A STUDY OF TOPRAKSU'S MACHINERY MAINTENANCE OPERATIONS AND THEIR FUTURE TRAINING NEEDS

by

Gerald O. Hubbard

Instructor-Agriculture Engineering

DIESEL TECHNOLOGY AND HEAVY EQUIPMENT OPERATION

WEST HILLS COMMUNITY COLLEGE

February 1975

in Turkey
June 24 to July 24, 1974

Contract No.
AID/ASIA-C-1101

TABLE OF CONTENTS

I. INTRODUCTION

The following report was brought about by the Cooperation of U.S. AID and TOPRAKSU Agency of the Turkish Government. The purpose for which technical assistance and report were brought about was to:

1.0 Make a study of operation and maintenance problems at all levels, i.e., the job site, provincial work unit level, regional office level, and at the Central Directorate level in Ankara.

2.0 In consultation with personnel from the Machinery and Supply Division of TOPRAKSU, prepare operation and maintenance pro-forma delineating the order of maintenance most appropriate for each level of administration, spare parts supply, personnel assignments, physical facilities needed, training required.

3.0 Assist in the preparation of a short training course last two weeks of assignment to introduce principles of equipment maintenance and upkeep most suitable to Turkish conditions. Also will act as advisor to Turkish Course leaders.

The report describes some of the problems that have made it difficult for the machinery and operations section of TOPRAKSU to keep up with mechanical repairs of the equipment used in their various, land leveling, drainage and construction projects throughout Turkey.

The last portion of this report will suggest various training programs that would also help improve their maintenance servicing and operators of equipment. By implementing these programs as soon as possible, a competent staff will be available to handle the maintenance, servicing and operation during the large projected growth in machinery purchases over the next few years.

The following locations and operations in the TOPRAKSU Organization were visited to compile information for this report.

The first trip was to the TOPRAKSU Machinery and Operations Center in Ankara. This included a discussion of problems that have occured in the operation and a tour of the workshop and supply center.

The second trip was a visit to the TOPRAKSU Research Center in Ankara and to visit their workshop and supply center. We also looked at and discussed the scale model of the new workshop, supply center and administrative buildings. The site for these buildings is now under construction in Ankara. These new facilities will become the Central Workshop, Supply Center and Administrative building for all the machinery and supply operations of TOPRAKSU in Turkey. The third trip was to the Adana Region to see the workshop, supply center and field operation that were installing drainage tile. While in the area a short trip was also made to Tarsus to visit

the TOPRAKSU training center. A short visit was also made to the Adana University of Cukurova to see their facilities in the Agriculture Engineering Division.

The fourth trip was made to Izmir and Manisa workshops, supply centers and field operations. The field operations at Manisa that we visited involved a land leveling project. While in the area of Izmir, we also visited an Engine Cylinder liner manufacturing company which also made some farm machinery and small land leveling scrapers for 35 to 65 hp. rubber tired farm tractors.

The fifth trip was to the Samsun, Sinop, Amasya and Tokat. Our first stop was made at the workshop and supply center. Then we drove to Sinop to see a field operation project where they were building an earth fill dam for an irrigation project. After a short visit with the director of Toprakso at Amasya, we went on to Tokat where we observed the new workshop facilities also looked at several new pieces of land leveling equipment that will be going out into the field soon.

Additional meetings and discussions were made in Ankara with the training and machinery operations section to gather information and establish some prospective training programs and courses for the machinery and operations section of TOPRAKSU.

II. FACILITIES

TOPRAKSU's machinery inventory is rapidly expanding to meet the project goals of a five year plan. Current land development capacity is approximately 30,000 hectares per year according to TOPRAKSU data. They wish to expand this to 60,000 hectares per year in the next couple of years. This means almost doubling their equipment requirements. In order to handle this increase, new facilities are now being planned and built, existing facilities are being up dated with new workshop equipment. TOPRAKSU personnel are fully aware of the need for providing good facilities and workshop equipment.

The new workshop facilities looked well designed. The only comment I can make is that the spare parts and supply should not be a separate facility. I will discuss this item in more detail later in the report.

The workshops, are broken up into small shops within the complex. These included electrical, welding, battery, vehicle repair, heavy equipment repair, machine shop and engine shop.

III. WORKSHOP TOOLS AND EQUIPMENT

Hand Tools - The workshops that were visited all seemed to be well stocked with a wide range of hand tools for their master (mechanics). The quality of tools was excellent. The range in sizes of tools for working on large heavy duty equipment to working on small equipment was also very adequate. It was observed that most of these larger tool kits were quite new, very well kept and were readily available for the mechanics to use.

