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FACTORS TO CONSIDER BEFORE INVESTING CAPITAL IN NEW EQUIPMENT

(Remarks of Charles E. French, Purdue University,
Before 52nd Annual Convention of Milk Industry Foundation,
Miami Beach, Florida, October 7, 1959)

Capital accumulation is a necessary component of economic growth in a capitalistic society. Capital can be invested or it can be saved. To accumulate more capital, investment is important. But wise investment is a complicated and difficult procedure.

Historically we have invested our capital heavily in equipment. The productivity of our land, labor and management has been pyramided as a result. Such economic growth has given us the highest standard of living in the world.

The dairy industry has done a relatively good job of mechanization. However, this process of automation is not in itself automatic. Many equipment purchases have gone awry. Some have given much less than desired. What considerations should be made before investing capital in new equipment? I will discuss two very broad ones which I feel to be important--(1) the signs of our times and (2) the relative economic relationships.

Signs of Our Times

Two imposing signs of our times backdrop today's management decisions on capital outlays for equipment--(1) the all-out attempt to make production processes automatic and (2) the companion attempt to routinize data-processing to assure the ultimate use of high-speed computing equipment in the management process.

The first sign, automation, I view philosophically and possibly from a unique and uninformed definition of automation. Apparently, a Ford Motor Company Vice President, a Mr. Harder, coined the word in 1946 when describing some automatic work-feeding and materials handling devices. Mr. Harder coined the term in a narrow sense, but it was soon broadened by the press. A Massachusetts Institute of Technology professor, Dr. Wiener, made headlines of the subject with his book on "cybernetics," a term he used to mean "control and communication in the animal and the machine."1/

I view this development essentially as an extension of industrialization. Yet, I do agree with Mr. Ralph J. Cordiner, President, General Electric, who said that, "It is important to recognize that 'automation' is only one phase in the process of technological progress, a natural evolutionary step in man's continuing effort to use the discoveries of science in getting the world's work done."2/

I view it as essentially evolutionary, not revolutionary. Thus, I like the definition of Professor James R. Bright, Harvard University, that "Automation simply means something significantly more automatic than previously existed in that plant, industry or location."1/

My technician friends list five basic considerations in automation. Let me discuss them briefly. The economic considerations I shall attempt to cover later. These five technical considerations are: (1) availability of automatic machinery, (2) nature of raw materials, (3) production processes, (4) factory or plant layout and (5) product design.1/

Automatic machines are obviously not available for some food processes. However, an appraisal of available machines, especially in other industries, might be quite encouraging. There is no doubt that automation is going at a rather rapid pace. Undoubtedly, official statistics are lagging the actual development. Development in other industries cannot be overlooked as a tremendous potential for adaptations in the food industry. Often we either have the automatic machinery or we can get it.3/ 4/ 5/ 6/

1/ Footnote numbers indicate number of reference in bibliography.

Raw material considerations in food industries suggest opportunities for automation. It has been said, "The 'flow' concept of automation is most easily applied in the processing of liquids, gases and energies, such as electrical energy. Thus, in the chemical, petroleum and electric utility industries you will find a high degree of automation already in existence."2/ Milk is a highly definable, chemical substance which is dependable within the flow concept of automation. The necessity for improved materials handling in the food industry might give us an extremely valuable by-product on this score.

Production processes in food handling should be subject to automation. Batch processes did not generally allow it, but almost complete continuous processes do.

Our factory layouts are extremely inefficient in many cases. Yet, potential may be here for automatic processes. Some developments in this area are showing up in new layouts as we put all control devices in one area. This is not a very long step toward automation but it indicates the direction. Modern dairy plant layouts can have a wide span of mechanization with the high level of penetrating mechanization possible for automation.

Product design may give us some problems in automation. Recent years have seen an increase in number of products.7/ However, we have tended to specialize the processes on particular products within individual firms. Moreover, we may not need the extremely wide line of products developed more for competitive reasons than for efficiency. Proper evaluation may not have warranted introduction of many new products merely to meet competition. Many products are the result of our hanging on to the traditional artistic concept in food.

The technical outlook for automation is not all bright. Actually, we have done very little to automatize fully the control procedures in food plants. Possibly, we have done more than we realize to mechanize certain processes. However, actual elimination of man hours has not come as we might hope.

