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THE USE OF SECOND-HAND EQUIPMENT IN THE INDUSTRIALIZATION OF DEVELOPING COUNTRIES

Report by

Prof. A. Wiemer
THE POTENTIAL OF SECOND HAND EQUIPMENT IN THE INDUSTRIALIZATION OF DEVELOPING COUNTRIES

PREPARED FOR:
Centre for Industrial Development
United Nations
New York, New York

BY:
Prof. Adam Wiener
Nassau College
Garden City, New York

October 1965
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<td>5.6 Conclusions</td>
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</tbody>
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Attachments

"A" - Surplus equipment of U.S. corporations
"B" - U.S. Department of Defense equipment
"C" - Corporate liquidation notices
"D" - Second hand equipment publications
"E" - Second hand dealer brochures
"F" - U.S. Agency for International Development
    Excess Equipment Program
Introduction

1.1 Statement of Problem

Acceleration of economic development of the developing countries is one of the dominant themes of our time. The aspiration of the developing countries to early industrialization is recognized as necessary to peace, stability, and economic well being of all nations. Study of practical measures for implementing industrial development must be accorded major importance in the plans of national and international organizations.

One measure increasingly put forth has been the utilization of second hand equipment generated in economically advanced countries. The use of this second hand equipment is proposed as a method of economizing on scarce capital; enabling the developing countries to obtain more capital equipment with the same capital expenditure. Many other methods of economizing on scarce capital are under investigation by organizations assisting industrialization. These other methods include economies of scale, use of labor intensive techniques, increasing productivity of labor, standardization, extending the life of equipment by improved maintenance, more intensive use of capital equipment, and development of "autonomous technologies" using techniques and materials particularly suitable to local conditions.
Although there is some relation between these various methods of economizing on scarce capital, for purposes of analysis they must be clearly differentiated and considered individually.

The controversy between the advocates and critics of the use of second hand equipment is in the last analysis reduced to the question "Does the use of second hand equipment, in fact, economize on scarce capital when compared with new equipment?" This is the problem to which the report that follows is addressed.
1.2 The Purpose of the Report

The potential of second hand equipment to economize on scarce capital depends on three factors: the present and future supply in the industrially advanced countries, the net cost of second hand versus new equipment, and the mechanisms for transferring this equipment to the developing countries. It is the purpose of this report to analyze these three factors and thus provide a better basis for answering the question, "Does second hand equipment, in fact, economize on scarce resources when compared with new equipment?"

The answer to this question may be different for each category of equipment. The answer for textile equipment may not apply to electrical equipment. The report will investigate the three factors as they operate in the case of metalworking equipment. This category is estimated to account for 27.4 percent of all equipment required in 1975 by the manufacturing industries of the developing countries, more than 4 times as much as the next largest category. A second purpose of the report is to develop an analysis for metalworking equipment which will apply to every type of equipment.
On the basis of this analysis of metalworking equipment, it is the third purpose of the report, to make recommendations that would enable second hand equipment to best reach its potential in economizing on the scarce resources of the developing countries.
1.3 The Demand for Capital Equipment in the Developing Countries

The demand for imported industrial equipment by manufacturing industries of the developing countries is estimated to rise from $3.9 billion in 1961 to $7.5 billion in 1975. This is the potential market for second hand equipment discussed in this report.

Some indication of the geographic distribution of the demand for industrial equipment may be gained from Table 1.

Table 1.
Projections of total value added by manufacturing industries, 1975.

<table>
<thead>
<tr>
<th>Region</th>
<th>Billions of 1953 U.S. Dollars</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa (excluding South Africa)</td>
<td>6.8</td>
<td>5.1</td>
</tr>
<tr>
<td>Asia (excluding Japan and centrally planned economies)</td>
<td>35.4</td>
<td>26.8</td>
</tr>
<tr>
<td>Middle East</td>
<td>5.6</td>
<td>4.2</td>
</tr>
<tr>
<td>Latin America</td>
<td>57.2</td>
<td>43.3</td>
</tr>
<tr>
<td>Europe (Greece, Spain, Portugal, Turkey, Yugoslavia)</td>
<td>27.1</td>
<td>20.6</td>
</tr>
<tr>
<td>Total, Underdeveloped Countries</td>
<td>132.1</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The composition of the requirements for industrial equipment can be seen in Table II.
Table II.

1975 Estimated Percentage Distribution of Equipment Requirements of Manufacturing Industries in Developing Countries.

I. Non-electrical machinery

<table>
<thead>
<tr>
<th>Item</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engines and turbines</td>
<td>0.7</td>
</tr>
<tr>
<td>Machine tools, metal-working machinery</td>
<td>27.4</td>
</tr>
<tr>
<td>Cutting tools, jigs and fixtures</td>
<td>1.7</td>
</tr>
<tr>
<td>Special industrial machinery</td>
<td>34.5</td>
</tr>
<tr>
<td>Pumps and compressors</td>
<td>2.9</td>
</tr>
<tr>
<td>Elevators and conveyors</td>
<td>6.8</td>
</tr>
<tr>
<td>Blowers and fans</td>
<td>1.8</td>
</tr>
<tr>
<td>Power transmission</td>
<td>0.5</td>
</tr>
<tr>
<td>Refrigerator equipment</td>
<td>1.8</td>
</tr>
<tr>
<td>Industrial machinery n.e.s.</td>
<td>4.8</td>
</tr>
<tr>
<td>Total, manufacturing equipment proper</td>
<td>82.9</td>
</tr>
</tbody>
</table>

II. Electrical Industrial machinery

<table>
<thead>
<tr>
<th>Item</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motors and generators</td>
<td>3.3</td>
</tr>
<tr>
<td>Transformers</td>
<td>0.8</td>
</tr>
<tr>
<td>Electrical control apparatus</td>
<td>2.2</td>
</tr>
<tr>
<td>Electrical Welding</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Electrical appliances</td>
<td>0.5</td>
</tr>
<tr>
<td>Total, electrical machinery</td>
<td>8.2</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>III. Transportation equipment</td>
<td></td>
</tr>
<tr>
<td>Motor vehicles</td>
<td>3.0</td>
</tr>
<tr>
<td>Locomotives and railroads</td>
<td>1.8</td>
</tr>
<tr>
<td>Total, Transportation Equipment</td>
<td>4.8</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
</tr>
</tbody>
</table>
1.4 Examples of the Use of Second Hand Equipment

There is a small but active international trade in second hand of every type. This trade may be conveniently divided into 3 categories; 1. individual pieces of equipment that are part of a complete plant such as a diesel driven generator, a lathe, a welder, a pump, or lift fork. 2. major components that form the core of a complete plant, such as a sheet rolling mill, a cigarette making machine, or a forging hammer. These require only ancillary equipment to form productive unit. 3. Complete Plants - For every example of the successful use of second hand equipment there is another example where it proved uneconomic and technically unsuitable. The two examples cited below illustrate some of the difficulties in establishing a clear answer to the question, "when is second hand equipment more economical than new?"

In the first case, a complete synthetic rubber plant was transferred from the U.S.A. to India. The process used, had become entirely obsoleted in the U.S.A. by a cheaper process using refinery gases as raw material. In India, the older raw material, ethyl alcohol, was cheap and in plentiful supply. Even though 15 years old when purchased, the plant had operated only 3 1/2 years. A major U.S. rubber company held an equity position in the Indian firm. A commercial bank loan was available and the purchase price was low due to the obsolescence of the process. A firm of
experienced engineers was available to dismantle and reassemble the plant on a turnkey basis. Moreover, the original designers, erectors, and operators of the plant also owned the process and thus had a vested interest in its proper operation. Through their cooperation, a plant was found still using the process where Indian personnel could be sent for training. After inspection of the plant and its operating records which showed the plant had consistently outproduced its design capacity, the decision was made to purchase the plant. The plant was put into operation a year sooner than if it were new. It has operated profitably and without any special operating or maintenance problems since its construction.

This example demonstrates the importance of a feasibility study that shows the price and local availability of a raw material adapted to an obsolete process, the domestic market and price for the final product, and the ability of the plant to pay for itself long before the raw material for the more efficient process would be available. The engineering of the plant on a turnkey basis, the equity and royalty interest of major U.S. firms, and the prior training of personnel were all factors in ensuring the efficient performance of the second hand equipment.

The second case is that of a steel mill in a Latin American country which required a sheet rolling mill. The choice was between an expensive semi-continuous mill of
which additional strands could be purchased as demand increased and an inexpensive second hand reversing mill with a rather high capacity. The decision to buy the second hand mill proved a costly mistake. The mill produced an uneven product of fixed width. The cost of a rolled sheet was some 60% more expensive per ton than the international price. The installed sheet rolling mill had an excess capacity which could not be exported because of prohibitive price. By 1975, the local demand will enable the mill to operate at capacity. Even then, the local sheet steel user will be penalized for this mistake by paying an exorbitant price for an inferior product.

This example shows the danger that the original low price paid for second hand equipment is very expensive indeed if it results in high unit cost of final product and poor quality. If the feasibility study was a fault, surely some of the blame is shared by the lure of low original cost of second hand equipment.
1.5 Outline of the Report

Three terms of reference form the next section of the report. The U.S.A. second hand market is used as the basis of analysis because the U.S.A. is the largest potential source. Second hand equipment should be considered an alternative to new equipment whenever it meets specifications determined on the basis of function. The third assumption is that any analysis contains elements of uncertainty that make it indicative rather than precise.

Present and future supply forms the third section. Topics discussed include generation of equipment, the second hand market, the trends in technological innovation. This section is supported by published material that forms the attachments to the report.

The factors entering into the net cost of equipment are discussed next. These factors are the original and operating costs. An example of the data and calculations needed to obtain net cost is presented.

The mechanisms of transfer form the fifth section. These include exporting, importing and financing organizations and what are termed conditions of transfer. Conditions of transfer considers inspection, classification,
appraisal, repair, spare parts, operating know-how, servicing, and guarantees that accompany second hand equipment on its journey to the developing countries.
Terms of Reference

2.1 The U.S.A. as the Largest Potential Source

Almost every country has a market in second hand equipment. The West European countries have an active export trade of many years standing. They have relatively new plant facilities and an emphasis on the export of new equipment. In the Federal Republic of Germany, the Government, under its foreign aid program, supports the export of second hand equipment to developing countries by providing financing and through its tax policy. The Government's policy is to ensure that the equipment under this programme is technically and economically efficient and that the constant availability of spare parts is assured. The German machine tool manufacturers are opposed to the plan. They are concerned this programme will destroy their reputation for quality products and service.

The U.S.S.R. and the newly industrialized countries of Eastern Europe are also intensifying their export of new machinery and complete plants to the developing countries. Thus far, it has not included second hand equipment.
equipment.

Logically starting point in any investment of second hand annually in metal-working equipment make the U.S.A.

measures, and a second hand equipment market of $5 billion in determination to modernize its industrial plant through tax

The potential of $300,000 average metal-working machines,

provide additional stimulus to the modernization of misequable - we are falling behind. We must start now to

ment is unprofitable and fragmentary; but the trend is un-

The available evidence on the age of our industrial equip-

productivity and worsening our competitive position abroad.

Obsolescence is slowing down our growth, handiapping our
divided our attention from our aging industrial plant.

"Eliminating new factories and headliness about automation have

Kennedy presented his position in the following way:

Industrial Conference Board in February 1961, President

on capital equipment. In a speech before the National

to the adoption of tax incentives of shorter depreciation

ment circles. This was one of the major factors that led

has excited general concern in both industrial and govern-

the trend to a larger proportion of over-age equipment,

potential source of second hand equipment. In the U.S.A.,

to that of the rest of the world, must remain the largest

The U.S.A., with an industrial production almost equal
2.2 Choice of Technology and Size of Plant

Some advocates of small scale units and labor intensive technology have pointed to the special suitability of second hand equipment. It is quite true, the principle reason given for the disposal of equipment is that it has become obsoleted by equipment having either much greater capacity or much greater capital intensity and most frequently both. Older equipment is usually of smaller capacity and more labor intensive than new equipment. This however should have no influence in a decision to use second hand equipment.