Power Tools (Hand) - In the larger workshops there appeared to be an adequate range of power tools, hand drills, grinders, portable hydraulic presses etc. In some of the smaller workshop units there appeared to be a need for equipping the carpentry shops with more hand power tools, such as saber saws, drills, hand planners, routers, sanders and skill saws.

Power Equipment - Nearly all the larger workshops visited, seemed to be well equipped with lathes, drill press, grinders, boring bars, air compressors, hydraulic presses, hoist and steel saws. The Samsun area however, needed hoist equipment to handle the repair of some of the larger crawler tractors.

Specialized Equipment - The larger workshops such as the one in Adana area was very well equipped. It had new automotive tune up and testing units, automotive front alignment and headlight units, diesel fuel pump calibration and testing units, large portable hoist, track pin and bushing press and track rebuilding welder for rails and rollers.

The medium size workshop such as the one in Manisa had a track pin and bushing press. The Izmir workshop had automotive tune up and testing equipment and also had a diesel fuel pump calibration stand. The Ankara shop also had a new diesel fuel pump calibration pump stand and new automotive tune up equipment.

It is difficult to make too many judgements on the type of equipment needed and where it should be located to be most beneficial. However, it is observed that when the new large central workshop and supply center is completed in Ankara, and as it is equipped and supplied as planned, there should be a limited need for any of the other workshops to have use for diesel fuel pump calibration stands or track pin and bushing presses. The track rail and roller welder unit in Adana should be adequate to handle all of that type of work for years to come from all of the workshops in Turkey.

I certainly feel that there is a need for all the regional shops as well as the Central workshops to acquire some basic Hydraulic System Testing Equipment. A unit that is built by OTC manufacturing company for testing pump flow, pressure output, cylinder and valve leakages etc. would be satisfactory.

Service Vehicles - The service vehicles (trucks) that were observed were very well equipped with air operated lube systems, hose reels, etc. Every field operation observed had the service vehicle assigned to perform daily lubrication and fueling. Each machine had a service record chart that was maintained by the service truck operator.

IV - SPARE PARTS AND SUPPLY

The establishment of a central supply center will help reduce the overall parts and supply inventory and with the future installation of a computerized parts central system. There should be some improvement in parts and supplies movement to the workshops and field for maintenance and servicing.

In the meantime, a study could be made of the current method of requisition of parts from the parts and supply house. It seems that a smoother method could be developed by eliminating some of the paper work and authorization steps. Also there appears to be at times a lack of communication between the workshop and the parts and supply house as to what is actually available. With the use of a computer this could be improved as a computerized parts list could be delivered to the shops occasionally. In the meantime, possibly the delivery of an extra copy of the yearly inventory to the workshop could be made.

The inventory of some of the parts and supply houses were quite large and it was indicated and observed that some of the parts that were in stock were obsolete and probably would never be used. These parts take up valuable storage space and are costly to reinventory every year. A means should be developed to either return them to the manufacture or dispose of them by some other means.

It was observed that parts and supplies were usually stored in a building separate from the repair shop. This is quite evident in the planning of the newer shops. It is recommended that, whenever possible, parts be located in the same building or attached-building. This would help save time for acquiring parts and also may help streamline paper work and improve communications between the two.

It is also suggested that a parts exchange or component exchange philosophy be adopted. The parts and supply warehouse, especially the central ones, could then order these components from the manufacturer as complete units. Generators, starters, fuel pumps, for example, are frequently used items and the stock of these would be much greater. Only a few items like radiators, torque converters and whole engines (stripped of accessories) would be needed in stock at either Adana or Central Parts and Supply at Ankara. The number of parts stocked of course depends on the number of machines that are in operation. The maintenance trucks (See Attached Figure 1) would be

the key to this operation. Upon receiving word from the field as to what the repair problem is, a truck would leave with the proper parts from the warehouse for the field to make the parts or component exchange on the machine. This system will be discussed in more detail later in the report.

The spare parts and supply availability will always be a problem to a large degree and will probably be one of the biggest factors in machinery down time for repairs. These problems will be discussed in more detail in the next section of this report.

V. MACHINERY

The method of acquiring money for the purchase of machinery through the World Bank and other Foreign Country Banks is very good, but it has its draw backs. For instance, all machinery items must be purchased through bid and the lowest bid must be accepted regardless of manufacture quality in comparison to one another, which can be quite a problem. I will discuss this also in more detail later on. The low bid will probably be a different manufacture each year, hence you have a mechanics and operator training problem. The stocking of spare parts becomes more difficult as related parts will not usually interchange between different makes. It is without question a difficult situation, and TOPRAKSU is very much aware of these problems and is trying to take steps to help improve some of them.

