PROCEDURE FOR EVALUATING PROCESSING EQUIPMENT

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The ordinary source of plant equipment is the supplier whose business it is to design, build, and sell equipment. Problems can arise for the user in procuring equipment when he has no experience with a piece of equipment and he must secure information as to its performance and suitability for his use. A common way of obtaining such information is to get it from other users who have had experience. If this can be done, it is an excellent way to proceed. When user experience cannot be obtained, help can be secured from the equipment supplier. A well established supplier may be able to provide what is needed, especially if the item is one that he has manufactured previously. He may, however, not have had direct experience in the user's application, and under these circumstances, the most he may be able to do is to offer an opinion as to performance.

If the item is a new one, or one under development, the user is apt to find it most difficult to secure information to guide him. It may be that the supplier has not been able to evaluate his equipment adequately and desperately needs a field test by a customer. This situation, while somewhat risky, need not deter the user. As a first customer, he may obtain a preferred position with the supplier. For example, as compensation for assisting the supplier in evaluating the unit and proving it out, he might secure an option for additional ones before his competition would be offered an opportunity to purchase. If the item should prove to be good, this lead time could be valuable.

In accepting a new untried piece of equipment, even on an experimental basis, the user should be aware that the trial could be expensive for him. If the unit should require changes, the tests to establish what is needed and then to prove that an improvement has been made, involve plant time, product, space, etc., all of which do not come free. Unless an agreement covering payment of such costs by the supplier is part of the arrangement, the user finds that these costs are his.

The evaluation of equipment, regardless of what amount of prior information the user can secure on its performance, should be made by him by a method that provides information that applies to his particular situation and needs. To use, or more importantly, to extend the use of equipment without making a proper evaluation of its suitability, can lead to a mistaken understanding of its value. Best results are obtained in the evaluation when a defined procedure of evaluation is followed and when personnel who understand such a procedure follow it.
The evaluation procedure usually involves two steps:

1. An appraisal based on available information and intended to guide the selection of equipment before physical installation and testing, and

2. Evaluation of a test installation under plant conditions.

The first step involves the obtaining of any pertinent information that the supplier or others can provide. This might include performance claims, costs, and availability. What the user will require will depend upon his judgment, interest, and experience. Some basic requirements at this stage are:

1. A definition of the problem to be solved or the proposition to be considered.

2. An accurate description of the new process or process step and associated equipment.

3. An estimate of all pertinent expenses over a period long enough to encompass seasonal factors, usually one year.

4. An analysis of the basic inter-play between investment and total annual expense.

5. Similar information for alternate methods and in a form to permit comparisons.

The obtaining of these requirements can be assisted by the use of several forms for the development and recording of the information. Three separate forms might suffice and can be identified as:

1. Basis Form (Exhibit A)

2. Cost Form (Exhibit B)

3. Comparative Form (Exhibit C)

**The Basis Form**

The purpose of the Basis Form is to define the problem or the proposition. The sections of this form are completed as follows:

**Process.** A short descriptive name of the process or operation, e.g., Splitting Cattle, Formulating Frankfurters.

**Input Materials.** Listed here are the items at the start of the operation. For example, if a new method of packaging frankfurters is being evaluated, the input materials could be: chilled peeled frankfurters, packaging film, and shipping containers.
Output Items. Listed here are the items as they are at the end of the operation being evaluated. In the above example the output items would be frankfurters in 1-pound packages in the shipping carton.

Output or Input Volume. Which volume basis is used should be designated. Volume can be stated in any convenient units per unit time. Because volume has an important effect on manufacturing expense, it is necessary to select a proper volume. A value cost comparison can be made only if the same volume is used for all methods being compared.

Starting Point. This is the point in the total process at which we begin to accumulate costs. It must be the same for all methods being compared.

End Point. This is the point of the total process at which we stop accumulating costs. Like the Starting Point, it must be the same for all methods being compared.

