100%</strong></td>
<td><strong>363</strong></td>
<td><strong>100%</strong></td>
<td><strong>179</strong></td>
<td><strong>100%</strong></td>
<td><strong>542</strong></td>
<td><strong>100%</strong></td>
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| % of Grand Total | 36% | 31% | 67% | 33% | 100% |

#### SISU Operational and Repair Breakdown:

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<th>LE137</th>
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<tr>
<td>34</td>
<td>11</td>
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<td>69</td>
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**Source:** Situación del Equipo Mecánico - SEN (VEHICULOS)
Lima, Julio de 1980

**Pages 25 & 26 (attached) and 27 - 38 (not attached)**

**Ford (In Brief):**
Newest Unit: 1968, most 1963

**Dodge (In Brief):**
Newest Unit: 1972, most 1964
### SEM National Heavy Equipment Inventory

**Graders**

<table>
<thead>
<tr>
<th>Producer</th>
<th>Operational</th>
<th>% of All Operational</th>
<th>Under Repair</th>
<th>% of All Under Rep.</th>
<th>Subtotal</th>
<th>% of All Subtotals</th>
<th>Out of Service</th>
<th>% of All Out</th>
<th>Total</th>
<th>% of Grand Total</th>
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<td>CATERPILLAR</td>
<td>80</td>
<td>66%</td>
<td>25</td>
<td>19%</td>
<td>105</td>
<td>42%</td>
<td>7</td>
<td>13%</td>
<td>112</td>
<td>37%</td>
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<tr>
<td>ALLIS-CHALMERS</td>
<td>8</td>
<td>7%</td>
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<td>12%</td>
<td>15</td>
<td>6%</td>
<td>16</td>
<td>30%</td>
<td>31</td>
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<tr>
<td>LOKOMO</td>
<td>11</td>
<td>9%</td>
<td>61</td>
<td>47%</td>
<td>72</td>
<td>29%</td>
<td>12</td>
<td>23%</td>
<td>84</td>
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<tr>
<td>OTHERS (FIVE)</td>
<td>21</td>
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<td>13</td>
<td>10%</td>
<td>34</td>
<td>13%</td>
<td>15</td>
<td>28%</td>
<td>50</td>
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<td><strong>TOTAL</strong></td>
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<td>130</td>
<td>100%</td>
<td>251</td>
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<td>53</td>
<td>100%</td>
<td>304</td>
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% of Grand Total: 40%

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<tr>
<th>CATERPILLAR GRADERS</th>
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<td>112E</td>
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<table>
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<th>LOKOMO GRADERS</th>
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</table>

**Source:** Situación del Equipo Mecánico - SEM (Maquinas)
Lima, Julio de 1980
Page 22 (attached) and 23 - 29 (not attached)
The charts which follow on the next three pages illustrate the age of the fleet. Chart V is a summary analysis, while Charts VI and VII provide greater detail.

What becomes clear is that a significant part of the SEM fleet is of CATERPILLAR manufacture, predominantly of certain years. This type of concentration could permit an efficient crash maintenance effort — described later in this report — to be conducted after a disaster.

The Peruvian Army has also reported a significant amount of heavy equipment, in particular:

- about 90 D6 and D7 tractors, predominantly CATERPILLAR
- about 20 front-end loaders, predominantly CATERPILLAR

The Army reports that about 60% of this equipment is operational at any time. However, cross-checks between this data and the SEM inventories tend to suggest that these units may be carried on both inventories at the same time. This is something which will clarify itself in the moment of an emergency but needs to be taken into consideration as well.

The Army also reports that it possesses about 500 trucks, a significant transport capability which could be used to support recovery efforts after a disaster. It seems doubtful that this particular equipment would be carried on the SEM inventories as well.

Some Areas Requiring Strengthening in the Maintenance Approach

In an observation related to the normal maintenance of SEM equipment, one USAID official suggested that significant improvements could be made.