The procedure suggested by Tinbergen is making the choice between say labor and capital intensive development projects is to use the criterion of "national economic profitability." This criterion involves adjusting market prices of factors of production to reflect their real costs to the economy. He calls these adjusted market prices, "Shadow or accounting prices."

The use of second hand machinery should be considered when computing costs of both the labor intensive and capital intensive project. In short, the decision to use new or second hand equipment is independent of any consideration of choice of technology or size of plant. It is the position of this paper that second hand equipment meeting functional specifications should be an alternative to new equipment in the decision to purchase equipment. The decision of new versus second hand to be made on the basis of economic analysis.
2.3 The Indicative Approach

Economic analysis of second hand vis-a-vis new equipment is a necessary calculation in making a decision. It is nevertheless important to note that certain of the factors that should enter into any economic analysis are difficult to establish for a period of time as long as the economic life of the average machine. The economic life may be as short as 11 years for chemical machinery and as long as 20 years for metalworking machinery. The factors which can only be imperfectly ascertained include:

1. Utilization factor which often depends on product demand. When transistors replaced rectifier tubes in many electrical circuits, special machinery used in making tubes was put on a stand-by basis or scrapped.

2. Downtime of a machine due to weakness of design or deterioration may force the shutdown of an entire plant or require costly subcontracting. In either case, the machine would be charged with high costs difficult to foresee. This could occur in any process plant.

3. The economic life itself is subject to obsolescence due to the introduction of new processes or machines. The introduction of a superior military fighter plane ends the economic life of the previous model. Within a few years, the process of making synthetic rubber from refinery gases
made every U.S.A. plant using ethyl alcohol obsolete.

4. Future labor costs are likely to rise due to such factors as unionization, labor laws, dismissal policy in a manner that defies prediction. The U.S. textile plants that moved from New England to the Southern states largely because of wage differentials are now finding this differential narrowing rapidly.

Therefore, any economic analysis is to be considered indicative rather than precise. It is worth noting that factors 1, 3, and 4, would apply equally to new and second hand equipment. However, on the average, a second hand machine may be more subject to downtime than a new one. For this reason, any analysis should show a considerable economic advantage of the second hand machine before a decision is made in its favor.
The Supply

3.1 Projections of Supply

The demand by manufacturing industries of the developing countries for capital equipment is expected to increase from $3.5 billion in 1961 to $7.5 billion in 1975. If the 27.4 percent share of the metalworking equipment shown in Table II is assumed as correct, the imports of metalworking equipment will rise from $1.96 billion in 1961 to $2.06 billion in 1975. This is the potential market for second hand equipment.

The purpose of this part of the report is to determine what portion of the total demand for imported machinery can be potentially supplied from second hand equipment. Clearly any expansion in the use of second hand equipment in the developing countries depends on an adequate supply in the developed countries. Moreover, any proposed expansion of the use of second hand equipment would incur certain costs that are inflexible. These costs are discussed under mechanisms of transfer. Apportioning these costs to a small volume of second hand imports, would have a substantial effect on the net cost of second hand versus new equipment.

There are no reliable figures on the amount of used equipment in the United States which is at present surplus to requirements, nor, a fortiori, is there any satisfactory
data on the amount of equipment which should be replaced to secure the most efficient operation.

Much of the concern about obsolescent machinery followed a McGraw-Hill survey based on responses of businessmen who were asked: "What would be the cost to replace all obsolete facilities with the best new plant and equipment?" The answer - covering all manufacturing and mining, the petroleum industry, transportation and communications, electric and gas utilities and all of finance, trade, and service - was $95,000,000,000.

Another survey which has attracted much attention was the eighth American Machinist Inventory of Metalworking Equipment which showed that there had been a continuous rise in the age of machine tools in the post-war years. The primary conclusions of this latter study were: "More machine tools are over-age (more than 10 years old) than at any time since the depression days of the 1930's: 60 percent of metal cutting machines and 62 percent of metal forming machines are over 10 years old...the bulk of them are of 1939 design." On the next two pages the tables give more detailed information from the American Machinist's Inventory.

The $95 billion figure cited by the McGraw Hill accounted in 1958 for 14 percent of the total U.S.A. value of all
## Equipment Available in Various Industries and Percentage Over-Age

<table>
<thead>
<tr>
<th></th>
<th>Totals, Machine Tools</th>
<th>Metal Cutting</th>
<th>Metal Forming</th>
<th>% of Total Equip. in each Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Units</td>
<td>Over</td>
<td>10 yr and 20 yr</td>
<td>Units</td>
</tr>
<tr>
<td>Farm Machinery</td>
<td>56,989</td>
<td>72%</td>
<td>27%</td>
<td>45,329</td>
</tr>
<tr>
<td>Construction, Mining, Mat. Hdlg.</td>
<td>74,599</td>
<td>63%</td>
<td>21%</td>
<td>62,496</td>
</tr>
<tr>
<td>Metalworking Machinery</td>
<td>178,884</td>
<td>62%</td>
<td>17%</td>
<td>169,304</td>
</tr>
<tr>
<td>Special-Industry Machinery</td>
<td>91,273</td>
<td>71%</td>
<td>23%</td>
<td>81,472</td>
</tr>
<tr>
<td>General Industrial Equipment</td>
<td>160,612</td>
<td>67%</td>
<td>19%</td>
<td>145,926</td>
</tr>
<tr>
<td>Fabricated Metal Products</td>
<td>517,860</td>
<td>61%</td>
<td>19%</td>
<td>326,317</td>
</tr>
<tr>
<td>Office and Service Machines</td>
<td>94,622</td>
<td>65%</td>
<td>24%</td>
<td>71,351</td>
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<tr>
<td>Electrical Equipment</td>
<td>164,665</td>
<td>57%</td>
<td>18%</td>
<td>111,406</td>
</tr>
<tr>
<td>Household Appliances</td>
<td>40,082</td>
<td>64%</td>
<td>17%</td>
<td>28,830</td>
</tr>
<tr>
<td>Communications Equipment</td>
<td>72,520</td>
<td>42%</td>
<td>7%</td>
<td>53,524</td>
</tr>
<tr>
<td>Motor Vehicles &amp; Parts</td>
<td>163,885</td>
<td>47%</td>
<td>20%</td>
<td>124,874</td>
</tr>
<tr>
<td>Complete Aircraft</td>
<td>34,122</td>
<td>51%</td>
<td>1%</td>
<td>24,962</td>
</tr>
<tr>
<td>Aircraft Parts</td>
<td>131,323</td>
<td>50%</td>
<td>4%</td>
<td>116,076</td>
</tr>
<tr>
<td>Precision Mechanisms</td>
<td>98,091</td>
<td>59%</td>
<td>16%</td>
<td>81,216</td>
</tr>
<tr>
<td>Ordnance, Shipbdg., Rways.</td>
<td>92,287</td>
<td>73%</td>
<td>20%</td>
<td>81,543</td>
</tr>
<tr>
<td>Forge Shops, F-dries, Misc</td>
<td>245,928</td>
<td>60%</td>
<td>17%</td>
<td>182,358</td>
</tr>
<tr>
<td></td>
<td>2,217,742</td>
<td>60%</td>
<td>18%</td>
<td>1,706,984</td>
</tr>
<tr>
<td></td>
<td>Welding Equipment</td>
<td>Heating Equipment</td>
<td>Cleaning and Finishing</td>
<td>Industrial Trucks</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td></td>
<td>Units</td>
<td>Over 2 yr</td>
<td>Units</td>
<td>Over 2 yr</td>
</tr>
<tr>
<td>Farm Machinery</td>
<td>2,053</td>
<td>49%</td>
<td>7%</td>
<td>2,951</td>
</tr>
<tr>
<td>Construction, Mining, Met. Hdg.</td>
<td>20,927</td>
<td>35%</td>
<td>3</td>
<td>3,017</td>
</tr>
<tr>
<td>Manufacturing Machinery</td>
<td>5,411</td>
<td>60%</td>
<td>3</td>
<td>6,617</td>
</tr>
<tr>
<td>Special-Industry Machinery</td>
<td>6,324</td>
<td>48%</td>
<td>5</td>
<td>2,405</td>
</tr>
<tr>
<td>General Industrial Equip.</td>
<td>11,330</td>
<td>47%</td>
<td>7</td>
<td>7,055</td>
</tr>
<tr>
<td>Fabricated Metal Products</td>
<td>11,755</td>
<td>47%</td>
<td>5</td>
<td>18,024</td>
</tr>
<tr>
<td>Office &amp; Service Machines</td>
<td>9,767</td>
<td>47%</td>
<td>9</td>
<td>2,616</td>
</tr>
<tr>
<td>Electrical Equipment</td>
<td>14,044</td>
<td>48%</td>
<td>10</td>
<td>8,721</td>
</tr>
<tr>
<td>Household Appliances</td>
<td>6,190</td>
<td>43%</td>
<td>6</td>
<td>1,475</td>
</tr>
<tr>
<td>Communications Equipment</td>
<td>7,443</td>
<td>43%</td>
<td>2</td>
<td>6,047</td>
</tr>
<tr>
<td>Motor Vehicles &amp; Parts</td>
<td>34,906</td>
<td>28%</td>
<td>5</td>
<td>8,930</td>
</tr>
<tr>
<td>Complete Aircraft</td>
<td>2,564</td>
<td>49%</td>
<td>0</td>
<td>772</td>
</tr>
<tr>
<td>Aircraft Parts</td>
<td>9,077</td>
<td>30%</td>
<td>1</td>
<td>6,123</td>
</tr>
<tr>
<td>Precision Mechanisms</td>
<td>3,856</td>
<td>51%</td>
<td>6</td>
<td>4,772</td>
</tr>
<tr>
<td>Ordnance, Shipbdg. Rways.</td>
<td>22,973</td>
<td>59%</td>
<td>4</td>
<td>5,316</td>
</tr>
<tr>
<td>Forge Shops, F-drias, Misc.</td>
<td>21,199</td>
<td>53%</td>
<td>5</td>
<td>14,183</td>
</tr>
<tr>
<td>Total</td>
<td>89,711</td>
<td>46%</td>
<td>5</td>
<td>99,024</td>
</tr>
</tbody>
</table>

**Source:** American Machinist
privately owned plant and equipment of $683 billion. Assuming an equal division between plant and equipment, this gives $47 billion in over-age equipment. If this modernization is achieved over 10 years, $4.7 billion of second hand equipment will be generated annually. It must be added that U.S.A. industry remains largely unconcerned and that the tax incentives providing for shorter tax write-off of equipment have had only very limited effect.
3.2 Generation of Equipment

Equipment is generated in the developed countries by
1. obsolescence 2. change in product demand 3. liquidations
and 4. deterioration. Obsolescence may take the form of
new designs, new processes, or new materials. The new
design of basically the same machine has typically a
higher initial cost and lower operating costs due to greater
capacity, higher speed, automatic control, lower maintenance,
spoilage, reliability, etc. A new process such as welding
of parts has replaced castings in many machine components.
Partially as a result, 1,500 foundries of 3,200 have gone
out of business in the last 10 years.9 Offset presses using
a photographed plate have largely replaced letterpresses,
using manually set metal type, in the printing industry.
New materials such as beryllium and titanium in the aerospace
industry have led U.S. Air Force to plan the disposal of
$521 million of machine tools it lends to its contractors.
Plastics have replaced many metal stampings with an attendant
obsolescence of much stamping equipment.