Other. Here is entered additional information needed to describe the problem or operation. For example, the volume listed may be an average volume over the period covered by the costs, and it could be noted here that seasonal variations require installation of equipment capable of handling twice the average volume on an instantaneous rate basis.

The Cost Form

The purpose of this form is to accumulate all pertinent investment costs and operating expense. The form is such that in comparing methods, the relationships among the various items of cost such as investment, operating expense, labor and supplies, etc. are clearly set forth in order to assist in selecting the best method. The sections of the Cost Form are completed as follows:

Process. Same as Basis Form.

Method. Means to accomplish process step.

Description. A brief description of the method covering the essential steps between starting and end points.

Footnotes. Here are entered any explanatory notes particularly the source, computation or content of figures entered on the right-hand column.

Equipment. This normally is the delivered cost of the equipment used in carrying out the described method between starting and end points.

Installation. As the name indicates, the cost involved in putting the equipment in place, connecting utilities, etc. are entered here.

Other. Miscellaneous cost items are entered here. For example, if building changes are needed, they should be listed here.

Total. This first total is the sum of the costs for equipment, installation, and other items of an investment nature.
Labor. This is the estimate of the total annual labor expense to carry out the method between the stated starting and end points and at the stated volume.

Utilities. This is an estimate of the total annual utilities expense, including steam, electric power, water, gas, etc.

Maintenance. This is the estimated total annual maintenance expense. This estimate can be made specific for the equipment in question or if not, it can be approximated by use of standard costs based on a percentage of the fixed capital investment, such as follows:

<table>
<thead>
<tr>
<th>Type of equipment</th>
<th>% of fixed capital investment (considered as annual maintenance cost)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple - light use</td>
<td>2 to 4</td>
</tr>
<tr>
<td>Average</td>
<td>6 to 7</td>
</tr>
<tr>
<td>Complicated - severe use</td>
<td>8 to 10</td>
</tr>
</tbody>
</table>

Equipment expense. This item covers costs associated with owning the equipment and which are independent of its use. It may be calculated as a percentage of the total investment as follows:

- Taxes 2%
- Insurance 1
- Value of money 4
- Total 7%

To this is added 5.5% of the equipment investment to permit write-off of money invested, making a total of 12.5%.

Total. This is the sum of all the annual expenses.

Miscellaneous. Here may be entered items of particular interest. For example, it may be useful to show the cost on the basis of cost per unit or per cwt, or as expense per day, per week, or per month.

Comparative Form

The purpose of this form is to bring together on one sheet the principal information relating to several methods or equipment associated with them. This information is derived from individual Cost Forms. The several headings of this form are completed using information similarly identified on the Cost Forms for each of the methods or equipment. By so assembling the information on all under consideration a selection of the best can be made.
An example of the use of these forms is given in the comparison of two methods for packaging frankfurters, one method involving manual banding and the other automatic banding.

No strong brief is made for the particulars of these three forms. It is believed, however, that they do list the key information and something similar to them is needed. Details different from those shown may be appropriate to some circumstances. These forms illustrate the kind of orderly analysis of appropriate information to enable an accurate comparison of alternates or to determine the value of a particular piece of equipment.

The analysis just indicated is a first step. Basically it is the assembly of available information and is a guide to choosing the equipment needed from two or more alternates. The next step is to obtain the equipment of choice and to evaluate it.

In proceeding to the actual step of obtaining and evaluating the equipment on a performance basis, it should be recognized that this step may be carried out in an atmosphere that is not always conducive to obtaining meaningful results. Recognition of this situation and alertness to the problems involved will help to avoid mistakes.

First, there usually exists incomplete understanding between the designer, manufacturer of the equipment, and the user. This lack of understanding can be several sided. The designer may understand very well what is needed and he may have provided all that is needed. The user, on the other hand, may not understand how this has been done and what he must do to get the most out of the equipment. The designer-manufacturer may not have provided what in fact is needed, because either he could not or because he did not know what was needed. A strong effort must be made to arrive at a basis of common understanding between the designer-manufacturer and the user.