He cited the example of tractor maintenance: at present SEM lacks the equipment in the field to remove and reverse track pins. As a
### Chart V

**SEM National Heavy Equipment Inventory**

#### Age of Current Fleet

<table>
<thead>
<tr>
<th>Year</th>
<th>Heavy Equipment*</th>
<th>Trucks/Vehicles*</th>
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<tbody>
<tr>
<td>1963</td>
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<tr>
<td>1964</td>
<td>7%</td>
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<td>1966</td>
<td>19%</td>
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<td>1967</td>
<td>15%</td>
<td>22%</td>
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<tr>
<td>1972</td>
<td>9%</td>
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<td>1973</td>
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<tr>
<td>1979</td>
<td>11%</td>
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**Sources**

- **Situación Inventarial de Máquinas A Nivel Nacional**
- **Situación Inventarial de Vehículos A Nivel Nacional**

**SEM (Renardet Team/World Bank), July, 1980, Detailed Back-Up Charts Attached**

*As percentages of total fleet in each category. Year selected are those when principal acquisitions were made.*
<table>
<thead>
<tr>
<th>AGE</th>
<th>AUTOMOBIL</th>
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**NOTA:**
- La diferencia de 3 unidades que se encuentra en esta planilla en comparación al inventario se muestra en fechado 1949.
result, each pin can be used for only about 1,000 hours (cost: US$4 per hour) instead of 2,000 hours (cost: US$2 per hour), he argues. Compressors required to regularly clean out air filters are also not available, which aggravates all maintenance problems.

With proper maintenance, the official asserted, road maintenance costs could be reduced by 50%. To this end, stress in the normal program would be laid on the provision of tool trucks, lubricating trucks, and other mobile maintenance equipment, together with a regional approach to the issue. The World Bank is assisting in the establishment of one regional maintenance center at Huanaco; the Government of Peru has reportedly budgeted US$1 million for the establishment of a second at Terrapoto. The current maintenance center in Lima reportedly needs to be upgraded, and four additional rural regional centers are recommended, in Arequipa, Cuzco, Ica and Chiclayo.

Such a program would, without doubt, assist the Government of Peru in strengthening its capacity to deal with a severe disaster in Lima or elsewhere in the country.
REVIEW OF THE LITERATURE: THE GUATEMALA EXPERIENCE

Little or no reference to this type of activity is made in the literature about disasters in the region. However, from the files of the USAID offices in Guatemala, a number of documents describing a program undertaken there after the 1976 earthquake provide some possible guidance in the event of such an occurrence in Peru.

One of the chief tasks facing the Government of Guatemala at that time was re-opening, repairing and maintaining the rural road network in the Highlands which had been largely closed for the first few days, and then provisionally opened but needing repair for some time thereafter. The demands on the Government for rubble-removal and other heavy equipment were enormous. Like Peru, the Guatemalan Government has a significant amount of non-operational equipment.

From a special disaster-related Congressional appropriation, US$2 million were dedicated to assisting the Government of Guatemala to strengthen its capability to conduct the work. Under the grant, three specific tasks were undertaken:

(a) Two private firms (MAYATRAC and TECUN) were contracted, at a cost of about $435,000, to repair equipment of the Ministry of Public works and Communications.

(b) About US$1.3 million of the grant was spent to procure U.S. Government surplus property, front-end loaders and other equipment.

(c) About $350,000 was appropriated for a heavy equipment field maintenance program designed to keep the equipment rehabilitated or purchased under (a) and (b), above, in good working condition. Mobile private contractor field teams performed these tasks.

( 21 )
Finally, a small amount of money was used to procure the services of a maintenance/spare part/repair expert from the United States who provided technical assistance and helped to coordinate the overall effort.

The Government of Guatemala and the AID Mission were highly satisfied with the results of the program. The USAID Auditor General shared their enthusiasm, particularly for aspects (a) and (c) above. The audit report called into question, however, the appropriateness of the purchase of the U.S. Government surplus equipment using disaster relief funds; that is, the purchase was not questioned, but the appropriateness of the use of those particular funds was raised as an issue.

Balanced with that criticism, it should be noted that the entire program, including the procurement component, enabled the Government of Guatemala to multiply and accelerate its recovery efforts many times and at very little cost. For example:

"(There is) approximately $118,000 invested in the Clark (-Michigan) Loaders, or about $10,000 per unit (the new acquisition cost is $87,500 each)."

Because of the volume of materials obtained through the courtesy of USAID/Guatemala Mission (and in particular Ing. Carlos Crowe, formerly AID/Guatemala Mission Engineer), it has been collected and indexed in a separate volume, Book A, accompanying this report. This compendium includes:

-- the Country Agreement/Project Description
-- Job Descriptions for all Participating Agencies

* See Evaluation Report, Annex D, Book A accompanying this report.
-- A list of equipment repaired and procured under the program, with costs, specifications, etc.