A drop in product demand generates equipment used in
manufacturing the product. A whole variety of U.S. consumer
products such as textiles and household appliances are
subject to wide fluctuations in product demand.
Liquidations occur when an entire plant is shut down and usually sold at auction. The decision to liquidate may be due to bankruptcy, discontinuance of a plant or a division by a multiplant corporation or a merger consolidating production in one plant. One recent liquidation was caused by the decision of a large manufacturer of metal office furniture to contract out his entire production. In 1964, there were 2,254 business failures in the mining and manufacturing industries in the U.S.A. The principle underlying cause in 93.6 percent of cases was reported as incompetence and inexperience. No estimate of the value of plant and equipment was included.

Deterioration refers to equipment worn out due to age or use. This equipment is sometimes relegated to secondary function or sold for scrap value to dealers. This equipment is not suitable for use in developing countries and is not considered in any potential supply of second hand equipment.

Equipment is generated from private corporations, governmental agencies, and liquidations. Many large multiplant corporations including Union Carbide Corporation, General Electric Company, American Machine and Foundry Company, Radio Corporation of America, and E.I. duPont de Nemours & Company operate central surplus equipment departments. Equipment not required by a division is placed on a surplus list and circulated to all other divisions who have first call.
on the equipment. If no division of the company requests the equipment, bids are solicited from prospective buyers, chiefly dealers. Divisions usually prefer if their equipment is sold rather than claimed by other divisions of the company because, in most cases the selling price is greater than the book value which is the basis of transfer to other divisions. Divisions compete with each other on the basis of independent profit and loss statements. A monthly list of idle equipment of a large chemical company includes the following categories of equipment:

1. Electrical Equipment
2. Material Handling
4. Instrumentation
5. Laboratory Equipment
6. Air Compressors, Blowers, & Fans
7. Process Equipment
   A. Crushing, Grinding, Screening & Separating
   B. Centrifuges, Filters, Strainers, Collectors
   C. Heat Exchange Equipment
   D. Extruders
   E. Tanks, Columns, Kettles
   F. Pumps
   G. Mixing Equipment
8. Construction Equipment
9. Pipe, Valves & Fittings
10. Transportation Equipment
11. Office Equipment
Sample lists of surplus equipment generated by corporations form Attachment "A". No estimate of the total value of equipment generated from this source is available. One large corporation is estimated to generate $6 million in surplus equipment per year.

The U.S. Department of Defense owns industrial equipment which it makes available to contractors (private corporations) for manufacturing and development. This equipment is of special interest for 2 reasons: 1. it has a high rate of obsolescence due to very rapid changes in arms demand and technology and 2. through the U.S. Agency for International Development, developing countries have a high priority and an established channel for obtaining it. The industrial equipment under the jurisdiction of the Defense Industrial Plant Equipment Center is shown in the following table:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Number</th>
<th>Value in $ Million</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine Tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>metal cutting &amp; forming</td>
<td>150,700</td>
<td>2,305.5</td>
</tr>
<tr>
<td>Testing &amp; Measuring</td>
<td>23,116</td>
<td>193.6</td>
</tr>
<tr>
<td>Welding</td>
<td>12,329</td>
<td>63.8</td>
</tr>
<tr>
<td>Heat Treating Furnaces</td>
<td>11,541</td>
<td>172.9</td>
</tr>
<tr>
<td>Woodworking</td>
<td>4,793</td>
<td>13.0</td>
</tr>
<tr>
<td>Foundry</td>
<td>3,686</td>
<td>26.6</td>
</tr>
</tbody>
</table>

Table III

Inventory of Plant Equipment of the U.S.A.11

Defense Industrial Plant Equipment Center, June 30, 1965
Special Industries 10,733 89.2
Other 4,703 64.7
Total 221,601 2,928.9

This is industrial equipment having an original value of at least $1,000 per item. It is divided about equally among the three services. About 66 percent is in use with the remainder idle. All of the Air Force equipment is in the hands of contractors, of the Navy equipment half is in the custody of contractors, and of the Army, equipment 70 percent is in the hands of contractors.

A good indication of the future of this equipment is contained in a recent Air Force study. The study states that of the 1964 inventory of 31,800 machine tools acquired at the cost of $653 million, only 1,700 worth $59 million will be retained in 1975. Applying this rate of obsolescence to the Army and Navy, the U.S. Defense Department will generate about $270 million in excess industrial equipment for each of the next 10 years of which $210 million will be metalworking machinery. The table on the following page is taken from the Air Force study and details the obsolescence of various categories of equipment.

Liquidations consist of auctions at which usually contents of entire plants are sold to the highest bidder.
TABLE 3

OBSOLESCENCE OF 1966 DIPEP INVENTORY FOR ACTIVE AIR FORCE EQUIPMENT FOR SIX MAJOR CATEGORIES OF PRODUCTION EQUIPMENT (1)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>60.8</td>
<td>51.8</td>
<td>41.5</td>
<td>27.9</td>
<td>27.2</td>
<td>27.9</td>
<td>27.9</td>
<td>27.9</td>
<td>27.9</td>
<td>27.9</td>
</tr>
</tbody>
</table>

(1) Based on data obtained from Defense Industrial Production Equipment Center on July 18, 1965, which was processed by Computer Section of WAPPS and further evaluated by Task Force.

TABLE 4

SUMMARY OF DIPEP INVENTORY FOR ACTIVE AIR FORCE EQUIPMENT IN ELECTROMAGNETIC TEST EQUIPMENT, MEASURING AND TESTING EQUIPMENT, AND HEAT TREATING FACILITIES (2)

<table>
<thead>
<tr>
<th>Group in Active Inventory</th>
<th>Value of Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nonnuclear</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Electromagnetic Test Equip.</strong></td>
<td></td>
</tr>
<tr>
<td>Blueprints and related instruments and apparatus</td>
<td>100 50 43 35 30</td>
</tr>
<tr>
<td>Vanadium and ferromagnetics</td>
<td>100 50 43 35 30</td>
</tr>
<tr>
<td>B.f and radar test equipment</td>
<td>100 50 43 35 30</td>
</tr>
<tr>
<td>Nuclear and electrical measuring instruments</td>
<td>500 100 50 25 10</td>
</tr>
<tr>
<td><strong>Electronic measuring equipment (A/P/SP)</strong></td>
<td>500 100 50 25 10</td>
</tr>
<tr>
<td><strong>General electromagnetic testing equipment</strong></td>
<td>100 50 43 35 30</td>
</tr>
<tr>
<td><strong>Power supplies (for electronic measuring and testing)</strong></td>
<td>100 50 43 35 30</td>
</tr>
<tr>
<td><strong>Complete industrial X-ray units</strong></td>
<td>100 50 43 35 30</td>
</tr>
<tr>
<td><strong>Total Electromagnetic Test Equipment</strong></td>
<td>14,000 2,000 1,740 1,500 1,260 1,050 890 830 760 700</td>
</tr>
</tbody>
</table>

| **MECHANICAL AND TESTING EQUIPMENT** |                   |
| **Total mechanical testing equipment (A/F/P/SP)** | 1,000 500 250 125 62 |
| **Steam and gas equipment** | 100 50 25 12 6 |
| **Laboratory and industrial optical instruments** | 500 100 50 25 10 |
| **Mechanical measuring instruments (A/F/P/SP)** | 500 100 50 25 10 |
| **Total Mechanical and Testing Equipment** | 15,000 2,500 1,250 750 475 |

| **HEAT TREATING FACILITIES** |                   |
| **Total heat treating facilties** | 1,000 500 250 125 62 |
| **Total Heat Treating Facilties** | 15,000 2,500 1,250 750 475 |

(2) Includes nonnuclear equipment.

TABLE 5

SUMMARY OF DIPEP INVENTORY FOR ACTIVE AIR FORCE EQUIPMENT IN MATERIAL REMOVAL, SHEET METAL FORMING AND WELDING CATEGORIES ("IAS OF JULY 18, 1965"

<table>
<thead>
<tr>
<th>Category</th>
<th>Value of Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MATERIAL REMOVAL CATEGORY</strong></td>
<td></td>
</tr>
<tr>
<td>Bending and forming machines</td>
<td>1,277 190 30 5 1</td>
</tr>
<tr>
<td>Drilling machines</td>
<td>748 120 20 3 1</td>
</tr>
<tr>
<td>Grinding machines</td>
<td>3,743 600 120 20 5</td>
</tr>
<tr>
<td>Lathes</td>
<td>3,437 600 120 20 5</td>
</tr>
<tr>
<td>Milling machines</td>
<td>1,900 350 70 10 2</td>
</tr>
<tr>
<td>Micromachining machines, etc., not classified</td>
<td>6,198 1,000 200 40 10</td>
</tr>
<tr>
<td>Total Material Removal Category</td>
<td>8,000 1,400 300 60 20</td>
</tr>
</tbody>
</table>

| **SHEET METAL FORMING CATEGORY** |                   |
| Bending and forming machines | 1,277 190 30 5 1 |
| Power driven | 748 120 20 3 1 |
| Micromachining machines | 3,743 600 120 20 5 |
| Forging machinery and hammers | 1,900 350 70 10 2 |
| Micromachining machines, etc., not classified | 6,198 1,000 200 40 10 |
| Total Sheet Metal Forming Category | 8,000 1,400 300 60 20 |

| **WELDING CATEGORY** |                   |
| Electric arc welding equipment | 1,772 110 20 5 1 |
| Microwelding equipment | 948 60 10 5 1 |
| Mechanical process, power driven | 748 120 20 3 1 |
| Micromachining machines | 3,743 600 120 20 5 |
| Forging machinery and hammers | 1,900 350 70 10 2 |
| Micromachining machines, etc., not classified | 6,198 1,000 200 40 10 |
| Total Welding Category | 8,000 1,400 300 60 20 |

(3) Includes nonnuclear equipment.
There is a separate bid for each piece of equipment. The principle buyers at these auctions are machinery dealers who resell the equipment to manufacturers. The bulk of liquidations involve a multiplant corporation disposing of one plant. In about half of liquidations the product line is available for sale which means the company is discontinuing the manufacture of the product entirely. Since the plant is usually worth more as a unit, a company makes efforts to sell it to one buyer before resorting to liquidation. The net sales of equipment at auctions are estimated at $50 million annually. Attachment C contains several notices of liquidations and more detailed catalogues are among the enclosure.
3.3 The Second Hand Market

There is an established second hand market in virtually every type of industrial equipment. In the September 1965 issue of Used Equipment Directory, the largest of several monthly magazines in the field, 576 dealers list 17,000 pieces of equipment for sale.

The Directory lists the following categories of equipment:

- Air Moving
- Chemical
- Controls
- Construction
- Electrical
- Fabricating
- Food
- Foundry
- Heat Treating
- Inspection
- Machine Tools
- Maintenance
- Material Handling
- Metal Forming
- Mining
- Plastic
- Plating
- Power
- Refinery
- Rock Products
- Rubber
- Steel Mill
- Testing
- Tooling
- Welding
- Wire
- Woodworking

Frequently dealers specialize in one or two categories of equipment. Dealers locate buyers by advertising in second hand equipment magazines which are distributed free to manufacturers, (See Attachment D), by mailing brochures of available equipment to prospective buyers (See Attachment E), and by establishing personal relationships with manufacturers who came to regard the dealer as a trusted source of supply.
Dealers obtain equipment by bidding at liquidations, U.S. Department of Defense auctions, offerings of surplus equipment departments of large corporations, and again by personal relationship with manufacturers who rely on dealers to dispose of plant equipment that becomes surplus from time to time. Most dealers have small warehouses where equipment is cleaned, painted, repaired, and exhibited for sale. There are usually facilities where a buyer can test the equipment in operation. A few of the largest dealers have facilities for completely rebuilding a machine, but most rely on independent rebuilding companies or new equipment manufacturers for this service. Dealers will arrange for financing or leasing of equipment. The members of the Machinery Dealers National Association give a 30 day money back guarantee on most sales with the buyer paying the cost of the return transportation. Only a few dealers do a sizable export trade although one reports 30% of his sales are overseas, chiefly in Europe. A list of the leading second hand equipment dealers appears on the next page.