Moreover, mechanization is not easy. It is not simply keeping in touch with the most recent developments in automatic equipment. It must consider the entire operation, including not only factors such as design, materials and processes which go to make up the interior operation but also the marketing practices and the overall environment on the exterior.

The second sign, modern management, I view with a bit more experience and confidence. Central machines here are high-speed computers. It has been said, "When the history of our age is written, . . .it will record three profoundly technological developments: nuclear energy, which tremendously increases the amount of energy available to do the world's work; automation, which greatly increases man's ability to use tools; and, computers, which multiply man's ability to do mental work. Some . . .believe that of these three, the computer will bring the greatest benefit to man."[8/]

This area involves two aspects--routine data processing and management problem solving. Automation of routine data processing is getting well started. The problems here are akin to those on processing operations. We are optimistic that automation can do much for this nearly forgotten area of dairying. However, machines are a long ways from replacing all of our clerical staffs. The human brain, housing more than ten billion cells, is vastly more complex than the most complicated machine.[9/] Of course, this is all the more reason to use it well.

Use of a computer for management problem solving is made possible by the fact that a computer can often handle complicated problems more accurately and much quicker than can man. Large repetitive problems are most appropriate. You can get either a large number of interpretations of a small amount of data or you can get fewer interpretations of a large amount of data. Now that we have derived more and better operating data, we can take advantage of such machines and solve problems today which are too complicated for the human mind to comprehend.[10/11/12/]

Automation potential in management problem solving is beyond appraisal, but it is tremendous. Many traditional management problems today can be handled effectively. Economics will feel profound effects of automation in this area.

Thus, within this environment a manager spends his money for equipment. The momentum for mechanization is powerful. In American industry, the installed horsepower per worker is estimated at about 15. In a sustained rate of effort, an individual can produce 1/10 to 1/20 horsepower himself. It is no wonder that he has used machines to allow himself the equivalent of 150 manpower.[13/] To resist mechanization requires good reason. To be carried along without reason can be expensive. Fortunately, some guidance on this problem can be garnered from our storehouse of economic relationships.

Relative Economic Relationships

Capital cost is small relative to many other costs. Wise equipment expenditures require proper orientation. Such orientation is best achieved by scanning the typical income statement or cost breakdown of a milk plant. Where does capital cost stand relative to other costs? By any reasonable classification, capital cost is relatively small.

Milk is the main outlay item (currently about one-half of our total cost and expenses) in dairy plant operations--a fact so easily overlooked, (Table 1). Other ingredients also add a percent or so to the raw material.

Labor is the next most important outlay (currently about one-fourth of our total cost and expenses).

Containers take about 6 or 7 percent of the total outlay and advertising about 2 percent.

Table 1. Breakdown of Costs--Average for Clients of Edward B. McClain Company, Memphis, Tennessee, 1958

Item	Outlay per hundredweight	Percentage of total costs and expenses
Raw milk	$4.99	51
Ingredients	.11	1
Labor	2.41	25
Containers	.63	6
Advertising	.16	2
Depreciation, repairs, rent, taxes, and insurance	.86	9
Other	.58	6
TOTAL	$9.74	100

The basic charges which are normally associated with equipment thus are not large. The depreciation, repairs, rent, taxes and insurance probably reportedly take about 9 percent of total outlays Even if we add the other costs that go into our operation, we still would have difficulty in finding more than about 1/6 of our total outlet in this area This is not to infer that equipment costs are unimportant, but their relative position in the total cost structure is a basic consideration when deciding upon additional equipment expenditures.

Interrelationships of capital costs and other costs are many. Capital items tend to be substituted for many other cost items. Moreover, equipment and other capital items form the backdrop for the entire operation of a plant. A change in equipment may not affect the whole operation, but often it does.

The engineers have an approach that gives good economic orientation to equipment changes, (Chart 1). The wisdom of this orientation lies in two aspects of their approach. First, they say, "Check the big things first." They contend that a change in column 1 of Chart 1 may well precipitate a change in each of the other columns of the chart. Likewise, a change in column 2 may be expected to effect changes in columns 3, 4 and 5, but not necessarily in column 1. Thus, they say work on the changes from left to right in this chart and not the other way around. For example, before seriously considering a change in bottle washers (column 4), be sure you have decided to stay for some reasonable time in glass products (column 2). The column 2 decision here, of course, makes little sense unless we have some direction from column 1 regarding our interest so far as home delivery is compared to wholesale accounts.