-- A Project Evaluation, prepared by the heavy equipment management expert. This report covers all aspects of the program, including the results of field inspections.
Because the scope of the type of on-going maintenance program required by the Ministry of Transport so transcends the needs and value of such a program with respect to disaster preparedness, it is not included in this report as a specific recommendation, despite its significant developmental desirability.

However, the conduct of a program similar to the Guatemala model could provide an opportunity for effective post-disaster inputs. In Guatemala, USAID's small "leveraged" investment yielded about ten times the value in functioning equipment, and this performance could be repeated.

There is no need to purchase new equipment in order to assist the Government in its recovery effort. An intensive maintenance, rehabilitation and spare part procurement effort would be a better investment. This view is shared by both the USAID and World Bank experts consulted in the course of this survey.

SEM has heavy equipment and trucks closeby Lima (for example, in Ica and Ancash) and in more remote locations which could provide heavy equipment support to the Capital in case of need. Charts VIII and IX provide a digest of heavy equipment located in these areas closest to the City.

Such a program, adapted in Peru's needs, might include some or combinations of the following components:

(a) Rehabilitation of Down Equipment: SEM has an excellent staff of mechanics who, in the view of one observer, "do miracles with what they have to work with". However, SEM's performance in terms of
<table>
<thead>
<tr>
<th>Type of Equipment</th>
<th>Lima</th>
<th>Ica</th>
<th>Ancash</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bulldozers</strong></td>
<td></td>
<td></td>
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<tr>
<td>CATERPILLAR</td>
<td>7</td>
<td>1</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>KOMATSU</td>
<td>10</td>
<td>6</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>ALLIS-CHalmers</td>
<td>4</td>
<td>1</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>21</td>
<td>8</td>
<td>7</td>
<td>36</td>
</tr>
<tr>
<td><strong>Front-End Loaders</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CATERPILLAR</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>ALLIS-CHalmers</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>KOMATSU</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>15</td>
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<tr>
<td><strong>Dump-Trucks</strong></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>HINO</td>
<td>9</td>
<td>0</td>
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<td>10</td>
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<td>DODGE</td>
<td>2</td>
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<td>11</td>
</tr>
<tr>
<td>FORD</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
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<tr>
<td>OTHERS</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>21</td>
<td>11</td>
<td>12</td>
<td>44</td>
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<td><strong>Graders</strong></td>
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<td></td>
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<tr>
<td>CATERPILLAR</td>
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<td>1</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>ALLIS-CHalmers</td>
<td>2</td>
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<td>1</td>
<td>3</td>
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<tr>
<td>LOKOMO</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>11</td>
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<tr>
<td>ADAMS-LETourNEAU</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>KOMATSU</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>OTHERS</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>16</td>
<td>7</td>
<td>7</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total Vehicles of All Kinds</strong></td>
<td>45</td>
<td>21</td>
<td>20</td>
<td>86</td>
</tr>
<tr>
<td><strong>Total Heavy Equip. All Kinds</strong></td>
<td>79</td>
<td>37</td>
<td>21</td>
<td>137</td>
</tr>
<tr>
<td>(includes four listed above and all others)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Inventory Value (GRAND TOTAL)**
- S/365 million
- S/112 million
- S/226 million = S/703 million

**Source:** Situación del Equipo Mecánico
SEM - Julio de 1980
Departmental Breakdowns

(25)
## Chart IX

**Partial Analysis: Distribution of SEM Vehicles and Heavy Equipment**

<table>
<thead>
<tr>
<th>Type of Equipment</th>
<th>Ancash</th>
<th>Ica</th>
<th>Lima</th>
<th>Total</th>
<th>% of National Inventory</th>
<th>National Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicles</td>
<td>20</td>
<td>21</td>
<td>45</td>
<td>86</td>
<td>15%</td>
<td>582</td>
</tr>
<tr>
<td>Heavy Equipment</td>
<td>31</td>
<td>27</td>
<td>79</td>
<td>137</td>
<td>15%</td>
<td>926</td>
</tr>
<tr>
<td>TOTAL</td>
<td>51</td>
<td>48</td>
<td>124</td>
<td>223</td>
<td>15%</td>
<td>1,508</td>
</tr>
</tbody>
</table>

**Source:** Situación del Equipo Mecánico - SEM Lima, Julio de 1980
By Departmental Office

**Note:** 80% of equipment on the SEM inventory is assigned to SEM Departmental Offices. An additional 20% is distributed in different ways: to special projects, militia projects, etc.
through-put time has not been as good as it desired. The private sector -- including some of the major dealers in Lima -- have a capacity to organize and manage such an effort. The names of some private sector dealers (including the CATERPILLAR representative) are included in the List of Contacts.