The usual pattern is for large corporations to dispose of their excess equipment to dealers who in turn sell it to smaller companies. The pattern is not invariable. Large corporations frequently turn to second hand dealers when seeking standby equipment, equipment for short runs, equipment
with low utilization factor, and for any equipment when the delivery time of new equipment is long. The price level fluctuates widely with the business cycle. As lead time for new equipment lengthens, large manufacturers eager to increase production enter the second hand market and push prices up. The necessity to get into production fast makes the price of equipment secondary. At this same point in time, most large manufacturers hold on to their excess equipment. With the increased demand and decreased supply prices skyrocket. In the spring of 1965, this situation existed in the U.S.A. machine tool market. As an example, a 14" x 120" Norton Cylindrical Grinder was purchased new in 1937 for $8,004. The company estimates it was used continuously since then for about 3 hours per day with equal time for set-ups. The machine was never rebuilt. It was sold in March, 1965 to a dealer for $4,300. In July 1965, he was asking $12,500 for the machine. At this time, a similar new machine was selling for $30,000 with 18 month delivery. In such a fluctuating market the machinery dealer is apt to be an astute businessman.
MACHINE TOOL DEALERS

Botwinik Brothers, Inc.
3 Welton Parkway, New Haven, Connecticut

Eastern Machinery Company
1005 Tennessee Avenue, Cincinnati, Ohio

Goldberg - Emerman Corporation
877 W. 120th Street, Chicago, Illinois

Given Machinery Company
3855 Santa Fe Avenue, Los Angeles, California

Johnson Machinery Company
249 Frelinghuysen Avenue, Newark, New Jersey

Laurens Bros., Inc.
2778 Highland Avenue, Cincinnati, Ohio

The MacDell Corporation
232 No. Morgan Street, Chicago, Illinois

Machinery Trading Corporation
544 Oakwood Avenue, West Hartford, Connecticut

Morney Machinery Co.
4-69 26th Avenue, Astoria, New York, N.Y.

Noll Equipment Co.
3913 St. Clair Avenue, Cleveland, Ohio

Tippins Machinery Co., Inc.
1001 Washington Blvd., Pittsburgh, Pennsylvania

O'Connell Machinery Co., Inc.
1699 Genesee St., Buffalo, New York

Pearl Equipment Co., Inc.
843 7th Avenue, N. Nashville, Tennessee

S & S Machinery Co.
134 53rd Street, Brooklyn, New York, N.Y.

U.S. Equipment Co.
6546 E. Palmer Avenue, Detroit, Michigan

WELDING EQUIPMENT DEALERS

American Industrial Equipment Corp.
116 49th Street, Union City, New Jersey

Power Press Sales Co.
2701 23rd Street, Detroit, Michigan
ELECTRICAL EQUIPMENT DEALERS

Belyea Company, Inc.
46 Howell Street, Jersey City, New Jersey

Chicago Electric Company
1319 W. Cermak Road, Chicago, Illinois

Sandman Electric Co., Inc.
666 Parker Street, Boston, Massachusetts

Arthur Wagner Co.
1426 W. Randolph St., Chicago, Illinois
The market just described is for equipment which may be used in a variety of industries or for which there is a constant demand. The market in highly specialized equipment, such as say cigarette making machinery, is less well organized. Frequently new machinery dealers will sell second hand machinery as a sideline. Distributors of industrial supplies who visit many manufacturers in a given industry will attempt to locate second hand equipment as a service to customers and end up doing a regular small business. Where the special machine is large and expensive as for plate glass, the number of manufacturers is so limited each knows all the others. In this case, second hand equipment may be sold by direct negotiation between principles.

In 1965, The Machinery Dealers National Association estimates member sales of second hand equipment consisting largely of metal cutting and forming machinery at $380 million. Assuming that members of MDNA account for 3/4 of all sales, the U.S.A. second hand metal working machinery market is about $500 million annually. This total includes U.S. Government surplus equipment purchased by dealers at auctions and resold.
3.4 Trends in Technological Innovation

Every manufacturing industry subject to the so-called "profit squeeze" between inflexible prices and rising labor and other costs is looking to technological innovations as a way out of the dilemma. Large appropriations are made for research and development. In some industries, the results of U.S. government research are being applied. Industries composed of small companies are sponsoring research at independent laboratories.

The results have been most spectacular in the field of communications. In manufacturing, the progress has been slow but steady. The future development of new processes and materials will have an effect on both supply and net cost. In general, it will increase the supply and therefore also increase the second hand operating costs. The effect of a few new processes and materials was discussed in 3.2. In the metal working field, several new processes are coming into use. It is beyond the scope of this paper to more than briefly describe them.

EDM - Electrical Discharge Machining uses controlled vaporization of metal by spark discharges from an electrode. There are several EDM machines on the market and they are increasingly used for finishing of complex die cavities in die casting and forging die industries. They replace expensive and often inaccurate hand work. The high cost of replacing electrodes appears as chief obstacle to wider use.13
ECM - Electro Chemical Machining is metal removal by passing direct current via electrolyte between workpiece and shaped tool. Metal removed is flushed away by electrolyte. ECM is the reverse of electroplating where metal is deposited on the work-piece. ECM can perform the mechanical equivalent of turning, milling, grinding, and drilling. A 10,000 amp. machine removes about 60 cu. in. per hour. It is now used on very hard materials for very intricate shapes. The chief drawback is the high power consumption.

CM - Chemical Machining uses etching to dissolve metal that is not coated with photo sensitive film. It is currently used in blanking of metal and plastic sheets, decorative etching, and printed circuit etching.

NC - Numerically Controlled machining uses a magnetic tape to control the path of the cutting tool and work piece. It eliminates the need for an operator just as the tape controlled pianola played without a pianist. NC is today an economical way of machining intricate parts in small lots. The tape can be stored and reused whenever the part needs to be made again. NC attachments can be adapted to existing machines. It is estimated NC will account for 10 percent of the value of all new machine tools sold in 1965, and by 1985, 75 percent of all machine tools will be NC operated.
HEAF - High Energy Rate Forming uses an explosion to control the deformation of sheet metal. In one type, hydroforming, a low explosive in water is used for contouring, spinning, and drawing of sheet metal.

Ultrasonic machining using sound waves and abrasive machining using grinding are among the other processes commercially feasible in limited applications. Cutting metal with laser beams is in advanced experimental stage. Clearly, the pace in metalworking is very rapid indeed. The U.S. Air Force study that states only 15 per cent of 1964 metalworking equipment will be in use in 10 years may be an extreme position based on their special needs; but the rest of the economy will not be very far behind.

The appendix contains a number of clippings from Metal-Working News detailing the progress in adoption of these innovations. The previously cited U.S. Air Force study forecasts substantial decreases in value of conventional machines and increases in value of new type equipment in its inventory by 1975. Value of boring machines will decrease from 18.5 percent to 10.3 percent, lathes will decrease from 15.2 percent to 5.5 percent. Electrochemical machining equipment, on the other hand, is expected to increase from $.6 million or 0.1 percent in 1964 to $47 million or 8.3 percent in 1975. It is certain these innovations will displace a large range of conventional metal cutting and metal forming machines such as boring mills, grinders, lathes, drills, presses, and forges.
3.5 Conclusion: Supply

The 1965 demand for metal working equipment in the developing countries is approximately $1.2 billion. The U.S. supply of second hand metal working equipment is about $500 million. Assuming the U.S.A. to account for half of the total second hand equipment available, theoretically the second hand market could supply 83 percent of all demand in the developing countries. In practice, the entry of developing countries into the second hand market in strength would undoubtedly push up the price of second hand versus new equipment.

The supply of second hand equipment is sufficiently large to justify a close investigation of its net cost versus new equipment and of the mechanisms for transferring it to the developing countries.

Technological innovations in metalworking in the industrially advanced countries will make available, in the next ten years, a supply of second hand equipment to match the growing demand for capital equipment in developing countries.

Due to its very nature, the second hand market is a less reliable source of equipment for the developing countries. Although standard equipment is certain to be available at all times, special or heavy equipment may not be available when needed.
4.1 **Cost Analysis**

The purpose of this part of the report is to present a method of answering the question "is second hand equipment more economical than new equipment?" The answer takes the form of an economic analysis of alternative equipment. This economic analysis of alternative investments may be based on annual cost comparison, rate of return comparison, or present worth comparison. The annual cost comparison is the most commonly used method in industry and will be used here for illustration purposes. The annual cost comparison involves finding a uniform annual cost of all expenses incurred over the economic life of each alternative equipment. The annual cost is given by:

\[ AC = P-L \left( \frac{1-(1+i)^{-n}}{(1+i)^{n}-1} \right) + L + D \]

where

- \( P \) = investment in equipment
- \( L \) = salvage value at end of economic life
- \( i \) = minimum rate of return on capital
- \( n \) = economic life in years
- \( D \) = series of equal annual disbursement for operating expenses

The first term represents the uniform amount required for capital recovery of the investment less its salvage value. The capital recovery factor \( [\ldots] \) can be found from tables.
Where in the third term the actual disbursements vary over the years, they can still be mathematically converted into a series of equal annual disbursements.

As an example, new machine N costs $10,000 with a salvage value of $2,000, an economic life of 10 years, and operating disbursements of $400 a year. Second hand machine S costs $6,000, has an economic life of 5 years, no salvage value, and operating disbursements of $600 a year. The minimum rate of return is 15%.

Annual Cost N = 8,000 \times 0.19925 + 2,000 \times 0.15 + 400 \\
= 1,600 + 300 + 400 \\
= 2,300

Annual Cost S = 6,000 \times 0.29832 + 0 + 600 \\
= 1,800 + 600 \\
= 2,400

In this example the annual cost of the second hand machine is $100 greater than of a new one. The comparison disregards the costs that would be incurred after the 5 year life of machine S. It is not easy to foresee what machine will be available at that time, but technological change may be rapid. If a future machine F, costing $5,000, no salvage value, a 5 year economic life, and operating disbursements of only $300 per year is predicted, the annual cost of S + F can be calculated to be $2,200. Now the
combination of the second hand machine S and the vastly improved machine predicted for 5 years hence have a lower annual cost than the currently available new machine N.

The proper application of all formulas requires accurate data on investment costs and disbursements for both alternatives. In a comparison, any investment costs or disbursements that are equal for both alternatives may be omitted without affecting the difference between their annual costs.

The investment costs include:

1. Equipment & accessories (for second hand include inspection, repair, appraisal)
2. Freight
3. Installation
4. Engineering and planning
5. Salvage
6. Avoided costs

The disbursement should account for the following operating expenses:

1. Direct labor
2. Indirect labor
3. Productive materials
4. Fuel and Power
5. Auxiliary Equipment and Services
6. Taxes and Insurance
7. Licenses
8. Space Costs
9. Subcontracting
10. Maintenance
4.2 Original Cost

The original cost may be defined as the annual cost to own the equipment. It is roughly calculated as the acquisition cost less the salvage value with the difference divided by the economic life. Any comparison on this basis assumes all equipment meets the same specifications of capacity and accuracy.

Acquisition cost of new equipment must be taken as the lowest price for the equipment available on the international market. The acquisition cost of second hand equipment will vary with type, age, condition, and the fluctuations of the second hand market may be ignored since they are usually accompanied by similar fluctuation in the cost of new equipment. A greater rise in the costs of second hand equipment is compensated by the very long lead time for the purchase of new equipment compared to the immediate availability of second hand. The conclusion of this section 4.6 gives some generalizations regarding acquisition costs of two types of metal-working equipment. The two types are: 1. standard machine tools and 2. heavy or special metal-working equipment. For each type, a comparison was made using 10 year old rebuilt equipment and 10 year old equipment in good working condition.
The economic life of equipment is difficult to determine. First equipment may undergo functional degradation. A machine tool may be used on the main production line, then on secondary service, then on occasional service, and finally on stand-by. A generator may be used for base load, then peak load and last on stand-by.