Second, however, these engineers do not preclude some feed back from the columns on the right to those on the left. Thus, they caution that you must consider the possible far-reaching effects of a change, such as in equipment, in column 4, on columns 1, 2 and 3. Especially do they caution us on this so far as accounting changes are concerned.

This approach calls for two other analyses. First, we fill in the last column on the right--Rough Estimate of Savings. A little pencil pushing will usually show the economic feasibility of more detailed study on the group of changes indicated by any one column. These rough calculations will call for a revision of our list of changes and will pinpoint the areas for future work.

Put your emphasis where there is the best chance of its paying off. This may not always be on the first line. In some cases, it may well be the little changes of the fifth line that make the biggest over-all <u>net</u> savings. However, the point is this--you have considered the big changes and have ruled out their possibility as uneconomic. Now, you can undertake these small changes with some hope that this is the proper thing to do.

Accounting is the fundamental thread that weaves itself throughout business life of today. The quantitative precision of modern business will not tolerate out-of-date accounting. Thus, the last analysis involves the bottom line. This gives a summary of the accounting changes which must accompany all changes made above in any one of the columns. This assures us that the total effects of our proposed changes have been considered in light of our accounting system.

The economic leverage in capital use is often strong. The concept of leverage is driven home to us in elementary physics. We have the same type of thing in economics. We can illustrate the economic leverage which certain savings have on capital use. Let us consider labor savings (Chart 2). With a wage rate of $1.50, one hour saved each day has enough economic leverage to effect an initial capital outlay of nearly $4,000 This is economic leverage.

The difficulty people have in making a decision concerning industrialization often involves this problem of trying to add a very large number of quite small savings and compare this total against a large individual outlay as of a given time. It is a rather simple economic problem. Let me illustrate it by what we call the "Dirty Five." At Purdue we spell "dirty," d-i-r-t-i. This stands for depreciation, interest, repairs, taxes and insurance. If we want to know how much we can afford for a labor-saving piece of equipment as of today, we can probably do this by calculating our anticipated savings during a normal year's use on this piece of labor-saving equipment, divide this savings by 15, and multiply by 100. That's our answer. The reasoning behind this? We expect these five items annually to make up approximately 15 percent of the initial cost for the type of equipment which is normally used to save labor in a processing plant. Thus, if we divide this possible annual savings by the percentage annual use cost, we derive the initial investment possible for amortization over the life of the equipment. That is the reason for dividing by 15 and multiplying by 100. Economic leverage in capital use is important.

Each capital cost comparison may be unique. Beware of set answers on capital outlays. Our work with computer analysis and the newer mathematic techniques has dramatized for us why plants should demonstrate uniqueness and individuality.14/ Each plant is different. There is no set product line for all plants. There is no set labor schedule for all plants. There is no set equipment complement for all plants.

For example, a problem in equipment expenditure may involve savings in fat loss. It is possible to evolve guide lines for problems in this area, (Chart 3). A problem in equipment choice may involve bulk tank premiums paid to farmers for raw milk, (Chart 4), or the problem may involve management time, (Chart 5). Consider the differences in the answers you may get regarding capital outlay depending upon the characteristics of your particular problem. Consider the characteristics of your problem carefully. Don't look for a recipe; however, give some thought to the use of charts such as these to give guide lines for capital expenditures in various re-occurring problem areas. Also, you will find such charts an eye-opener for top management. They make accounting data meaningful and useful.

A capital cost problem usually presents several alternatives. Too often we approach a capital outlay problem as a race horse does the grandstand--with blinders. Widen your vision on capital problems. Usually, alternative solutions exist; choose among all relevant ones. Again, our newer management techniques have the edge; for example, in linear programming we get the one best alternative among the feasible ones.

Let us illustrate this point with a problem. Assume we have a choice of two packaging machines for producing a product. The cost of the machines, the labor bill, the capacity of the machines, the variable plant costs and the selling costs are shown in Table 2. Also, we know that we can sell 250,000 units of our product

Table 2. Which Machine to Choose--a Hypothetical Problem?