As is also mentioned later in the report the appearance of machinery that was observed working in the field was very good. The operators of the equipment were very concerned with the operation of the equipment and appearance. TOPRAKSU has been training good operators and is now in the process of setting up more training programs to meet their future needs.

VI. MAINTENANCE PERFORMANCE

Current Workmanship - The overall performance of the workshops in relationship to the actual repair and maintenance of the equipment seemed very good in all of the sites visited. The mechanical ability of workman was observed to be very good. The complete rebuilding of batteries, rewinding of starter, generators, engine block reconditioning and machine shop lath work was quite impressive.

The competent performance I believe is brought out by the condition of some of the older equipment that is in use. Every machine that was observed particularly two older Caterpillar D7E (47A series) (12 years old) that were pulling scrapers in the Sinop area appeared to be in excellent condition. Exceptional care seems to be taken in replacing all the parts properly including all the shields and guards etc. after they have been worked on.

Fuel or oil leakes on any piece of machinery that was observed working was rare.

The most obvious maintenance error that was observed was on some older D4 crawler tractors that had failed to have their pins and bushings turned hence they only obtained approximately one half of the potential use of that set of pins and bushings. At this workshop, they had recently installed a press to turn pins and bushings so this type of error will probably not happen again.

Lubrication and Service Trucks - The daily lubrication, servicing and adjustment of the machinery is absolutely one of the most important parts of keeping a fleet of equipment in operation.

In the Adana area there were several well equipped trucks as was mentioned earlier in the report. They were keeping a daily service record on each machine and the machinery seemed like it was getting good daily lubrication and servicing. I did not observe or know when routine minor adjustments were made but I assume that they were also done when the machine was lubricated and serviced.

Everyone that I came into contact with, was aware of the importance of performing all the recommended maintenance operations that were required in the operator's manual for each machine. Again as I have mentioned before the equipment observed seem to show this awareness by showing signs of having had adequate daily lubrication.

Maintenance Truck (new concept) (See Figure I attached) - To handle most of parts exchange or component exchange concept of machinery maintenance. These types of units will be described in more detail later in the report. Maintenance trucks could be dispatched as needed from the workshops. They would probably be operated by a master (experienced) and a helper. Some of the typical parts that can be fairly easily exchanged in the field are, starters, generators diesel fuel pumps, injectors, radiators, water pumps, torque converter transmission, hydraulic pumps, etc.

Portable Workshop - These units of which TOPRAKSU has several, would seem to be most ideal to handle maintenance problems on the machinery that is working on construction projects that are located in remote areas of Turkey. They would be ideal to handle, any welding or machine work on parts. Also where there is large concentration of equipment such as in the drainage project outside of Adana a unit of this type is ideal to handle miscellaneous repair jobs. We saw one of these units on the job site in Adana and it seems to be quite effective.