(b) **Mobile or Stationary Maintenance Units** Contracts for periodic maintenance services, to insure that functioning and rehabilitated equipment incur the least possible breakdowns would be another valuable service which could be rendered with disaster funds.

(c) For both of the foregoing programs, spare parts would be required. The cost-benefit of procurement of these parts in the United States, whether or not they are available through the local dealer, should be explored. Parts in stock have duty-paid on them already, and dealing with customs authorities in Lima at present is complex at the best of times. Whether procured in the U.S. or Lima, independent monitoring and expertise should closely monitor purchase procedures, prices, and other such processes.

(d) To conduct such a program, USAID should definitely contract the services of a heavy equipment management expert as a technical resource. Such a person could assist in program development, supervision, technical assistance and careful scrutiny and monitoring of procurement efforts.

Two such individuals are known to the authors of this study, and this list is hardly exhaustive. They are:

(1) **Ing. Filippo Fiorentini Coliger**, a former World Bank consultant. He is currently residing in Lima, working in the private sector. He has had direct, extensive working experience with SEM.
knows the organization "inside-out" and would be an ideal liaison or technical resource. The fact that he is residing in Lima offers added advantages.

(2) Ing. Leeowen T. ("Tex") Taylor, an independent consultant in equipment management, was originally recommended to USAID/Peru by USAID/Washington's Office of Engineering. His performance on a previous AID contract with SEM was rated as excellent. He is a seasoned veteran who is familiar with USAID practices and procedures as well.

It would not be difficult to find a high-quality veteran manager, should a donor choose to pursue this. Resumes for both identified experts are included as Appendices I and II to this volume.

From a logistical standpoint, tightest control must be maintained at airports and ports for parts arriving by air or sea. These should be provided immediate customs release by the Government of Peru as a condition of entering into such a program (more detail on these procedures will be presented elsewhere in this report) and should be directly turned over and signed for by the appropriate agency -- SEM, the private contractor, the expert consultant, or whoever will be responsible for accountability of the items.
LIST OF CONTACTS

SERVICIO DE EQUIPO MECANICO (SEM), MINISTRY OF TRANSPORT

Ing. José Argaluza La Torre
Director Encargado del SEM
Avenida Tupuc Amaru 1596
(ca. Universidad Nacional de Ingeniería)
Distrito de Rímac
Lima
Teléfono: 813984

Ing. Andrés Barrientos Rayme
Jefe Interino
División de Operaciones
Same as above address
Teléfono: 812889

Ing. Orlando Salhuana
Encargado
Taller Central de Lima
Avenida Próceres 1098
Distrito de Rímac
Teléfono: 812325
810330

Ing. Alberto Cavassa Arias
Jefe, Unidad de Inspectoría
Avenida Tupuc Amaru 1596
(ca. Universidad Nacional de Ingeniería)
Distrito de Rímac
Lima
Teléfono: 810420

General Telephone Number for SEM: 810420

Ing. Jorge Orozco Ramos
Jefe, Unidad de Normas Técnicas
(Responsible for specifications)
Same as above address
Teléfono: 812889
LIST OF CONTACTS (continued)

TECHNICAL ASSISTANCE EXPERTS

Ing. Filippo Florentini Goliger
IMPRESIT DEL PACIFICO S.A.
Avenida Navarrete 672
Lima
Teléfono: 606360

Leeowen T. ("Tex") Taylor
13005 Stoney Brook Drive
Reno
Nevada 89511
Telephone: (702) 825-6220

Owen S. Beckner
Address available from
Francis J. Kenefeck, USAID/Washington

MAJOR PRIVATE SECTOR REPRESENTATIVE FIRMS

CATERPILLAR

Enrique Ferreyros y Compañia, S.A.
Avenida Industrial 675
Lima
Telephone: 523070

ALLIS-CHALMERS

FIAT

FIAT-ALLIS/EMPECO, S.A.
203 Omega
Lima
Telephone: 510920

JOHN DEERE

MASSEY FURGUSON

Comercial Peruana, S.A. (CIPSA)
1928 Avenida N. de Ayllun
Lima
Telephone: 313070

(30)
LIST OF CONTACTS (continued)