Information available	Machine A (10 yr. life)	Machine B (10 yr. life)
Initial cost	$48,000	$ 5,000
Labor cost (annual)	$21,000	$35,000
Output per hour	300 units	200 units
Variable plant costs	$.051/unit	$.023/unit
Selling cost	$.020/unit	$.040/unit
Solution calculation		
Annual capacity (1464 hours)	439,200 units	292,800 units
Sales that would be made	400,000 units	250,000 units
Sales income	$84,000	$70,000
Capital and labor costs	$28,200	$35,750
Variable plant costs	$20,400	$ 5,750
Selling costs	$ 8,000	$10,000
Net profit	$27,400	$18,500

for 28 cents/unit or we can drop the price to 21 cents/unit and sell 400,000 units. Which machine would we choose? If we calculate the answer as shown in the bottum of Table 2, machine A appears to have the edge and probably this would be a quite profitable operation. Would we buy machine A? If machine B were our only other alternative, probably we would. However, suppose you scouted around and found that you could buy this product custom packaged from a reliable source for 11 cents/unit. Then purchase of either A or B is out the window. The only question now is whether to buy 400,000 units or only 250,000. The 400,000-unit purchase appears to be the best bet. Of course, other factors are considered, but the point is, "consider all feasible alternatives in equipment purchase."

These alternatives run a wide gantlet in economics. We have what we call opportunity cost. Since most of us usually have a limited amount of capital to invest, we feel that the particular outlay should cover the cost of the opportunity which this outlay has elsewhere. For instance, in our problem we might net a greater return by producing an entirely different product. Or maybe this outlay should be put into general advertising, or into in-place cleaning, or even into the comptroller's salary! Or, possibly it should be saved for a future contingency. The point? A capital expenditure in equipment must be considered against the feasible alternative uses for that capital.

Summary

Many factors must be considered in an equipment outlay:

(1) Costs both absolutely and relatively must be considered. Shopping around is still good policy. Machines should be adapted to the job, not vice versa. Absolute costs may be quite high. Then costs relative to alternatives must be derived. These will be difficult to calculate. Often the indirect returns may be much higher than the direct returns.

(2) Modern management must be allowed to function. Managers today cannot be interested in the generalist concept--they are too young. They tend to be specialists. Therefore, they must have large amounts of timely, precise, over-all information on which to make decisions. They want the type of information which you can get with automatic control--both in data processing and technical plant processes. Their problems are large and complicated. Solution of them takes system and speed.

(3) Tradition must be broken. Too much tradition exists in the dairy industry, especially in quality considerations, long working hours, reverence of fat, artistic concept of products and processes, and sacred attitude toward the traditional institutions of the industry. Automation calls for considerable "eggheadedness." Acceptance of that is often a break with tradition.

(4) Resources must be adjusted as needed with improved productivity. We will see continued technological unemployment as a development of automation. This is part of our changing times. In numbers, we must expect a declining industry in nearly all respects. The importance of this attitude toward adjustment reminds one of the story told of Walter Reuther. Supposedly he was visiting a large automobile plant and was asked rather facetiously by the manager, "Well, Mr Reuther, how are you going to collect trade union dues from these machines?" Reuther replied, "How are you going to sell them motor-cars?"15/

(5) Automation can instill dignity into the modern concept of work. Mr. Magnus Pyke in his book, Automation, Its Purpose and Future, makes a forceful case that development of assembly lines was one of civilization's most degrading stunts. It reduced the tradesman from a man of respect for his trade to a man who was merely interested in getting his job over with so he could go out and live. Mr. Pyke says that as we develop machines to do the arduous and menial tasks of the day, man will regain his dignity and respect for work.

Thus many factors warrant consideration before investing capital in new equipment.

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Chart 1. Diagram Illustrating Interrelationships Involved in Various Management Decisions

Possible Changes In:					
(Column 1) Company Size and Merchandising Practices	(Column 2) Product Size, Kind, and Number	(Column 3) Materials Handling Methods, and Plant Processes	(Column 4) Plant Design, Equipment Selection and Layout	(Column 5) Work Methods	(Column 6) Rough Estimate of Savings
					Necessary Accounting Changes

Source: Cordially Yours, Newsletter, Edward B. McClain Co., November, 1957.

Chart 2. Labor Savings vs. Capital Outlay

How to use:
Find your time savings on the bottom of the chart, look directly above this to the diagonal line labeled with your hourly wage rate; then by looking directly across to the left of the chart you will find how much you can spend for labor-saving equipment and yet break even.