Second, the user should recognize that the designer-manufacturer tends to be optimistic as to the performance of his equipment. Realism in this area is needed and the user cannot blindly accept what is claimed. Prior to his own performance evaluation, the user needs to employ what means are available to him to assist in judging the extent of the validity of the claims for performance. It is probable that specific information will be difficult to obtain. Common sense and general technical knowhow, however, can be of good value in avoiding the acceptance of unreasonable claims.

Somewhat unique to meat operations and an area which many equipment designer-manufacturers do not fully appreciate is the nature of the environment in which their equipment will operate. Packing house requirements tend to center on ruggedness and resistance to corrosion from moisture, salt, smoke, etc. Water is a major cause of equipment failure. Not only is it widely used in processing and cleaning, but humidities are generally high. Water is a principal cause of the failure to electrical components. Sealing such units may not be sufficient. Heat on a continuous basis, even when the equipment is not in use, may be needed to keep them dry and operational.
Special attention must be paid to those parts of equipment which are in contact with products or ingredients. Improper equipment components can be corroded or deteriorated by product. Alternatively product can be contaminated. Certain metals cannot be used. Some such as lead or cadmium are toxic. Others such as copper can affect product quality or stability. Similarly sanitary needs are not always satisfied. These situations are much better now than they have been and ordinarily experienced builders of food processing equipment practice sound design. Problems may arise with builders who do not have a proper understanding and who lack experience.

While only a very rare occurrence, it does happen that what amounts to a fraud is attempted by an occasional supplier. An alert user who takes a common sense viewpoint and who employs competent and qualified personnel to assist him and who deals with suppliers of known integrity is not likely to be "taken in."

Within his own organization there may exist a set of circumstances that the user needs to recognize. It is likely that the interest in a particular piece of equipment may originate with an operating or engineering group—not top management. It is also quite possible that initially top management may not be sympathetic. The convincing of the people who can authorize the purchase or even the testing of the equipment may be a problem. A somewhat reverse situation can also exist. Top management might have been "sold" by an outsider. Despite resistance from their own organizational units concerned with equipment innovations and use, they might require action. In both circumstances, once top management is convinced, they may not understand or accept what is involved in an adequate evaluation, especially if this takes appreciable time. They may push for utilization of the equipment without a real evaluation. Resolution of this situation can be difficult.

Another internal problem area involves plant operators. They can be suspicious of new equipment. It could reduce the skill required for an operation and thereby devalue their services. It might increase efficiency and may even replace them. It is too much to expect human nature to be happy with such possibilities. If the operators are aware that an evaluation to determine the future of a piece of equipment is being made, all sorts of problems may arise. Some difficulties might be mysterious in their origin and may be even difficult to identify as aberrations from the normal. The extreme can be out-and-out sabotage. Alertness and a determination to proceed regardless are needed to overcome such difficulties.

Sometimes in a multi plant organization, the local management may be unsympathetic. Tests interfere with regular production. If the new equipment functions poorly, as it may until problems causing difficulty are solved, efficiency is reduced. Defensively Plant A would be happy to see Plant B do the evaluation of new equipment. In such an environment those who need to do the evaluating may find problems that can be solved only by strong backing from headquarters.

As one proceeds to evaluate the equipment, a plan of action is needed. If at all possible, the equipment should be installed on a test and not a production basis. Nothing will interfere more with the obtaining of proper data than requirements to fill orders for product. Further the
reliance on untried equipment for meeting production needs is extremely hazardous. Equipment failure, the possibility of which is undoubtedly greater than with a proven facility, simply puts one out of operation. The best, but not always the simplest approach, is to parallel existing equipment. Under this condition, a test run can be made on the new equipment with the knowledge that the regular equipment is always available should it be needed. The test unit can be taken out of operation any time adjustment or modification is indicated. If the new equipment can not be installed parallel with existing equipment, it should not be committed to production for filling orders until its performance is proved to be satisfactory. Alternatively, arrangements for quick reinstallation of the regular equipment, when needed, will be helpful.