The economic life of equipment on the main production line depends on obsolescence and deterioration. Obsolescence requires the replacement of existing equipment with equipment of improved design. This new equipment may have the following advantages:

1. lower fuel & power consumption due to higher design efficiency
2. higher productivity due to higher productive speeds
3. lower maintenance due to better design
4. fewer breakdown due to better design
5. less spoilage due to more accurate design
6. less floor space due to more compact design
7. less labor and supervision due to more automated design

Deterioration requires the replacement of existing equipment with equipment of essentially the same design because of:

1. Increased fuel & power caused by lower machine efficiency
2. Increased maintenance & repair due to failure of parts
3. Increased labor idle time due to increased frequency of breakdowns
4. Increased spoilage, labor, & material wastage due to unreliability
5. Increased labor due to reduced speed & lower productivity
6. Increased inspection costs due to loss of reliability
7. Increased overhead due to unreliable equipment

The economic life of so-called tool-room equipment used for repairs, making of tooling and prototypes, and production in small lots is longer than of production equipment. Attachment "B" contains a list of economic lives of metal-working machinery as accepted by the U.S. Department of Defense for productive purposes.
4.3 Operating Costs

The reports from underdeveloped countries repeatedly cite two difficulties in the operation of second hand equipment: maintenance and spare parts. All equipment requires more maintenance with age. However, evidence points to the gradient being very flat. One old study shows the cost of maintenance of textile machinery rising from 1 percent of original cost after 1 year to 2 percent after 10 years. One large chemical company reports it has no record of any piece of equipment being replaced due to cost of maintenance but that replacement due to obsolescence occurs daily. In industries with low obsolescence rate, such as machine building, it is not uncommon to see 40 year old equipment in operation.

The difficulties with maintenance of second hand equipment in underdeveloped countries would appear to stem from 2 sources. First, the level of maintenance is generally low with a tendency to place the blame on equipment being second hand. Secondly, this equipment frequently arrives without the regular lubrication, inspection, and adjustment schedule supplied by the manufacturer of the equipment, the staff is less likely to have been trained in the care and operation of a second hand machine, the seller is less likely to have a staff capable of servicing it, and the machine may have arrived in poor condition to begin with. In short, the difficulty of maintenance is due more to the fact it is second hand than that it is old.
Second hand machines being older require more spare parts. In the U.S.A. where the cost of maintenance is frequently 90 percent labor, this is a minor consideration. Most plants keep minimal stocks of parts. In a large industrial center, a part is usually available the same day. In one case, a telephone call to California brought a part to New York by air express the next day. Parts for older equipment are made to order and may require from a week to a month for delivery. One lathe manufacturer has templates for parts going back to 1922 and microfilmed blue prints to 1914.

In developing countries, the difficulties of distance, customs procedures, and foreign exchange may extend the one day delivery into 3 months for all spare parts. For second hand equipment, the difficulties are compounded. The lack of operators manuals and parts catalogues may make it difficult to describe the part needed. The lack of an identification plate may make the name of the manufacturer and serial number unknown, and the local distributor of new equipment is less likely to be of service. When a new machine is purchased in an underdeveloped country 5 to 15 percent of the total cost goes into provisions of spares. For second hand equipment spares are seldom available which not only makes for all the previously mentioned problems of delivery but multiplies their cost. A stock of spare parts also enables the user to arrange for their local pro-
duction before they are exhausted. The claims that some manufacturers charge exorbitant prices for spares and use long delays in delivery as a device for selling new machines, would further penalize second hand equipment which being older requires more spares.

Until channels for procurement of spare parts are assured, second hand equipment must be rated well below new equipment in reliability.
4.4 Unit of Transfer

The transfer of second hand equipment has been in the form of complete plants, major plant components, and standard individual machines. Probably the largest transfer of a complete plant took place when the Kaiser automotive plant was moved from Detroit to Argentina. The more difficult dismantling in Kentucky and reassembly in India of a synthetic rubber plant was referred to in 1.4. A chocolate and biscuit plant from Scotland is operating in Iraq. The transfer of a complete plant has the following advantages: the equipment is known to be compatible, experienced personnel is available for start-up and operation, equipment and production records are available, spare parts are available, and best of all the company providing the equipment usually has an equity interest in the new plant. This company has a vested in making sure the equipment is in good condition to begin with, and continues to operate efficiently. In addition, such a plant can usually be put into production 6 to 13 months before a new plant.

Heavy forging presses were recently sent to India that could become the nucleus of plant producing hand tools, agricultural implements and machine parts. Heavy stamping presses with dies were sent this year to Venezuela where they will become the core of a refrigerator manufacturing plant. The presses will form the refrigerator box. A die casting machine, an extrusion press, and a cigarette making machine are other examples of a major piece of
equipment that becomes the nuclei of complete manufacturing units. Another type of equipment that may be considered major components are ships, locomotives, airplanes, and road paving rigs. The advantage is that they are expensive and can therefore absorb the service costs of inspection, appraisal, rebuilding, and prior procurement of spare parts.

The ability of major components to absorb such service costs will add to their reliability without substantially decreasing their original cost advantage vis à vis new equipment.

Individual units of second hand equipment, even where advantageous by annual cost comparison, may not be advantageous from the point of view of the economy as a whole. This disadvantage stems from lack of standardization. If many models of one category of equipment are imported many of the advantages of standardization are forfeited. This proliferation of models is usually unavoidable in the case of second hand equipment. Some of the advantages of standardization include easier training of operators and maintenance men, interchangeability between plants of both equipment and labor, cannibalizing of equipment, and simpler spare parts procurement and inventory. Standardization with second hand equipment is possible but difficult since there will usually be only a limited number of a given model machine available second hand.
4.5 **Calculation of Net Cost**

The report by the Netherlands Economic Institute calculates the comparative costs of two machines: one second hand and one new, as follows:

**Comparative Costs of New and Used Machines**

<table>
<thead>
<tr>
<th>Item</th>
<th>Second Hand</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price (including installation costs etc.)</td>
<td>40,000.-</td>
<td>100,000.-</td>
</tr>
<tr>
<td>Depreciation (i.e. useful) period</td>
<td>10 years</td>
<td>15 years</td>
</tr>
<tr>
<td>Rate of interest for loans</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Yearly output (maximum)</td>
<td>18,000.-</td>
<td>18,000.-</td>
</tr>
<tr>
<td>Normal output level required</td>
<td>16,000.-</td>
<td>16,000.-</td>
</tr>
<tr>
<td>Overhaul and repair costs per year</td>
<td>500.-</td>
<td>400.-</td>
</tr>
<tr>
<td>Yearly costs of light, floor space, insurance etc.</td>
<td>1,000.-</td>
<td>800.-</td>
</tr>
<tr>
<td>Fuel and raw material costs for output of 16,000 units per year</td>
<td>16,000.-</td>
<td>15,000.-</td>
</tr>
<tr>
<td>Labour costs for output of 16,000 units per year</td>
<td>32,000.-</td>
<td>30,000.-</td>
</tr>
<tr>
<td>Raw material costs for output of 16,000 per year</td>
<td>16,000.-</td>
<td>16,000.-</td>
</tr>
</tbody>
</table>

Since the output to be produced per year by the two alternative machines is to be the same, it will suffice to compare the total costs per year of the two machines.

The first cost item to be calculated is yearly capital costs, consisting of depreciation + interest charges. For
calculating the annuity representing these costs, an approximate formula can be used instead of an annuity table.

According to this formula, the annuities are the following:

**Second Hand Machines**

\[
\frac{1}{10} \times 40,000 + \frac{1}{2} \times \frac{1}{10} \times 40,000 = 6,000
\]

**New Machine**

\[
\frac{1}{15} \times 100,000 + \frac{1}{2} \times \frac{1}{10} \times 100,000 = 11,500
\]

Other costs of the two machines are already given in the above table; consequently, total annual costs can be calculated:

<table>
<thead>
<tr>
<th>Annual Costs for Output of 16,000 Units</th>
<th>Used</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annuity</td>
<td>6,000.-</td>
<td>11,500.-</td>
</tr>
<tr>
<td>Overhaul and repair cost</td>
<td>500.-</td>
<td>400.-</td>
</tr>
<tr>
<td>Light, floor space etc.</td>
<td>1,000.-</td>
<td>800.-</td>
</tr>
<tr>
<td>Fuel and raw materials</td>
<td>16,000.-</td>
<td>15,000.-</td>
</tr>
<tr>
<td>Labour costs</td>
<td>32,000.-</td>
<td>30,000.-</td>
</tr>
<tr>
<td>Raw materials</td>
<td>16,000.-</td>
<td>16,000.-</td>
</tr>
<tr>
<td><strong>Total Costs</strong></td>
<td><strong>71,500.-</strong></td>
<td><strong>73,700.-</strong></td>
</tr>
</tbody>
</table>
It is apparent that in this case production with the second hand machine is more economical. The cost advantage is due to the lower purchasing price of the second hand machine which results in a lower capital charge per year, notwithstanding the fact that the useful period of the second hand machine is shorter.

The slight advantage of the second hand equipment in this comparison is open to question. The rate of interest on second hand equipment may well be higher than for new. The original cost of second hand equipment may well be higher considering that cost of transportation and installation are the same if not higher for second hand. The repair costs of the second hand also seem understated considering the maintenance and spare parts problem discussed in 5.2. On the other hand; "The depreciation period for second hand equipment is shorter and, thereby, the firm has the possibility of shifting to newer or different equipment at an earlier date in the future than would have been the case with new equipment. This may be an advantage especially in cases where markets are growing or quickly changing."

It may be concluded that the 3 percent advantage of the second hand machine in this comparison is not sufficient to overcome the lower reliability of the second hand equipment.
4.6 Conclusion: Net Cost

There can be no single answer to the question, "Is second hand equipment more economical than new?" However, in any given case the method for determining the answer is available.

For standard metalworking tools such as lathes, grinders, brakes, millers, and drill presses the following ratio of acquisition costs may be considered typical.

New 1965, U.S.A. ............................................. 100
New 1965, Japan............................................. 70 - 80
Second hand, new 1955, U.S.A., rebuilt..... 65 - 75
Second hand, new 1955, U.S.A. in good operating order.................. 25 - 45

Rebuilt standard metalworking tools have an insufficient if any acquisition cost advantage over new machines from Europe and Japan.

Second hand standard metalworking tools in good operating condition have a considerable acquisition cost advantage over new equipment. They also have higher operating costs caused by lower reliability due to difficulty in procurement of spare parts, lack of adequate information about condition and lack of service. This equipment should only be purchased by developing countries capable of making spare parts and with good repair facilities.
For heavy and special metalworking machinery such as boring mills, forging hammers, presses, and vertical turrett lathes the following ratio of acquisition costs may be considered typical:

New 1965, U.S.A. .................................................. 100
New 1965, Germany .................................................. 70 - 90
Second hand, new 1955, U.S.A. rebuilt ....................... 40 - 60
Second hand, new 1955, U.S.A., in good operating order ........................................ 30 - 50

Heavy and special metalworking equipment both rebuilt and in good operating condition has a considerable acquisition cost advantage over new. Both rebuilt and properly inspected equipment in good operating condition have higher operating costs due to lower reliability, but the margin of difference is small.