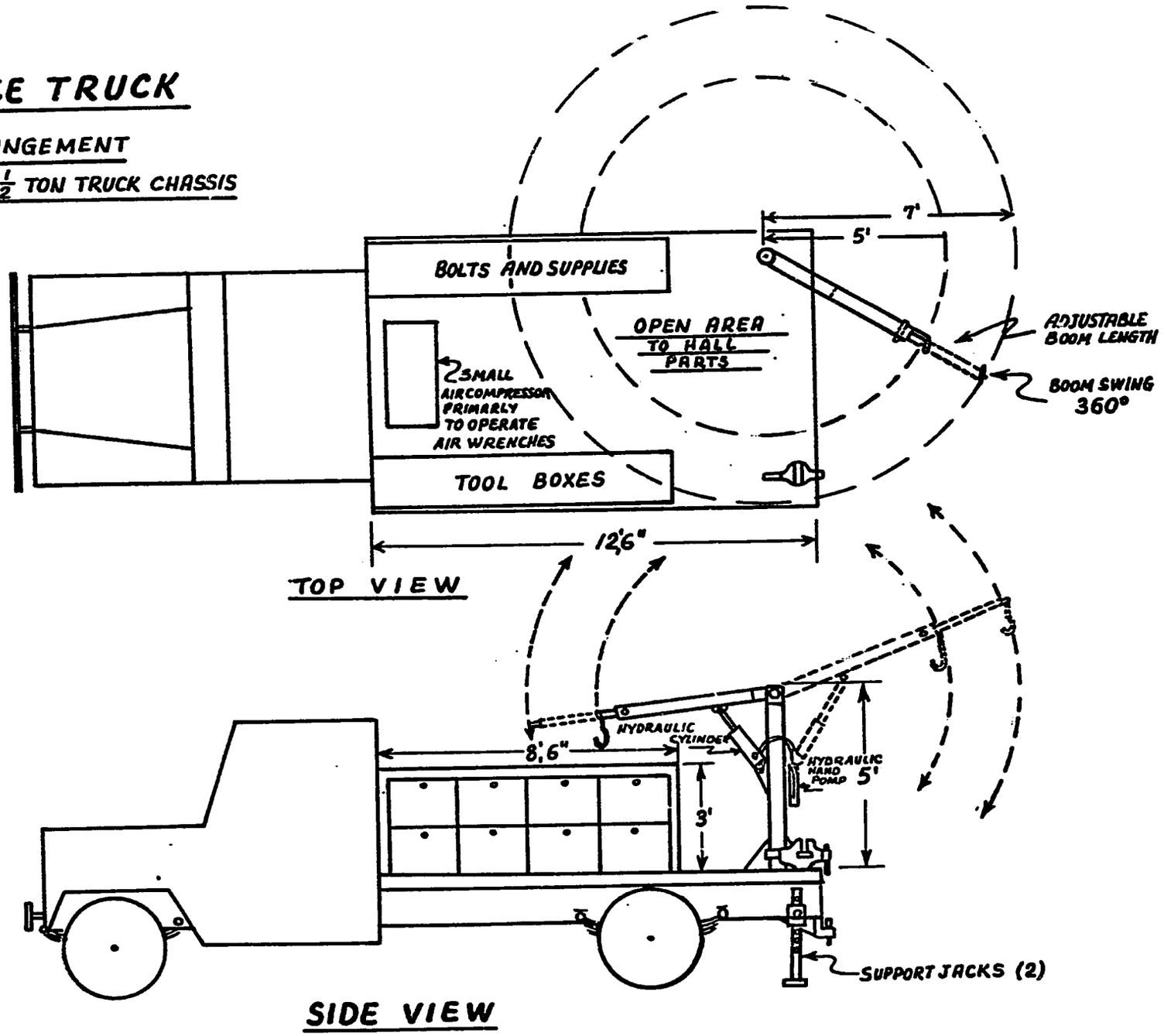
Regional Workshops - These shops although some what smaller than the Central Workshop such as Adana were pretty well equipped with hand tools, hydraulic presses, drills etc. The mechanics seemed well qualified and were performing good mechanical work.

FIG. 1

MAINTENANCE TRUCK

SUGGESTED ARRANGEMENT

MOUNTED ON A 1½ TON TRUCK CHASSIS



Central Workshops - The plans for establishing a central workshop have been developed and site preparation is underway. The building will not be built until next year. It will be quite large 7,700 square meters.

VII. PERSONNEL STRUCTURE

There are many duties and responsibilities that must be performed to keep a workshop operating at maximum efficiency. Below is a list of responsibilities that may be performed by some of the levels of personnel indicated:

Helper - 1) assiststhe master (mechanic) in making repairs, 2) cleans machinery prior to servicing or repair work, drains oils from units prior to working on them, 3) assists in lubrication and servicing of equipment, etc.

Master (Mechanic) - 1) removes and reassembles parts as needed for repairs, 2) helps foreman determine cause of parts malfunction, 3) helps foreman determine parts needed for repairs, 4) checks closely with foreman as to specifications required for proper reassembly of parts, 5) helps foreman trouble shoot machines to locate malfunctioning components.

If maintenance truck and parts exchange philosophy is adopted, the master would operate the maintenance truck and be responsible for making repairs with it in the field.

Foreman - 1) Along with the engineer makes daily work assignments for master and helpers, 2) supervises masters and helpers in their assignments, 3) along with the master and engineer assists in analyzing repair needs, 4) runs down parts for repairs.

Engineer - 1) Schedules equipment for repairs, 2) works closely with parts and supply to check on stock supply and flow of parts to the workshop, 3) assigns personnel to keep shop clean, painted etc., 4) assigns personnel to keep machinery storage yard clean and machinery parked in neat straight rows, 5) assigns personnel to keep track of required records for the workshop operation, 6) supervises foreman in making daily work assignments 7) on major repairs advises foreman 8) assigns personnel to set up equipment for field work.