The exact nature of the evaluation procedure will depend upon what the equipment is and what its purpose is. Evaluations which lead to a "figure of merit," a quantitative evaluation, are cleanest and simplest. Those involving a subjectively characterized result are least satisfactory and more difficult to judge. It is important not to accept or reject equipment with no more basis than a statement (usually made by an operating group) that "It works fine," or "It's no good." If at all possible, the measurement of performance should be an objective basis. Data need to be gathered and there should be a plan for which and how many data to be taken. This plan should be worked out according to good statistical procedures. Conclusions based on these data should be developed through appropriate statistical analyses. It may be helpful to log the operation through use of recording instruments rather than depending upon human effort for this.

Just what needs to be done cannot be given as a generalization. Information answering the following kinds of questions probably will be needed:

1. What is the capacity? (Average? Instantaneous?)
2. What is the product yield?
3. Does the product meet quality control specifications?
4. What percentage of reject product is produced?
5. What are the labor requirements and costs for operation?
6. What is the supply utilization and cost?
7. What is the utility utilization and cost?
8. Are there critical adjustments which are likely to constitute an operation problem?
9. For automatic equipment, is manual operation possible, should a breakdown of the automatic feature occur?
10. What amount of unscheduled down time is typical?
(11) What are maintenance costs?
(12) What inventory of spare parts is needed? Is there a source for spare parts?
(13) Is the equipment sanitary?
(14) What amount of labor is needed for clean-up?
(15) How long a continuous run is possible?
(16) Is the equipment safe?
(17) Is the equipment single purpose or is it easily adapted to other uses? To other products? To other unit sizes?
(18) Is the equipment sufficiently durable?
(19) Is corrosion likely to be a problem?
(20) Are the electrical and other fragile components protected against water and moisture?
(21) Is the equipment adequately instrumented to indicate or control its operation?
(22) Is there adequate provision for lubrication?
(23) Are there unusual installation requirements?
(24) Is service available from the manufacturer?
(25) Are manuals for operation and for maintenance available? Is each satisfactory?
(26) Are there particular advantages or disadvantages associated with the equipment?

Upon completion of the planned evaluation procedure the data are to be assembled and a report stating the conclusions of the findings to be written. A suggested outline for this report is as follows:

I. A. Description of new equipment.
   B. Description of use of new equipment.
   C. Description of present operation, if any.
   D. Believed advantages of new equipment.

II. Installation of new equipment.

III. Data on operation of new and alternate equipment.
IV. Expense comparison of new equipment with alternate equipment.

V. Projections, if any. (This section is concerned with installations of additional units. Since there are differences among plants, specific figures and not averages are needed in making these projections.)

VI. Conclusions and recommendations.

In some respects the report is an amplification of the forms used in the analysis prior to testing. It adds information secured through trials and covers important aspects of equipment design, manufacture, and use which are not emphasized in the first analysis. In essence, it combines cost elements and performance characteristics and these together are the most logical and likely basis for selection.

Following the evaluation procedure, and if the conclusion indicates that the equipment involved is worthwhile using, installation on a permanent basis should be made. Good management will provide for continuing assessment through adequate recording of performance and costs. Long term experience can bring out advantages or disadvantages not always discerned in a short term test. Critical evaluation of all manufacturing facilities on a continuing basis is a never-ending responsibility for continuing success.

**BASIS FORM EXAMPLE**

**Process.** Package 1 pound frankfurters.

**Basis.**

**Input materials.** Chilled peeled frankfurters
Film No. XYZ
Shipping containers

**Output items.** 12 one-pound packages in shipping container

**Output volume.** 1,000 lb./hour
16,000 lb./day
80,000 lb./week
4,000,000 lb./year

**Starting point.** Loose frankfurters in bins adjacent to operators and all supplies within reach.

**End point.** 1-pound packages in shipping container adjacent to operator.
COST FORM EXAMPLE A

Process. Package 1 pound frankfurters.

Method. ABC machine, manual banding.