VOLVO

VOLVO Distribuidora, S.A.
Kilómetro 16.5
Panamericana Norte
Lima

Telephone: 238003

SCANIA VABIS

SCANIA-VABIS DEL PERU, S.A.
Avenida República de Panamá 4679
Casilla 3190
Surquillo
Lima

Telephone: 459190
APPENDIX I

Biographical Data: Ing. Filippo Florentini
CURRICULUM VITAE

NAME : FILIPPO FIORENTINI

NATIONALITY : ITALIAN

LANGUAGES : Italian, English, French and Spanish.

UNIVERSITY DEGREE : Mechanical Engineer, Univ. of Rome, 1974.

POST UNIVERSITY STUDIES : Civil Engineering at Univ. of Milan, 1976

TRAINING COURSES :
- Earthmoving Equipment Production
  Caterpillar (Málaga - Spain - 1977 )
- Field Application Study
  Wabco (Peoria - U.S. - 1978 )
- Manufacturing Procedures
  Volvo - BM (Eskiltuna - Sweden - 1978 )
- Manufacturing Procedures
  Ruston - Bucyrus (Lincoln - U.K. - 1979 )
- Earthmoving Techniques
  Fiat Allis (Palombara - Italy - 1979 )
- Manufacturing Procedures
  International Harvester (Chicago - Fort Wayne, Moline - U.S.A - 1978).

//...
Earthmoving Production Estimate
John Deere (Holme, Phoenix - U.S. - 1979)

Crushers Design
Loro Parisini (Milan - Italy - 1979)

WORKING EXPERIENCE:

1966 - 75
INGE P. FIORENTINI S.P.A.
Via P. Fiorentini, 7 - Rome - Italy
Main Manufacturer of Heavy Construction Equipment, such as:

- Crawler Front Shovels Up to 2 Cu.M.
- Mobile Cranes Up to 35 Tons capacity
- Crushing and Screening Plants

DEALER OF: International Harvester Pay - Line Division,
Michigan, Ruston Bucyrus,
Dragon, Manitowoc y others

Mr. Filippo Fiorentini has received training in different areas, such as:

- Workshop
- Purchasing Department
- Designing Department
- Sales Department.

1976 - 79
ITALCONSULT SPA
Via Giorgione 163 - Rome - Italy (35)
Designing - Engineering - Consulting
Contracting

Mr. Fiorentini has been appointed -
Equipment Engineer responsible for :

- Estimating Equipment Needs
- Purchasing Planning
- Site Preparing
- Mechanics selection
- Workshop and Warehouse Organization
- Cost Control Supervision
- Market Surveys (In Irak, Algeria, Lybia
  Senegal, U.S.A., Perú, etc.)

During that period he was connected with -
the execution and construction of the fol-
lowing:

- Road Network (Lybia)
- Land Reclamation (Lybia)
- Chemical Plants (Algeria)
- Hotels (Irak, Lybia).
- Projects concerning various Water Systems,
  (Caribe, Saudi Arabia, Senegal)

1980 : THE AUSTIN CO.

Cleveland (U.S.A.)
Regional Sales Planner (Italy)
( 36 )
1981 : - REHARDET S.A.

8, Bd.G. Favon - Geneve (3WI)

Team Leader of the Technical Assistance - Program to the Ministry of Transportation of Peru.

This Program concerns the World Bank loan to the Peruvian Government, consisting also of Technical Support to improve and organize the maintenance of the entire Road System of this country.

ACTUAL SALARY : - 45,000 $ U.S. p.a. (Net).
APPENDIX II

Biographical Data: Leeowen T. ("TEX") Taylor
NAME AND LOCATION OF SCHOOL | MAJOR SUBJECTS | CREDITS COMPLETED | TYPE OF DEGREE | DATE OF DEGREE
--- | --- | --- | --- | ---
USA City, Calif | required subjects | | | 
Los Angeles Business College | business administration | | | 
Oakland, CA (reverse side) | apprentice-ship | | | 

EMPLOYMENT HISTORY
1. Give last three years. Continue on reverse to list all employment related to duties of proposed assignment.  
2. Salary definition - basic periodic payment for services rendered. Exclude bonuses, profit-sharing arrangements, commissions, consultant fees, extra or overtime work payments, overseas differential, or quarters, cost of living or dependent education allowances.