Chief Engineer - 1) In some of the large shops a chief engineer will make some of the personnel assignments that were mentioned under the Engineer above. 2) The chief engineer is responsible for the overall maintenance operation of machinery and workshop operation, 3) he should introduce new techniques and ways of improving the overall machinery workshop operation, 4) makes decisions as to the needs in the amount of shop personnel facilities, tools and equipment needed to run the shop,

5) he reports these needs to the regional director, 6) he also should assist in determining the type of machinery needed for future projects and 7) he should also assist in determining when to phase out worn out or obsolete machinery.

There are many more job responsibilities I'm sure ... and due to the short time that I had to observe shop operation, I'm sure there may be errors according to TOPRAKSU's view point. But it may serve as a model of structure responsibility guideline. I realize there are welders, machine shop, service truck operators that are not mentioned in the sample guideline but they could be added in where appropriate.

VIII. MAINTENANCE STRUCTURE

Machinery Operator - Operates machinery safely and within its designed capacity for doing work. Reports any unusual behavior of machinery to the person in charge of the machinery immediately.

Service Trucks - Handles the day to day lubrication, fueling and minor adjustments of the machinery. Reports any unusual problems leaks, excessive use of lubricants, worn or broken parts etc. to the person in charge of the machinery.

Maintenance Trucks (See Fig. I) - It is my suggestion that a fleet of these trucks be developed to handle field repairs whenever possible. These trucks should be of either the 1 ton 8 ft. flat bed or 1½ ton trucks with approximately a 12 ft. flat bed. They should be equipped with all range sizes of hand tools and equipped with a small air compressor and possibly a small welder (225 amps). Tool boxes should be mounted along one side of the bed and storage bins for bolts and some supply materials on the other side. A hydraulic boom mounted on the back of the bed in one corner to swing out across the bed and around to the back to lift heavy components from the machinery to the truck bed and vice versa.

The most important factor to make this system work is a communications system and proper diagnosis of the repair problem in the field. A message should be sent to have a maintenance truck pick up the necessary parts and bring them out to the field and make the repairs. By replacing the complete part component most of the time it makes it possible to get the machinery back to work faster. The malfunctional component is then taken back to the local workshop or to the main workshop in Ankara for rebuilding. After it is rebuilt it is painted and returned to the supply stock.

Portable Workshops - These units can handle larger welding jobs such as scraper dozer and bucket hardfacing, rebuilding and the manufacturing of some parts at the job site when it is faster and there is none available through normal channels.

Regional Workshops - The shops such as Manisa, Tokat, Samsun, Adana are difficult to group together due to the fact that some are operated and financed under different world and foreign bank loans. Also some are quite a bit larger in size and the scope of equipment they are responsible for. These larger shops should be equipped to handle any repair job on any piece of equipment that may occur. Some of the smaller area workshops may have to farm out to the larger workshops some of the more sophisticated repairs. The biggest responsibility for these workshops and will come in rebuilding and reconditioning equipment during the winter months. Every machine should be thoroughly checked so it will be ready to roll as soon as the field work starts in the spring and summer. While the machine is in the field if parts or components need repairs and they can be changed in the field by the maintenance truck or rebuilt by the portable shop, then this should be done. If not, the machine should be hauled into the area workshop for the major repairs, such as engine rebuilding, and final drive repairs, etc.

The need for lathes, diesel pump test stands, would be rather limited in some of these smaller regional workshops.

Central Workshops - For now it seems that two of these shops can handle most of the major component rebuilding and those jobs that require extensive repairs. Due to the very large amount of equipment in the Adana area, it is only logical that it be equipped to handle any and all types of repairs that may be necessary from that region of Turkey.

The workshop in Adana had a well equipped machine shop. At the time of our visit they were making engine cylinder sleeves from rough castings that they had purchased locally in Adana. Yet there is a cylinder liner manufacture in Izmir that uses a better quality casting and makes liners for all makes of machinery. It appears that it would be best for TOPRAKSU to purchase any liners that they would need from the manufacture in Izmir as they will probably be cheaper in the long run and of better quality. Some of this space could then be used for expanding engine repair facilities. Two or three lathes in the Adana workshop could probably handle all their other lathe work needs.

With the establishment of the very large and well equipped workshop in Ankara, it should be able to handle the major component rebuilding (parts exchange) type of work such as torque converters, engines, transmission diesel fuel pumps, injectors hydraulic pumps, etc., as well as machinery rebuilding and reconditioning for the rest of Turkey including some of the west coast, northern provinces and eastern provinces.