<table>
<thead>
<tr>
<th>Investment</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Equipment</td>
<td>$12,300</td>
</tr>
<tr>
<td>Installation</td>
<td>9,800</td>
</tr>
<tr>
<td>Other</td>
<td>--</td>
</tr>
<tr>
<td>Total</td>
<td>$22,100</td>
</tr>
</tbody>
</table>

Total annual expense

| Labor(1)     | $86,500  |
| Supply(2)    | 116,000  |
| Utilities(3) | 960      |
| Maintenance(3)| 6,700    |
| Equipment expense(4) | 2,800 |
| Lease        | 5,400    |
| Total        | $218,380 |

Footnotes.

(1) Estimate by AHP.
(2) Includes cost of film, bands, and shipping container.
(3) Estimate by PHA.
(4) 12.5% of installed equipment cost.

COST FORM EXAMPLE B

Process. Package 1 pound frankfurters.

Method. ABC machine, automatic banding.

Description. Operators place 5 frankfurters in sections of infeed conveyor to ABC machine. Packages automatically banded. Banded packages placed manually in shipping container.

<table>
<thead>
<tr>
<th>Investment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
<td>$23,500</td>
</tr>
<tr>
<td>Installation</td>
<td>12,200</td>
</tr>
<tr>
<td>Other</td>
<td>--</td>
</tr>
<tr>
<td>Total</td>
<td>$35,700</td>
</tr>
</tbody>
</table>

Total annual expense

| Labor(1)     | $67,000  |
| Supply(2)    | 114,000  |
| Utilities(3) | 1,120    |
| Maintenance(3)| 7,500    |
| Equipment expense(4) | 4,460 |
| Lease        | 5,400    |
| Total        | $199,480 |

Footnotes.

(1) Estimate by AHP.
(2) Includes cost of film, bands, and shipping containers.
(3) Estimate by PHA.
(4) 12.5% of installed equipment expense.

Miscellaneous

Cwt. $4.99
COMPARATIVE FORM EXAMPLE

Process. Package 1 pound frankfurters.

<table>
<thead>
<tr>
<th>Method</th>
<th>Total investment</th>
<th>Total annual expense</th>
<th>Miscellaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC Manual</td>
<td>$22,100</td>
<td>$218,380</td>
<td>$5.45 per cwt.</td>
</tr>
<tr>
<td>ABC Automatic</td>
<td>35,700</td>
<td>199,480</td>
<td>4.99 per cwt.</td>
</tr>
</tbody>
</table>

R. B. SLEETH: Thanks very much Walt for that very timely presentation. I believe the many problems that Walt has brought up in his talk are probably, at least some of the problems that he has raised and has not answered, is probably analogous to the new sultan who had just been introduced to his first harem. He knew what to do, but he didn't know where to start. I think this is real true from the standpoint of the packer getting new equipment in; what to do with it, who to bring in from the standpoint of the various departments within each of the groups within the company to evaluate it with the engineering, operations research, economic department, etc. It takes a lot of organization in order to make proper analysis of the equipment that is justified. Are there questions that you would like to direct to Dr. Urbain concerning his presentation? Walt, I guess you answered all the questions and problems the folks might have had. So in the interest of time, Bob, I will turn it back to you.

ROBERT SAFFLE: Thank you, R. B. The Board of Directors realized that in the past five or six years we have begun to see some research information on certain types of sausage products. However, in the area of semi-dried and dried sausage products, there is virtually no information available in research literature on the processing of these items. It was the hope and idea of the Board of Directors to have someone to talk on the subject of semi-dried and dried sausages primarily from a sausage-makers standpoint to give us some benchmarks or rules of thumb in the production of semi-dried and dried sausages; perhaps to encourage us to take this area away being completely art back to where we would have some good research information. I think we are very fortunate to have Bill Shannon to talk to us on the production, processing of dry and semi-dry sausages. Del Doty was not able to be here as listed in your program; however, Neil Webb with Eckhert Packing Company at Defiance, will handle the discussion period immediately after Bill's presentation. Bill.

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