<table>
<thead>
<tr>
<th>POSITION TITLE</th>
<th>EMPLOYER NAME AND ADDRESS</th>
<th>DATES OF EMPLOYMENT (Mo, Da, Yr)</th>
<th>SALARY</th>
<th>DOLLARS PER</th>
</tr>
</thead>
</table>
equipment consultant | Louis Berger Company  
100 Hall - East Orange, NJ | 1/73 - 4/78 | $2500 per mo | 
USAID & Bolivian Government | 3/73 - 4/78 | (40 days) | $120 per day | 
Louis Berger Co. | East Orange, NJ | 1/76 - 4/76 | $2500 per mo | 

SPECIFIC CONSULTANT SERVICES (Give last three years)

<table>
<thead>
<tr>
<th>SERVICE PERFORMED</th>
<th>EMPLOYER NAME AND ADDRESS</th>
<th>DATES OF EMPLOYMENT (Mo, Da, Yr)</th>
<th>DAILY RATE</th>
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</thead>
</table>
| making recommendations | Louis Berger Co.  
East Orange, NJ | 76/77/78 | $2500 per mo | 
| for maintenance and shop equipment | 
| making recommendations | USAID & Bolivian  
Government | 1978 | (40 days) | $120 per day | 

SPECIAL QUALIFICATIONS
1. A combination of education and experience may be acceptable instead of the indicated education.
2. An employer may require applicants to furnish evidence of (form, if necessary)

LANGUAGE PROFICIENCY

<table>
<thead>
<tr>
<th>LANGUAGE</th>
<th>SPEAKING</th>
<th>READING</th>
<th>WRITING</th>
<th>UNDERSTANDING</th>
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<tbody>
<tr>
<td>English</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Spanish</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CERTIFICATION:
To the best of my knowledge, the above facts as stated are true and correct.

Signature of Employee: ____________________________  
Date: July 2, 1979
15 (education - continued)

Have attended various consultant schools in heavy equipment maintenance programs and parts requirements at the following companies:

18 (language)

Two years of night school in Spanish, El Centro, Colombia

CONTRACTOR'S CERTIFICATION (To be completed by responsible representative of Contractor)

A. I hereby certify that (check one):

☒ The initial salary proposal herein meets the salary standards prescribed in the contract.
☐ The salary increase proposed herein conforms to the customary policy and practice for this organization for periodic salary increases.

B. JUSTIFICATION OR REMARKS:

[Signature]

[Title]

[Date] July 2, 1975

(40)
PERSONAL DATA:

Permanent Address: 13005 Stony Brook Drive
Reno, Nevada 89511
(702) 823-6230

Telephone:

Place of Birth: Carrolton, Texas

Date of Birth: May 5, 1959

Height: 5' 8"

Weight: 160 lbs.

Marital Status: Single

Physical Condition: Excellent

Social Security Number: 580-09-7603

PROFESSION: Equipment Consultant/Master Mechanic

KEY QUALIFICATIONS:

I have had extensive and varied experience over the past 40 years on projects involving motorized heavy construction equipment, its repair, rebuilding and maintenance. This expertise includes specification and purchase of new equipment.

I have been concerned with highway maintenance equipment for my entire working life as both a Master Mechanic and Heavy Equipment Specialist and have advised on procurement and the use of highway maintenance equipment. I am knowledgeable about product availability throughout the world and the ability of various countries to man and operate such equipment.

EXPERIENCE RECORD:

Consultant 1978 Made recommendations for heavy equipment to construct 180 kilometers of road. This included excavation equipment, maintenance equipment, quantity of technicians to supervise a training program of operators and mechanics in Lesotho, South Africa through the Louis Berger Company.