IX. TRAINING REQUIREMENTS

In order to have qualified personnel to meet the project growth needs, TOPRAKSU will need to step up its training programs for the machinery and operations division. The continued use of the DSI training programs in machinery repair and maintenance is encouraged. TOPRAKSU's training programs in machinery operation and servicing should be expanded into offering short courses for scraper operation (large units - small units). Dozer operators, motor grader operators, truck drivers, loader operators, backhoe operators, trenching machine operators, etc. The use of operator's manuals for teaching aids are ideal. Attached (Appendix No. 1) is a sample course outline for machinery operation. The course outline can be adopted to teach a course on the basic operation of any machine. Attached in (Appendix No. 2) is a list of courses that would make up a complete training program for mechanics operators, service and lubrication personnel. DSI, I am sure, has many courses similar to those on the list. For additional information on setting up courses or training programs I would be happy to provide as much additional information as I can:

Write:

Gerald O. Hubbard
Agriculture Department
West Hills College
300 Cherry Lane
Coalinga, California 93210

X. SUMMARY

In order to observe first hand and compile information for this report several trips were made to various TOPRAKSU operations in the machinery and operation division. Workshops parts and supply facilities field operations were primarily observed on the trips.

The workshops were generally found to be well equipped with hand tools testing equipment, power equipment. The use of lathes in making new parts and rebuilding parts was quite extensive especially in the larger workshops. I question the need for so many lathes in the larger shops for making parts. Even the smallest workshop observed had at least one or two very nice late model lathes. Some of the work possibly could be turned out to be private business with less expense involved.

It was observed that new equipment for automotive tuneup, diesel fuel pump calibration units were installed. Caution should be taken in regard to over equipping some of the smaller workshops with this more expensive equipment such as diesel fuel pump calibration stands; one or two of these units could handle pump repairs for three or four hundred tractors or more.

The installation of a track pin and bushing press and track rebuilding welding unit are pieces of equipment that can service many tractor units hence only one or two of these units could handle all this type of work.

There is a real need to acquire hydraulic testing equipment in the shops. Most of the newer machines have hydraulic systems. The need for testing equipment to help locate malfunctioning parts and evaluating their condition is essential.

According to information received TOPRAKSU over the next couple of years will computerize the parts and supplies department as well as it will computerize machine repair cost down time etc. This will help parts control and availability throughout the various workshops. The machinery, parts and supplies purchasing due to financing structure and mandatory low-bid acceptance has created problems. Almost every year a different manufacture wins the bid and most parts will not interchange. Thus a complete stocking of like items are required.

The parts and supply system should be studied to try to streamline paper work, authorization and inventory.

I also believe a philosophy of parts exchange method for field repairs would be very beneficial. Replace the complete part in the field later back at the workshop repair the malfunctioning part.

The machinery I observed working in the field appeared to be well maintained and in good operating conditions. The lubrication and service trucks I observed were well equipped and maintaining service records. If the parts exchange philosophy is adopted the development of a fleet of maintenance truck is recommended also. These trucks would be equipped with essentials for making field repairs especially parts exchange in the field.

The portable workshops that were in the field were well equipped for making repairs of the general nature as they contained welder arc and gas lathe drill press bolts and other miscellaneous supplies.

The regional workshops were generally well equipped with hand tools and power tools. They appeared to being capable of handling most of the repairs brought into them.

The development of a Central Workshop in Ankara will greatly enlarge the repair capabilities.

The workshop personnel structure as outlined in the report gives primarily my view point on assigned responsibilities.

TOPRAKSU has developed a maintenance structure that is pretty standard. I believe that if a fleet of maintenance trucks were developed the over efficiency of making repairs in the field would improve.

The training and retraining of personnel should be greatly expanded. Continued cooperation with DSI in training personnel should be continued. The need for TOPRAKSU to develop short training courses to train personnel in specialized area such as equipment operators and lubrication and service is highly desirable.

Attached are Appendices

No. 1 - Short Course for Machinery Operation

No. 2 - Suggested Training Courses for Toprakşu

No. 3 - Sources of Instructional Materials

APPENDIX No. 1

Machinery Operation

Sample Course Outline

1.0 Importance of Understanding Proper Operation and Daily Care.

2.0 Doing the 10-hour service jobs.

- 2.1 Servicing the air cleaner assembly
- 2.2 Checking the crankcase oil level
- 2.3 Checking the costing system
- 2.4 Doing the daily require servicing jobs
- 2.5 Removing water and sediment from the fuel
- 2.6 Safety checking of the machine and operator
- 2.7 Checking miscellaneous items (loose bolts, worn parts, etc.)