Complete plants of second hand equipment properly engineered on a turnkey basis have considerable acquisition advantage and very small operating disadvantages as compared with costs of new plants.
Mechanisms of Transfer

5.1 Functions

The purpose of this section of the report is to evaluate procedures by which second hand equipment is transferred to a developing country. These procedures or mechanisms of transfer include:

1. Exporting organizations
2. Importing organizations
3. Financing
4. Inspection and classification of condition
5. Repair and rebuilding
6. Appraisal
7. Spares, accessories, and motors
8. Operating know-how
9. Installation and service
10. Performance guarantees

The new equipment manufacturer may perform all these functions himself or contract with an export corporation to perform the overseas functions. Sometimes, an equipment manufacturer will combine with manufacturers of allied non-competing equipment to form the export corporation. In second hand equipment, there is no one firm that assumes responsibility for all these functions. Frequently, there is no one to
perform these functions and buyer dissatisfaction gives the trade a bad reputation. The lack of single responsibility for these functions stems from difficulties in trade over long distances and from the small volume of trade.

Reports from developing countries, some of whom have banned the import of second hand equipment, repeatedly cite failures in the performance of these functions. A middle-eastern country cites "lack of experience in acquisition and evaluation" and a problem of obtaining spare parts. A report from Africa cites "abuses in unloading of unsuitable equipment" and difficulty in locating equipment. A report from Latin America cites 2 cases where unsuitable equipment was obtained. Another African country reports lack of cooperation on the part of dealers in integrating individual items into a complete plant. The frequency with which developing countries have obtained equipment unsuitable for the task points to another difficulty: the determination of the machine most suitable for the job. Although equipment specifications are prepared independently of equipment manufacturers, in practice their advice and assistance is an important factor. Such advice is not regularly supplied by second hand dealers and where it is supplied it tends to be less reliable.
5.2 Exporting Organizations

Private corporations, on occasions, use second hand equipment to set up complete plants in the underdeveloped countries as subsidiaries or joint ventures. Individual pieces of equipment may also be sent to subsidiaries. Basically, these corporations have no interest in second hand equipment or its export. The disposal of second hand equipment is seen as an orderly salvage operation.

The larger equipment dealers are very much interested in expanding export to the developing countries. For large orders, they will put together a package: select equipment, arrange for repair, inspection, spare parts, appraisal, crating, shipping and even credit. They may even help install and guarantee the equipment for 90 days. They can only provide these services for major components because a single machine priced at $5,000 cannot absorb these additional costs and dealers seldom have an opportunity to provide these services on a group of such machines because they are not competitive with new European and Japanese equipment. There are equipment dealers and engineering companies who will on a contract basis select, install, and operate for a period of time complete plants using second hand equipment. All the larger dealers have facilities for storage and repair.
The U.S. Agency for International Development exports
excess U.S. government equipment to underdeveloped countries
at no charge to the recipient. In 1964, over $60 million
was exported under 3 programs. Under the Advanced Acquisition
program, AID selects and overhauls excess equipment in its
own repair shops, warehouses it, and circulates an AID
catalogue of available equipment to the developing countries.
It is available to approved projects. The recipient must
be a government agency or a wholly owned corporation. AID
calculates the cost of overhauling equipment into good oper-
ating condition and handling it at 15 percent of original
acquisition cost. Under the Direct Acquisition program, excess
equipment is selected by the developing countries from a
U.S. General Services Administration catalogue. (See
Attachment F) It can be reserved for the recipient who
has 30 days in which to inspect and accept the equipment.
On acceptance, it is legally taken over from GSA by AID,
overhauled, crated, and shipped to the recipient at AID
expense. Under the non-AID Financed program, the developing
country selects equipment from the GSA catalogue (See
Attachment F) and has an opportunity to inspect and accept
the equipment. In this case, the recipient must pay AID
for overhauling, crating, and shipping or arrange for these
services on his own.

Attachment F also includes the complete regulations
governing procurement of AID excess equipment.
5.3 Importing Organizations

Private companies, usually the small ones, are the most active importers of second hand equipment and the most active advocates of expanding second hand trade. Paradoxically, they are also most vocal in expressing disappointment in this equipment. Frequently, as they grow larger and more prosperous, they sell their second hand equipment and purchase new. Having limited capital and credit, they cannot afford new equipment and buy second hand out of necessity. They rely on second hand dealers in the developed countries. Since their specifications are often not exact, their communication with the dealers imperfect, the results are frequently disappointing. For major components and complete plants where the buyer and seller come into personal contact the results may be better.

Equipment dealers in developing countries buy second hand equipment for which there is a constant demand on their own account. More frequently in the case of individual pieces of equipment and almost always in the case of major components and complete plants, the purchases are made to the account of the buyer. The dealers usually purchase equipment from other dealers in the developed countries. At least in the case of Mexico, some dealers entered the U.S.A. and purchased equipment directly from
manufacturers and at auctions. The larger dealers in Mexico overhaul equipment themselves, install it, and provide continuous service. Generally, however, equipment dealers do not specialize in one type of equipment and lack capital and experience. Their chief function is to locate and import equipment for local buyers rather than provide technical services.

Public sector companies seldom import second hand equipment. In some cases, they are required to at least consider second hand equipment by the terms of the AID Development Loan Fund. In one case, a public sector firm bought second hand forging equipment because the lead time on new equipment was over one year in addition to a wide price differential.
5.4 Financing

Second hand equipment is more difficult to finance because it is second hand and therefore less reliable, but also because of the character of the companies purchasing it. These companies are usually small and with poor credit ratings. The policies of governmental and private banking institutions do not directly prohibit financing of second hand equipment. In effect, their policies discourage it. The international banks usually ask that the exporter have an equity interest in the project, that know-how as well as equipment be exported, that the loan be for a sum of at least, say - $250,000 and that the application be accompanied by very detailed information.

The Export - Import Bank does finance second hand equipment under its short and medium term export credit insurance and guarantee program. For this type of financing, answers must be furnished to the questionnaire reproduced on the next page.

The inadequate credit facilities available for second hand equipment should be contrasted with that available for new equipment from West Germany and East Europe. The financing offered by these countries may be for as long as 15 years and at interest rates as low as 2 percent. This availability of credit is frequently the over-riding consideration with the lower price of second hand U.S.A. equipment a very poor second.
Used Equipment Questionnaire

Where used equipment is included in an export credit sale, Eximbank and FCIA require full information concerning both the equipment and the transaction involved before reaching a decision. As a part of an application involving used equipment, answers to the following questions are required:

1. What is the name of the manufacturer of the used equipment?

2. What is the age of the used equipment?

3. What is the source of the used equipment?

4. Is the used equipment being replaced by new equipment purchased in the United States?

5. What is the extent of rebuilding and reconditioning of the used equipment and by whom performed?

6. What warranties will be given on the used equipment and by whom?

7. How is the value of the used equipment to be determined?

8. What part of the total value of the used equipment will be attributable to rebuilding and reconditioning?
5.5 Conditions of Transfer

Inspection and Classification. For individual pieces of equipment, the second hand dealer is usually the only source of information about its condition. Inspection should be carried out by an independent engineering, inspection service, or appraisal firm. The cost of inspection usually consists of a days pay for the inspector plus transportation. The inspection should be under power and should concern itself with both the suitability of the machine for the desired end use and the condition of the machine. The inspector should have the specifications of the engineering study and state if the machine meets the specification. He should list the serial number, model, year of manufacture, name of manufacturer, spare parts, accessories and power unit. Where accuracy is a factor, the performance of the machine should be checked against the original manufacturers manual. The next page describes the accuracy of a lathe as given by the manufacturer. The inspector should have a list of component parts and decide the condition of each. Finally, he should make an overall evaluation based on a condition code such as the one used by the U.S.A. General Services Administration. This code is reproduced on the two pages following. Inspection for the domestic trade is usually made by the buyer and the procedures include all those outlined above except for the evaluation by a condition code.
### ACCURACY

<table>
<thead>
<tr>
<th>Description</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bed level - transverse direction - in any 12&quot;</td>
<td>0.0045</td>
</tr>
<tr>
<td>Bed level - horizontal direction - in any 12&quot;</td>
<td>0.0065</td>
</tr>
<tr>
<td>Tailstock way alignment - in any 48&quot;</td>
<td>0.0005</td>
</tr>
<tr>
<td>Spindle center remount</td>
<td>0.0004</td>
</tr>
<tr>
<td>Spindle nose remount</td>
<td>0.0003</td>
</tr>
<tr>
<td>Cam action of spindle</td>
<td>0.0003</td>
</tr>
<tr>
<td>Spindle taper remount</td>
<td>0.0003</td>
</tr>
<tr>
<td>Headstock alignment - vertical - high at end of 12&quot; bar</td>
<td>0.0005</td>
</tr>
<tr>
<td>Headstock alignment - horizontal - at end of 12&quot; bar</td>
<td>0.0003</td>
</tr>
<tr>
<td>Tailstock alignment - horizontal - towards front at end of spindle when fully extended</td>
<td>0.0008</td>
</tr>
<tr>
<td>Tailstock alignment - vertical - high at end of spindle when fully extended</td>
<td>0.0005</td>
</tr>
<tr>
<td>Tailstock taper alignment - vertical - high at end of 12&quot; bar</td>
<td>0.0005</td>
</tr>
<tr>
<td>Tailstock taper alignment - horizontal - end of 12&quot; bar</td>
<td>0.0005</td>
</tr>
<tr>
<td>Vertical alignment of head and tail centers - high at tailstock</td>
<td>0.0005</td>
</tr>
<tr>
<td>Cross slide alignment, may face hollows or swacks only on 12&quot; dia.</td>
<td>0.0005</td>
</tr>
<tr>
<td>Face plate remount on diameter</td>
<td>0.0005</td>
</tr>
<tr>
<td>Chuck remount</td>
<td>0.0005</td>
</tr>
<tr>
<td>Face and periphery</td>
<td>0.002</td>
</tr>
<tr>
<td>Face of stops</td>
<td>0.003</td>
</tr>
<tr>
<td>Bar test 3&quot; from end of jaw, bar diameter same as hole</td>
<td>0.003</td>
</tr>
<tr>
<td>Collet chuck remount, 1&quot; from collet chuck</td>
<td>0.004</td>
</tr>
<tr>
<td>Lathe must be cylindrical with shank between centers on 12&quot; bar</td>
<td>0.0004</td>
</tr>
<tr>
<td>Lathe must be cylindrical with shank mounted to chuck on 12&quot; bar</td>
<td>0.0006</td>
</tr>
<tr>
<td>Loadbearing</td>
<td></td>
</tr>
<tr>
<td>Load per foot (non-oscillating)</td>
<td>0.0013</td>
</tr>
<tr>
<td>Load in any 4°</td>
<td>0.0005</td>
</tr>
<tr>
<td>Backlash on cross feed screw</td>
<td>0.004</td>
</tr>
<tr>
<td>Backlash on compound rest screw</td>
<td>0.004</td>
</tr>
</tbody>
</table>
I. CONDITION CODES AND EXPANDED DEFINITIONS

<table>
<thead>
<tr>
<th>Condition Code</th>
<th>Expanded Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-1</td>
<td>New or unused property in excellent condition. Ready for use and identical or interchangeable with new item delivered by manufacturer or normal source of supply.</td>
</tr>
<tr>
<td>N-2</td>
<td>New or unused property in good condition. Does not quite qualify for N-1 (because slightly shopworn, soiled, or similar) but condition does not impair utility.</td>
</tr>
<tr>
<td>N-3</td>
<td>New or unused property in fair condition. Soiled, shopworn, rusted, or damaged to the extent that utility is slightly impaired.</td>
</tr>
<tr>
<td>N-4</td>
<td>New or unused property so badly broken, soiled, rusted, mildewed, deteriorated, damaged, or broken that its condition is poor and its utility seriously impaired.</td>
</tr>
<tr>
<td>B-1</td>
<td>Used property but repaired or renovated and in excellent condition.</td>
</tr>
<tr>
<td>B-2</td>
<td>Used property which has been repaired or renovated and, while still in good usable condition, has become worn from further use and cannot qualify for excellent condition.</td>
</tr>
<tr>
<td>B-3</td>
<td>Used property which has been repaired or renovated but has deteriorated since reconditioning and is only in fair condition. Further repairs or renovation required or expected to be needed in near future.</td>
</tr>
<tr>
<td>B-4</td>
<td>Used property which has been repaired or renovated and is in poor condition from serious deterioration such as from major wear and tear, corrosion, exposure to weather, or mildew.</td>
</tr>
<tr>
<td>G-1</td>
<td>Property which has been slightly or moderately used, no repairs required, and still in excellent condition.</td>
</tr>
<tr>
<td>G-2</td>
<td>Used property, more worn than G-1; but still in good condition with considerable use left before any important repairs would be required.</td>
</tr>
<tr>
<td>G-3</td>
<td>Used property which is still in fair condition and usable without repairs; however, somewhat deteriorated, with some parts (or portion) worn and should be replaced.</td>
</tr>
<tr>
<td>G-4</td>
<td>Used property which is still usable without repairs but in poor condition and unsuitable or uncommercial in use. Parts badly worn and deteriorated.</td>
</tr>
<tr>
<td>G-5</td>
<td>Used property, still in excellent condition, but minor repairs required (estimated repair cost would not be more than 10% of acquisition cost).</td>
</tr>
<tr>
<td>G-6</td>
<td>Used property in good condition but considerable repairs required. Estimated cost of repair would be from 10% to 20% of acquisition cost.</td>
</tr>
</tbody>
</table>
- B-3. Used property, in fair condition, but extensive repairs required. Estimated repair costs would be from 25% to 40% of acquisition cost.