Consultant 1978 Made recommendations for maintenance facilities to maintain the equipment on land-clearing projects, roads and experimental stations on farm equipment for the Bolivian Government and US AID through Experience Incorporated.
EXPERIENCE RECORD:  (continued)

Consultant 1977

Equipment consultant on agricultural project for the Government of Jamaica and US AID. hillsides terracing of approximately 17,000 acres for growing vegetables, fruit trees, etc. Made recommendations for the type of equipment and quantity of equipment. Made recommendations for maintenance of such equipment. Also, made recommendations for quantity of technical assistants needed to train the Jamaicans who would be needed for said maintenance. (30 days)

Consultant 1977

Equipment consultant to the Government of Egypt and US AID. Made recommendations for equipment needed to maintain irrigation canals. Made recommendations for shop equipment to upgrade the repair shops of the Egyptian dredging co. and general irrigation workshops. Made recommendations on transporting equipment, and also for quantity of technical assistance needed to carry out shop repair and field maintenance program. (4 1/2 months)

Consultant 1975/76

Equipment consultant for a Highway Maintenance Program for the Sultanate of Oman Highway Department. Evaluated condition of existing equipment and prepared specifications for spare parts required to operate existing equipment and new equipment (including spares). Also, prepared specifications for equipment to be installed in two general overhaul shops and four field maintenance repair shops. Evaluated existing training program for technicians and developed training program for technicians. (5 months)

Consultant 1975/76

Consultant on equipment and repair shop facilities for coal mining for Utah International, Farmington, New Mexico. This was through Jacobs Associates.

Consultant 1975/76

Consultant on equipment for logging pine timber in the Laussen National Forest, Fall River Mills, California. Made recommendations for the type of equipment for skidding heavy pine timber. Also, loading equipment and hauling equipment for approximately thirty million feet of timber. This was through J. J. Bartle Loggers.

Consultant 1975

Was appraiser on approximately 2,500,000 million dollars of heavy construction equipment. This was between US AID, Bangladesh Government and Vinnell Construction Company. The equipment was to be purchased from Vinnell for the Bangladesh Government. This was through the Louis Berger Company.
Consultant 1975
Wrote specifications for agricultural equipment and
undeployed equipment for US AID and the Government of
Lesotho, South Africa - JUPC. (1 month)

Consultant 1974
Made recommendations on equipment for the Kenya Northern
Livestock Project. Equipment required for excavating earth water tanks, including water boreholes and
for building roads and tracks to develop approximately
six million acres of pasture land, and for livestock
grazing. The project is expected to last five years.
Prepared specifications for equipment and set up
preventative maintenance equipment to maintain
the equipment on the project. US AID and Kenya Government.

Consultant 1974
Made recommendations to the Liberian Government Highway
Department. Equipment that would be rebuilt and equipment
that would be scrapped, and new equipment that would
be purchased to carry out a highway maintenance program
and equipment to maintain the highway equipment. This
was through Afro-American Purchasing Center, New York,

Consultant 1974
Made recommendations for highway maintenance equipment
and transportation equipment that would be needed to
carry out a highway maintenance program, building new
roads. This included asphalt equipment, earth-moving
equipment, and maintenance equipment and spare parts
that would be needed to maintain the fleet of highway
equipment over a period of five years. US AID and
Mali Government.

Consultant 1974
Consultant on equipment requirements for clearing some
400,000 acres of land for cultivation, and for excavating
30 million yards of earth. Set up a complete system
for operation and maintenance of equipment on the rainfall
project in Khartoum, Sudan. US AID and Sudanese Government.

Consultant 1973/74
Advising the Sudanese Highway Department on the pur-
chasing of new equipment to replace existing equipment;
upgrading the shop facilities and converting shops to
complete general overhaul shops; making recommendations
for spare parts for the existing equipment and for the
new equipment being ordered, writing specifications and
bidding tenders to World Bank rules and regulations; estab-
lishing training programs for local workers. Through the
Louis Berger Company and Khartoum, Sudan. (approx 4 1/2
months).
EXPERIENCE RECORD: (continued)

Consultant 1972
Made recommendations to purchase highway equipment on a US AID loan for highway maintenance equipment and general construction equipment for roads and developing agricultural land; recommending lists on spare parts for the new equipment; making recommendations for setting up shops including equipment and spare parts; writing specifications and bid tender under US AID rules and regulations; establishing training program for local workers. For the Kingdom of Swaziland, South Africa. (approx 2 months)