3.0 Making adjustments to meet operating needs

- 3.1 Checking and adjusting seat position
- 3.2 Adding weight for traction and balance (rubber tired units)
- 3.3 Adjusting tire pressure to weight changes and highway conditions (rubber tired units)

4.0 Starting the machine engine

- 4.1 Identifying the type of engine
- 4.2 Preliminary starting precautions
- 4.3 Starting engine operations
- 4.4 Making adjustments during warm up

5.0 Controlling machine movement

- 5.1 Identifying the type of transmission or torque converter and how to use it
- 5.2 Starting machine movement
- 5.3 Operator a moving machine
- 5.4 Stopping machine movement

*6.0 Hitching to tractor operated equipment

- 6.1 Attaching equipment to the drawbar
- 6.2 Hitching rear mounted equipment
- 6.3 Connecting the power-take off (PTO)
- 6.4 Connecting the remote (Hydraulic) cylinder

* For machinery that have hitched equipment.

7.0 Operating a Machine under Field Conditions

- 7.1 Making adjustments before starting work
- 7.2 Matching gear selection and engine speed with load
- 7.3 Handling overloads without stopping the machine
- 7.4 Checking and correcting tire slippage
- 7.5 Operating machinery on slopes
- 7.6 Pulling out of mud hole or ditch

8.0 Doing the Routine Operational Jobs

- 8.1 Precautions to take when dismounting from the tractor
- 8.2 Precautions extra riders
- 8.3 Precautions to take when making short turns
- 8.4 Observing low tire pressure or loose tracks
- 8.5 Operating an engine with ignition knoc
- 8.6 Checking temperature and oil pressure gages and ammeter

9.0 Stopping the Engine

- 9.1 Gas or Diesel

10.0 Refueling the Machine

- 10.1 Gas or Diesel (safety)

APPENDIX No. 2

SUGGESTED TRAINING COURSES FOR TOPRAKSU

Machinery and Operation Section

1.0 General Information

1.1 For the various personnel levels (chief engineer, engineer, foreman, master, helper) course content would be subject to change to meet each level's needs.

1.2 Courses should be offered at a time to avoid conflict with busy season operations.

1.3 Courses should be designed as short courses lasting approximately 1-4 weeks. Some courses may require additional time.

1.4 Whenever possible Turkish or Foreign machinery equipment dealers should be involved in supplying teachers, and/or instructional materials

1.5 Instructors from within Topraksu Organization should be used whenever qualified personnel is available.

1.5.1 Topraksu should develop within the organization a qualified staff to teach whenever the need arises.

1.6 Tppraksu should develop an instructional materials library for future courses.

*1.6.1 Many manufacturers of equipment will provide charts booklets pamphlets and some slides and film strips free of charge while others charge a nominal fee to cover production costs.

*1.6.2 Many universities, colleges trade or technical societies and associations will provide instructional materials free or for a nominal fee.

2.0 Current Training Programs - 1974

2.1 Scraper and dozer operators training program for new equipment

2.1.1 General Information

* See attached list (Appendix No. 3) "Source of Instructional Materials" for address of manufacture universities, colleges and government agencies that have catalogs available free of charge.

2.111 level of instruction - operators
2.112 time - summer
2.113 length - 3 weeks
2.114 instructors - joint effort by Topraksu instructors and Massey Ferguson manufacturing company

2.1.2 Comments

2.121 This is an excellent approach to developing an instructional staff for Topraksu as the Chief Engineers are now to go out to the various Regional operations and instruct operators on the use and application of the equipment in the field.
2.122 The involvement of the manufacture company in the instruction program was very good.
2.123 The course outline was very complete for this type of training.

3.0 Suggested additional training programs that could be implemented in the future.

3.1 Workshop Operation - The day to day operation of the workshop, organization tool storage, clean up, equipment storage facilities appearance, etc.

3.2 Lubrication and Servicing - Instruction in the recommended procedures on how to perform the lubrication and servicing and adjustments for day to day operations of the machinery such as trenchers, trucks, loaders, tractors, scrapers etc.

3.3 Basic Hydraulics - Basic theory, technical information, operation, applications, component functions, and applied maintenance of Hydraulic Systems.

3.4 Workshop Skills - The identification and safe use common hand tools, power tools measuring devices, testing equipment specialized tools and equipment.

3.5 Welding Skills - Development of welding skills in arc and gas welding cutting torch, forging, hard facing, materials, hard-facing gas and arc welding, cast iron arc and gas welding.

3.6 Diesel and Gas Engines - Theory and applied practices in the maintenance and repair of engines, type of specifications required trouble shooting, etc.