- B-4. Used property, in poor condition, and requiring major repairs. Hadly worn, and would still be in doubtful condition of dependability and uneconomical in use if repaired. Estimated repair costs between 45% to 65% of acquisition cost.

- I. Salvage. Personal property that has some value in excess of its basic material content but which is in such condition that has no reasonable prospect of use for any purpose as a unit (either by the holding or any other Federal agency) and its repair or rehabilitation for use as a unit (either by the holding or any other Federal agency) is clearly impractical. Repairs or rehabilitation estimated to cost in excess of 65% of acquisition cost would be considered "clearly impractical" for purposes of this definition.

- Scrap. Material that has no value except for its basic material content.

II. AID COMMODITY CODES

<table>
<thead>
<tr>
<th>AID Commodity Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>Domestic U.S. Government-owned excess property</td>
</tr>
<tr>
<td>10</td>
<td>Foreign U.S. Government-owned excess property</td>
</tr>
</tbody>
</table>

III. NUMERICAL LISTING OF FEDERAL SUPPLY GROUPS

<table>
<thead>
<tr>
<th>Description</th>
<th>Federal Supply Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weapons</td>
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<tr>
<td>Nuclear Ordnance</td>
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<td>Fire Control Equipment</td>
<td>12</td>
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<tr>
<td>Ammunition and Explosives</td>
<td>13</td>
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<tr>
<td>Guided Missiles</td>
<td>14</td>
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<tr>
<td>Aircraft; and Airframe Structural Components</td>
<td>15</td>
</tr>
<tr>
<td>Aircraft Components and Accessories</td>
<td>16</td>
</tr>
<tr>
<td>Aircraft Launching, Landing, and Ground Handling Equipment</td>
<td>17</td>
</tr>
<tr>
<td>Space Vehicles</td>
<td>18</td>
</tr>
<tr>
<td>Ships, Small Craft, Pontoons, and Floating Docks</td>
<td>19</td>
</tr>
<tr>
<td>Ship and Marine Equipment</td>
<td>20</td>
</tr>
<tr>
<td>Unassigned</td>
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<tr>
<td>Railway Equipment</td>
<td>22</td>
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<tr>
<td>Motor Vehicles, Trailers, and Cycles</td>
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<tr>
<td>Tractors</td>
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<td>Vehicular Equipment Components</td>
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<td>Tires and Wheels</td>
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<td>Unassigned</td>
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<tr>
<td>Engines, Turbines,</td>
<td>28</td>
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<tr>
<td>Engine Accessories</td>
<td>29</td>
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<tr>
<td>Mechanical Power Transmission Equipment</td>
<td>30</td>
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<td>Bearings</td>
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<tr>
<td>Woodworking Machinery and Equipment</td>
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<td>Bauled</td>
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<tr>
<td>Backhoes and Excavating Machinery</td>
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<tr>
<td>Special Industry Machinery</td>
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</tr>
<tr>
<td>Agricultural Machinery and Equipment</td>
<td>36</td>
</tr>
<tr>
<td>Construction, Mining, Reservoir, and Highway Maintenance Equipment</td>
<td>37</td>
</tr>
</tbody>
</table>
For export, the inspection described above may be made for major components and complete plants but is seldom used for individual pieces of equipment.

Appraisal. A number of qualified firms specialize in the appraisal of industrial equipment. The valuation is based on both the U.S.A. market price and on the original cost minus depreciation. Where they differ, it is the appraisers job to reconcile them. No appraisal is made or required for the domestic trade. For export, only in case of major components and complete plants is an independent appraisal sometimes obtained. A few of the major appraisal companies include the American Appraisal Co., Inc., Consolidated Appraisal Co., Inc., Fidelity Appraisal Co., Inc., Industrial Appraisal Co., Keystone Appraisal Co., The Lloyd Thomas Co., Manufacturers Appraisal Co., and Marshall & Stevens Inc.

Repair. Second hand equipment is sold as is, rebuilt or somewhere in between. As is implied, no repairs have been made. Rebuilt equipment is almost equal to the original in accuracy and sometimes better in other respects. However, in general, rebuilt U.S.A. equipment costs 65 to 75 percent of the price of new U.S.A. equipment and 80 to 100 percent of the price of new equipment from Japan and Europe. Individual pieces of standard rebuilt second hand equipment have lost their margin of advantage over new equipment. The term overhaul is used to designate
repairs that put the equipment in good operating condition
with no repairs required after overhaul and considerable
use left before any important repairs are required. Inspection
should assign a condition code to equipment only after
repairs are completed.

Spare, Accessories, and Motors. Operating difficulties
due to lack of spare parts have already been discussed. A
supply of spare parts is usually exported with new equipment.
For second hand, this may be done for major components and
complete plants but seldom for individual pieces of equipment.
Some accessories are absolutely necessary for the operation
of the machine, others are necessary for performing specific
types of work, still others make the machine faster or more
automatic. Since accessories may be even more difficult to
obtain than spare parts, it is essential that accessories
be selected as carefully as the machine itself. The next
page lists the necessary accessories for a few common
machine tools. Motors are usually supplied with second
hand equipment in domestic trade. In export trade, electric
motors are usually omitted because of the differences in
electric current. It is easier to purchase these motors
locally than in the U.S.A. In a few cases, it is economical
to remind motors in the developing countries for local
requirements.
1. ENGINE LATHE - 10" to 16" swing
   a. Work holding chuck
   b. Cutting tool post and tool holder
   c. Centers
   d. Face plate
   e. Steadyrest work support

2. SUCCEEDING TYPE TURRET LATHE
   a. Work holding chuck
   b. Plate tool holders
   c. Flange mounted tool holders
   d. Flange mounted slide tool holders
   e. Cross slide square taper tool holders
   f. Tool holder bushings
   g. Multiple turning head

3. BAR TYPE TURRET LATHE
   (Hand Screw Machines)
   a. Work holding center chuck
   b. Work holding and bar feed chuck
   c. Flange mounted tool holders
   d. Flange mounted slide tool holders
   e. Tool holder
   f. Cross slide square taper tool holders
   g. Rear slide cut-off tool holder
   h. Tool holder bushings

4. PLAIN MILLING MACHINE, 0
   a. Milling cutter holder (various sizes)
   b. Milling cutter holder (adapters, etc.)
   c. Work holding vice
   d. Work holding clamp
   e. Arbor supports

5. HAND MILLING MACHINE
   (Same as 0)

6. VERTICAL MILLING MACHINE, 0
   a. Cutter holder (adapters & collets)
   b. Rotary work table (optional)
   c. Work holding vice
   d. Work holding clamp

7. UNIVERSAL MILLING MACHINE, 0
   (Same as 0 and dividing head - tailstock - drive mechanism & change gears)

8. MILLING SHANK - LIFTCENT
   a. Mill chuck
   b. Work holding vice

9. RADIAL MILL
   a. Mill chuck
   b. Work table

10. BORERS
    a. Tool holder post

11. FEDERAL BORED ENDS
    (Color shown)

12. UNIVERSAL TOOL AND CUTTER GUIDES
    (Color shown)
    a. Cutter holding collet
    b. Turret
    c. Rear and cut-off guide

13. STEADY REST (COLOR SHOWN)

CONTINUED ON OTHER SIDE
Know-how. For individual pieces of equipment transfer of know-how consists at best of the original manufacturer's instruction and parts manual. For a major component, the buyer's production engineer will be brought to the U.S.A. or the exporter will send a man to install, operate, and maintain the equipment for a limited period of time. For a complete plant, an engineering firm may be hired on a turnkey basis with training of local staff provided for in the contract or the entire supervisory staff will be sent for training to a similar plant which is in operation. The transfer of know-how is superior only in case of individual pieces of new equipment where equipment manufacturers frequently have overseas representatives who assist in installation, operation, maintenance, and training.

Service and Guarantees. With few exceptions, no guarantee or service arrangements are made in export of individual pieces of equipment. For major components, even when a guarantee is provided the servicing arrangements may be meager. If a breakdown occurs, the buyer will be asked to make the repair himself and charge the exporter. Next, the exporter may hire a local machinery firm to make the repair, only as a last resort will the exporter send his own staff to make good the guarantee. The exporters servicing responsibilities end with the expiration of the guarantee. For both individual pieces
and major components, new equipment manufacturers generally provide service on a continuous basis. For complete plants, both new and second hand, a turnkey contract may fix the contractor's responsibility for maintenance of the equipment for a period of time.
5.6 Conclusion: Mechanisms of Transfer

Individual units of equipment are less reliable and therefore have higher operating costs largely because of poor functioning mechanisms of transfer. No single organization assumes responsibility for selecting the proper machine for the job, determining its condition, providing spares, training personnel, installation and servicing.

Major components are more reliable in performance due to better operation of mechanisms of transfer. Only in service after installation are arrangements for new equipment superior. Expansion in this trade is held back by inadequate credit facilities, government restrictions, and inadequate information about sources.

Complete plants: Except for rare dealer activity, no mechanisms exist for locating or assembly of complete second hand plants to match the demand in developing countries. In fact, only large corporations have used the concept to set up and equip their subsidiaries in developing countries.

Transfer of second hand equipment to developing countries is in the hands of dealers who are reluctant to accept the fact that all transfer of equipment should be accompanied by transfer of know-how.
Conclusions and Recommendations

6.1 Conclusions

Supply
The second hand market can potentially supply some 80 percent of all demand for capital equipment in the developing countries.
The pace of technological innovation in industrially advanced countries assures the supply will continue in the near future.
Standard equipment is almost always available on the second hand market but it is a less reliable source of heavy or special equipment.

Net Cost
A method for determining the net cost of second hand and new equipment in any given case is available.
Rebuilt standard equipment has an insufficient acquisition cost advantage over new equipment.
Second hand equipment in good operating condition has higher operating costs than new equipment that are overcome by lower acquisition costs only in developing countries with good facilities for repair and making of spare parts.
Heavy or special equipment both rebuilt and in good operating condition has considerable acquisition cost advantage and small operating cost disadvantage vis-a-vis new equipment.
Properly engineered complete plants of second hand equipment have considerable acquisition cost advantages and small operating cost disadvantages compared with new equipment.