Consultant 1972
Loan implementation for water development program for livestock, heavy equipment and land-clearing project; earth tanks and dams and equipment for enlarging earth tanks and dams. Made recommendations for shop maintenance facilities and spare parts for the equipment required to maintain the equipment over a period of three years. Made recommendations for equipment required to maintain the roads and built new roads; development of water resources and road equipment; establishing shops to maintain the equipment. Also set up training program for local workers needed to carry out the maintenance of said equipment. For the Uganda Government and US AID. (approx 2 1/2 months)

Consultant 1971
Made recommendations and spare parts list for repair of approximately 10 million dollars for highway maintenance and general construction equipment in Ethiopia; made recommendations for setting up ten complete overhaul shops for the Imperial Highway Authority; made recommendations for carrying out a complete overhaul and maintenance program for the above equipment. Established a training program for local workers. For the Imperial Highway Authority, Addis Ababa, Ethiopia and US AID. (approx 6 months)

Consultant 1971
Made recommendations to National Youth Service for construction equipment for approximately 300 miles of new highway construction, land-clearing projects, maintenance facilities. Writing specifications and bid tender, inspecting equipment after purchasing at the factories in the U.S. to assure specifications were met. For the Government of Kenya. (approx 5 months)
Experience Record: (continued)

Consultant 1989
Made recommendations for spare parts components list; setting up purchase of equipment for five general overhaul shops, twenty preventative maintenance shops throughout Indonesia. Writing specifications for approximately 20 million dollars of general highway maintenance and construction equipment and approximately 8 million dollars for general overhaul shops and preventative maintenance shops. Through the Louis Berger Company and the Government of Indonesia. (Approx 5 months)

Consultant 1988
Made a trip to Togo to recommend equipment to set up a heavy equipment training school and repair shop. US AID and the Government of Togo.

Consultant 1988
Made recommendations for mining equipment including hauling, blasting, and drilling. US AID and the Government of Guinea. Inspected at the factory to see if they complied with the specifications. Through the Afro-American Purchasing Center.

Consultant 1988
Made an inspection of the Sudanese Highway Department for maintaining highways, building new roads and maintaining air fields. US AID and the Sudanese Government.

Consultant 1967
Made appraisal of equipment that was taken from the contractors in Nigeria by the civil war activities. Made estimate of damage. US AID and the Nigerian Government.

Consultant 1966
Made recommendations and purchases for highway maintenance equipment. Wrote specifications for highway maintenance equipment and facilities for maintaining the equipment. This included rock-crushing equipment, asphalt paving equipment and patching equipment. Recommended technical assistance needed for training local personnel. US AID and the Tunisian Government. Through the Afro-American Purchasing Center.

Consultant 1966
Made inventory and inspection of equipment for the Dahomey Government. Hwy Department of spare parts needed to rebuild their equipment.

Equipment Supervisor and Chief of Maintenance 1963/65
Was responsible for establishing and operating a modern equipment maintenance system and spare parts inventory. Was responsible for reviewing needs and recommending purchases of basic and new modern types of mechanization for land-clearing, irrigation, and planting. For the Central Aguirre Sugar Cane Co., Puerto Rico.
EXPERIENCE RECORD:  (continued)

Equipment Supervisor
1960/63

Was responsible for establishing heavy equipment requirement, purchase plan for the various equipment types needed for land leveling, drainage of salt marsh land, clearing land, and road building. Established and equipped a complete maintenance facility and system for the area. US AID and the Government of Spain.

Equipment Manager
1954/60

In charge of selection and development of multi-million dollar inventory of heavy equipment for the Spanish base construction program. Established the complete maintenance system including repair and overhaul shops, spare parts warehouses and inventory for Brown Raymond Walsh.

Equipment Advisor
1952/54

Was responsible for equipment needs and usage for land clearing, road building and for earth dam construction. Established schools for training Thais in the operation and maintenance of agricultural and heavy construction equipment. US AID and the Government of Thailand.

EDUCATION:

Completed two years of high school at Union High in Yuba City, California.

Completed operator's apprenticeship at Atlas Imperial Diesel Factory in Lodi, California.

Have attended various consultant schools in heavy equipment, such as: Caterpillar Tractor Company, Peoria, Illinois and Phoenix, Arizona; Northwest Engineering Company, Green Bay, Wisconsin, Allis Chambers, Springfield, Illinois; International Harvester Company, Peoria, Wayne, Indiana; Elliot Lubrication School, Galian, Ohio.

LANGUAGE:

Spanish - Good. Two years of night courses in Spa El Centro, Colombia.

[Signature]

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(46)