3.7 Power Trains - Theory and applied practices, clutches mechanical transmissions, hyd. assist, transmissions, hydrostatis drives, torque converters, differentials, final drives, power take-off, special drives.

3.8 Engine Air Systems - Air cleaners, pre-cleaners, turbo-charges, maintenance and servicing.

3.9 Electrical Systems - Alternators, generators, voltage regulators, wiring procedures, batteries, etc.

3.10 Under Carriage Crawlers - Service and maintenance, track pads, pins, bushings, links, rollers front idler, drive sprocket, rock guards, under carriage alignment, checking for wear, trouble shooting etc.

3.11 Front End and Steering - Alignment, adjustments maintenance procedures of the steering systems of cars, trucks and tractors.

3.12 Brakes Mechanical, Air and Hydraulic - Instruction in the skills of adjustment, repairing of brake systems on cars, trucks and tractors.

3.13 Fuel Systems - Instruction in the skills of adjustment, testing and repairing fuel systems Caterpillar Roosa Master, Bosch, Detroit Diesel, etc.

3.14 Tires and Wheels - Instruction in the maintenance, repair and application of tires and wheels on cars, trucks and tractors.

3.15 Cooling Systems - Radiators, inter-coolers, engine oil, transmission, and hydraulic cooling systems, how they operate, maintenance and repair.

3.16 Bearings and Seals - Instruction in the skills of removing and installing bearings and seals.

3.17 Recondition of Equipment - Instruction in the skills of reconditioning equipment, cleaning, sanding, painting etc.

3.18 Equipment Operators Training Courses - Grader operation, trencher operation, dozer operation, scraper operation (large units - small units) loader operation backhoe operation, heavy duty truck driving.

APPENDIX NO. 3

Sources of Instructional Materials

1.0 Sources of instructional materials can be obtained by writing the following manufacturers, universities, colleges and governmental agencies and asking for a catalog or list of their educational materials for training programs.

1.1 Manufactures:

1.11 Caterpillar Tractor Co.
Peoria, Illinois 61611, U.S.A.

1.12 John Deere Service Publications
John Deere Road
Moline, Illinois 61265, U.S.A.

1.13 Fiat Allis Co.
Construction Equipment Division
300 South 6th St. Springfield, Illinois 62703, U.S.A.

1.14 Cummins Engine Co.
Columbus, Indiana 47201, U.S.A.

1.15 Delco-Remy Division of General Motors Corp.
Anderson, Indiana 46000, U.S.A.

1.16 Detroix Diesel Engine Division
General Motors Corporation
Detroit Diesel Training Center
7707 West Chicago Boulevard
Detroit, Michigan 48204, U.S.A.

1.17 Diesel Injection Sales and Service Inc.
1120 East Brambleton Ave.
Norfolk, Virginia 23516, U.S.A.

1.18 Electric Auto-Lite Co.
Toledo, Ohio 43600 U.S.A.

1.19 Ford Motor Co.
Ford Tractor Division
2500 East Maple Rd.
Birmingham, Michigan 48808, U.S.A.

1.110 Implement and Tractor Publications Inc.
1014 Wyandotte St.
Kansas City, Mo. 46105, U.S.A.
(Repair Manuals for Farm Tractors)

1.111 International Harvester Co.
Construction Equipment Division
10400 West North Ave.
Melrose Park, Chicago, Illinois 60153, U.S.A.

1.112 Massey Ferguson Inc.
Training Center
6143 Brookville Rd.
Indianapolis, Indiana 46219, U.S.A.

1.113 Robert Bosch Corp.
2800 South 25th Ave.
Broadview, Illinois 60155, U.S.A.
(Fuel Injection Equipment)

1.114 Standard Screw Co.
Roosa Master Fuel Injection Equipment
Hartford, Conn. 06102, U.S.A.

1.115 Womack Educational Publications
2010 Shea Rd.
Dallas, Texas 75235, U.S.A.
(Hydraulics)

1.116 Vickers Corporation
Division of Sperry Rand Corp.
P. O. Box 302 Troy, Michigan 48084
(Hydraulic)

1.2 Universities, Colleges, Trade & Technical Societies and Associations:

1.21 American Welding Society (AWS)
345 East 47th St.
New York, N. Y. 10000, U.S.A.

1.22 American Association for Vocational Instructional Materials
Engineering Center
Athens, Georgia 30601, U.S.A.
(Educational Materials on Mechanics)

1.23 Vocational Education Productions
California State PolyTechnic College
San Luis Obispo, California 93401, U.S.A.
(Educational Material on Mechanics)