Mechanisms of Transfer

Malfunction of mechanisms of transfer such as selection of equipment, determining its condition, providing spares, training personnel, installation, and servicing are responsible for lower reliability and higher operating costs of standard units of equipment in good operating condition. No single organization assumes responsibility for these functions.

Only in service after installation are mechanisms of transfer superior for new major components of equipment than for second hand.

Expansion of trade in major components is held back by poor financing facilities, government restrictions, and inadequate information about sources. There is no trade in complete second hand plants because no mechanism exists for locating and transfer of plants for which a demand exists in the developing countries.
6.3 **Recommendations**

**Policies**

1. **Import of second hand equipment** should be subject to regulation but no blanket prohibition should be imposed.

2. The import of individual pieces of second hand equipment should be actively encouraged only when available at no cost.

3. Import of second hand major components and complete plants should be actively encouraged by improving the mechanisms for its location and transfer.
Actions by Developing Countries

1. All imports of second hand equipment should be accompanied by certificate listing.
   a. serial number, model, and year of manufacture (should be manufactured after fixed date)
   b. name and address of manufacturer (manufacturer should still be in business, number of models should be limited to achieve equipment standardization)
   c. classification by independent inspection (only condition codes H1, H2, E1, E2, O1, and O2 should be acceptable)
   d. valuation by independent appraiser
   e. provision of operating instructions, installation instructions, and parts manual of original manufacturer or equal
   f. provision of spare parts, accessories, and electrical motors, if any
   g. proposed end use

2. Imports of heavy or special and complete plants should be accompanied by an economic analysis comparing new and second hand equipment.

3. Development Banks and Industrial Development Corporations may require the use of second hand equipment.
as an alternate in bids for industrial projects. The Development Bank or Industrial Development Corporation should be prepared to provide names of second hand suppliers to be invited to submit bids. These bidders are to meet the same specifications as new equipment suppliers.

4. The technical and vocational education departments should expand their facilities by addition of second hand equipment available at no cost. The selection, overhaul, spare parts, crating, etc., to be arranged by a working party of the departments concerned or by an engineering firm on a contract basis.

5. The Industrial Development Corporations should expand existing and establish additional repair and machine shops. These shops should be equipped with second hand equipment leased from the Industrial Development Corporation, and obtained at no cost. The selection, overhaul, spare parts, installation and training of personnel to be arranged by an engineering firm on a contract basis.
Actions by International Organizations

1. The United Nations should provide experts to assist in preparation of industrial feasibility and economic analysis studies when requested by Development Banks and Industrial Development Corporations.

2. The United Nations should organize a meeting of national Development Banks, Industrial Development Corporations, The World Bank, interested foundations, and others to encourage their sponsorship of a non-profit Industrial Cooperation Bureau. The functions of the Bureau should include:
   a. promoting in developed countries, joint ventures involving transfer of both know-how and new or second-hand equipment for projects approved by national Industrial Development Corporations or their equals in the developing countries.
   b. Prepare lists of engineering firms and dealers to bid for major components and complete plants on turnkey basis using second-hand equipment. These lists to be supplied to national Industrial Development Corporations and Banks.
   c. Purchase of second-hand major components and complete plants for the account of national Industrial Development Corporations from “shopping list” provided by these corporations. The plants to be put into operation by engineering firms on turnkey basis.
Notes


2. All data on demand based on "Projection of Demand for Industrial Equipment" cited above.

3. Letter to Centre for Industrial Development from Deutsche Gesselschaft fur Wirtschaftliche Zusammenarbeit December 3, 1963

4. International Management, March 1963


   Dated September 10, 1965. The enclosure is included in attachment "B"

12. *Manufacturing Technology Division Study, Air Force Materials Laboratory, Wright Patterson A.F.B. reported in Metalworking News, June 20, 1965*


14. For a detailed study of all three methods and their refinements see George A. Taylor,

15. Dynamic Equipment Policy, George Terbovich, Machinery and Allied Products Institute, Washington


Precision Metals Seeks To Automate HERF Unit

EL CAJON, Calif. — Precision Metals Products, here, a division of Fairchild Camera & Instrument Corp., — with an eye toward the automotive market — is seeking to automate a high energy rate forming (HERF) machine.

The unit, rated at 600,000 foot pounds, was designed by Joseph Moritz, technical assistant to the divisional manager, and built by Maschinenfabrik AEG, Wengarten, A.G., Wengarten, Germany.

A spokesman for Precision Metals, which holds the license to sell the unit throughout the world, except Europe, said the firm plans to start a marketing program in 60 to 90 days.

Typical mechanism that the firm expects to accomplish includes pressing parts from an eight pound billet at the rate of 15 per minute, he added.

Accessories are still being developed and tested.

The automation process would be two-dimensional injection and withdrawal through mechanical means — rather than full electronic automation, it was noted.

Other HERF equipment makers and users alike are exploring mechanical means of automating production, industry sources noted.

The Fairchild division will use its machine for custom work and part testing. Mr. Moritz said discussions have been held with some steel producers in this country to provide a high strength steel at a low price. The special vacuum carbon steel used in Fairchild's unit was developed in West Germany and has a strength of around 168,000 PSI.

Precision Metal Products may produce the machines in this country.

A unique aspect of Mr. Moritz's design is the independent adjustment of two gas chambers, one on top of the machine and the other on the bottom, as previously reported.

The gas in the chambers is released at the same instant for an adequate gas expansion to achieve without loss or gain of heat, which moves the anvil, the press side, and the press itself at a very high speed, and creates enough kinetic energy to form.

At point of impact, both masses are free hanging and therefore no energy is applied to the billet.

5-Year Spurt Seen For N/C in Europe

Cable Fairchild

BRUSSELS — Sales of numerically controlled machine tools in Europe are expected to grow substantially over the next 5 years reaching what the United States level is today.

This was the consensus at the 9th European Machine Tool Exhibition, which closed here Sunday.

On display were 300 N/C machines showing varying degrees of sophistication. The number represents a five fold increase over the number of N/C machines shown 3 years ago at the Milan exhibitions.

A total of 25 different N/C control systems were counted, including a handful made for the first time by machinery builders themselves.

Learning Stage Over

There also was general agreement among the manufacturers interviewed that most of the learning stage is over, that they now understand the role of N/C machinery.

Two points stressed by many.

One operator could "run" several units at one time, and cutting down the number of numbers needed to handle and maintain control frames, to survive increased competition, will eventually have to use N/C units to produce at the most economic level.

A member of US NC, however, indicated they were hesitant to buy N/C units at this time. Many had heard that introduction of integrated circuitry might reduce control costs by as much as 25 per cent within one year.

There are currently 506 N/C machines in operation in Europe, Germany has the greatest number by country — about 100 units. Ferranti, Ltd., Lancashire, England, is the leader among controls producers with 250 installations. Second is Almac. Ltd., Birkinghamshire, a producer of low cost positioning systems, with 250 installations.

IGE is in third spot, with 200 installations. IGE entered the European N/C controls field just 3 years ago.

The firm is building plants in Italy and England for the production of N/C systems.

Plessis Co., Ltd., Essex, England, accounts for 95 units. Siemens Schuckert Werke, AG, Aulanger, W. Germany, has sold 80 Swedish Nash has sold an estimated 25 units, all in Scandinavian countries.

British builders estimated that in the next 2 years there will be a market in England for 200 N/C systems.

Continent builders estimated that sales on the Continent might range from 200 to 300 N/C systems during 1967.

Steelsman, which had been used during the first days, replaced by the end. However, reduced attendance by Americans was especially noted.
Sharp ECM Increase
Forecast in Late '60s

Major Equipment is Set Up
For Job, Line Hydroforming

CHICAGO - Major Equipment Co. has set up a hydroforming department for both job and production work.

Robert Major, general manager, said the $180,000 quick acting machine (600 parts per minute capacity) is the only one of its kind in the Midwest and the second one ever made. It was built by Cincinnati Milling Machine Co., Cincinnati.

He said that 4,000 parts can be taken up in a 30-inch blank and drawn 10 inches in depth. The unit will be used for major's own research and development work on products of which it produces a wide variety. It will also be used for job work.

Mr. Major said that hydroforming is the least expensive method of draw forming.

Hydroforming costs far less than normal draw forming, he said. The only die required is a male die. The machine utilizes a rubber diaphragm which pulls the parts of the female die.

Mr. Major said that on a job shop basis the facility will be available for short run, one-of-a-kind or high speed multiple value production. The hydroforming work will be backed up by the company's standard forming, drawing, bending, and standard hydroforming facilities.

and because of that it can be used for intricate shapes.

He indicated that hydroforming Major has been successful in using plastic epoxy tools for high production runs.
See EDM Replacing Lamination in Motor Pole Face Construction

by DARI FREIDLEBERG

KANSAS CITY, Mo. — After being hammers have applied electrical discharge machining to motor pole face construction, and, according to James E. Veavey, vice president, the success of this research effort could mean a new means of replacing the lamination techniques used in standard electric motor pole faces.

In an interview with Metalworking News last week, Mr. Veavey said there's no secret to the pole face work done for Westinghouse Electric Co., Kansas City. His firm has received a Westinghouse contract to make semi-recessed EDM.

"We expect to have little trouble in making the recess," he said.

The EDM process could mean greater efficiency for electric motors of all sizes, he explained. Laminated pole faces are composed of alternating layers of metal and insulation. In an operating motor, these layers create eddy currents, causing heat and eddy currents. With the EDM process, the pole face would be an ideal piece of metal and vibration would be eliminated.

The tests so far conducted at Aerovox, Inc. and the company specializing in EDM, were 3/4 inch long, 1 1/2 inches wide, 1/2 inches high with a recess 0.03 inch deep and approximate radius of 0.5 inches. Mr. Veavey said that if there were to be 1000 motors with the same material, the EDM process would cost approximately $150 per motor.

Mr. Veavey, said he first tried to make the EDM electrodes of copper but found that this material is not adequate due to rapid erosion.

Used Graphite

Next he went to the traditional EDM material, graphite, and found that by taking the unusual step of coating a grinding wheel the electrode could be made. The electrode thus to be within 0.0001 inch accurate, he stated.

Aerovox Tool recently purchased two grinders from Bayard-Beauvais Corp., Blowendorf, Mo., because of the accuracy that proved to fill a growing need.

"Knowing how to make the electrodes one of the first things not enough. Mr. Veavey said. A steady feed rate, all smooth, cleanliness of all, accuracy of electrode and interchangeability of parts are his criteria.

A little dirt or a break in the electrode groove was enough to ruin the entire piece, he recalled.

The secret in using, the EDM machines, discovered after months of research, was to have the electrode rotating continually. Continuous rotation provided a continuous supply of the graphite to the workpiece.

Mr. Veavey said the new Westinghouse rotor bars came for the making of 105 slot per pole, 10 slots per motor with the slots 0.003 to 0.006 inch wide and 0.006 to 0.009 inch deep.

In addition to designing some precision work in EDM is seeking more complex and electronic work and also plans to be an electrode supplier to other users of the EDM process.

Lower Price $150 See Cost Cutting Over

Continued from Page 1

ting controls costing $400,000 on these machines in the past due to reduction in setup and tooling costs and increased reliability," he said. "Shops making complicated parts in small quantities with high tooling and setup costs will be forced by competition to use EDM."

Less expensive controls have stimulated a number of machine tool builders to build new, less expensive machines designed for n.e. as he said.

"A number of machine tool builders will be exhibiting tools at the machine tool show this month that will sell for less than $100,000. These tools were not available in n.e. before," he said.

The arc division of Burner-Ramey, Inc. has not released sales and earnings figures, but Mr. Fried said that it is now showing a profit and has a larger to a third of the market control market.

"I don't see the less expensive controls systems growing in production, but the more expensive controls should get considerably more sales this year," he added.

"We won't be building any more 3000 controls this year," he added.

"We just can't justify publish-