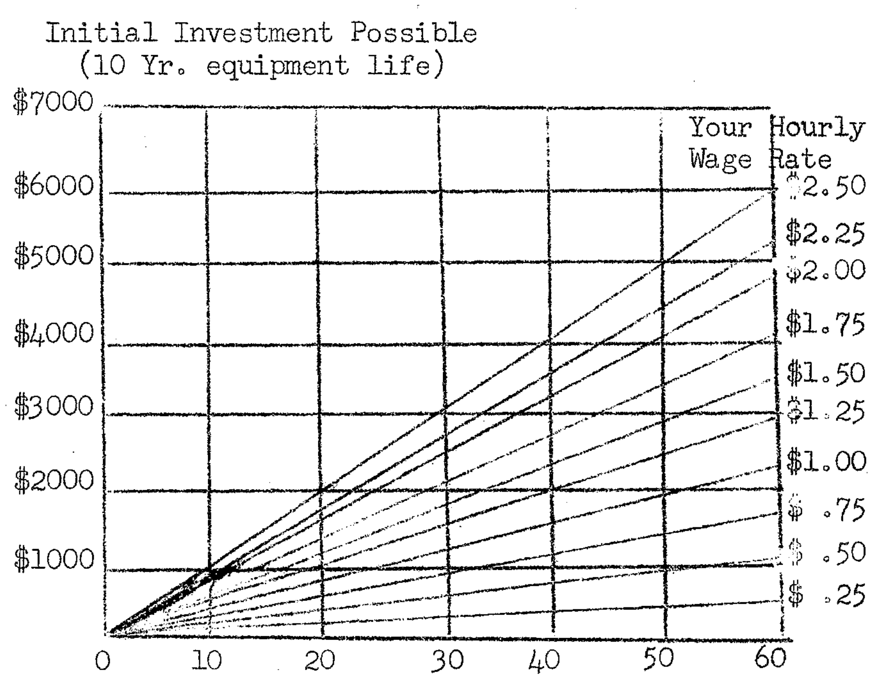
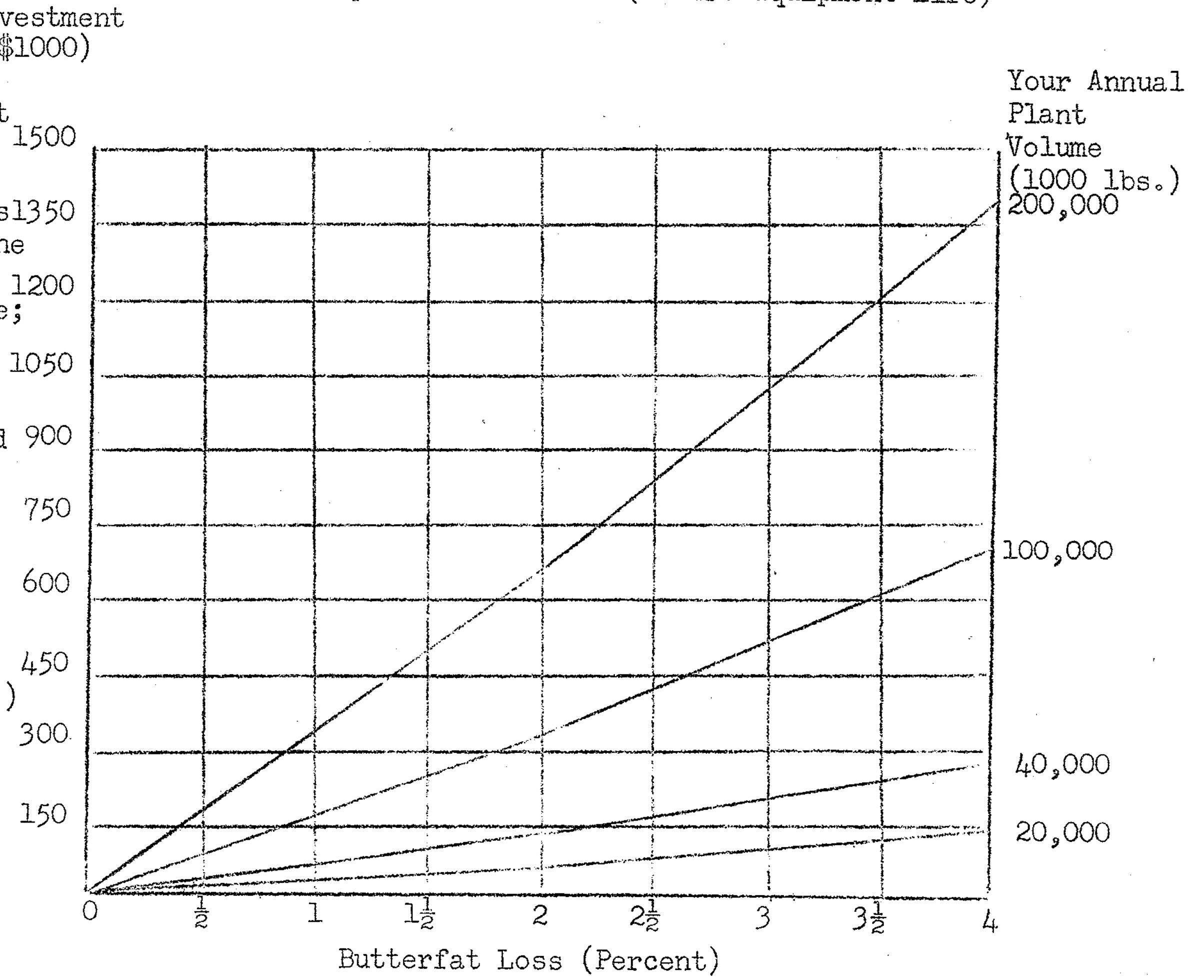
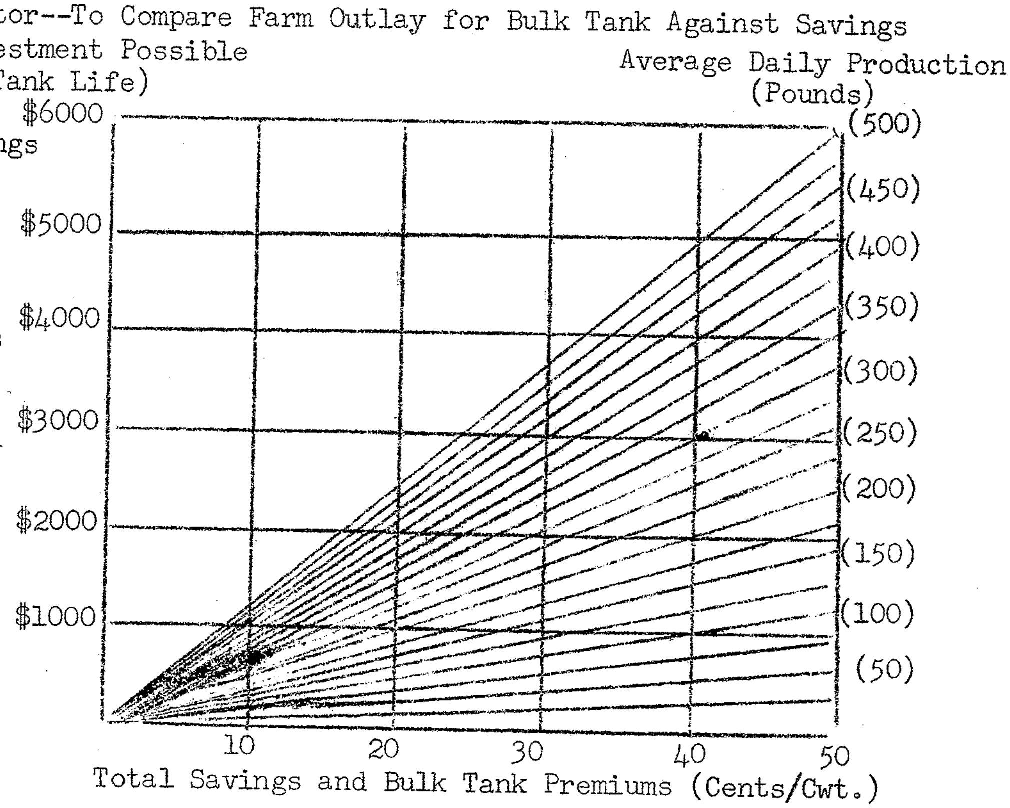


Chart 3. Butterfat Saved vs. Capital Investment (10 Yr. Equipment Life)



How to use:
Find your butterfat loss on the bottom of the chart, look directly above this to the diagonal line labeled with your annual plant volume; then by looking directly across to the left of the chart you will find how much capital investment you can make to avoid this loss and yet break even. (Based on data from Edward B. McClain Company, Memphis, Tennessee)

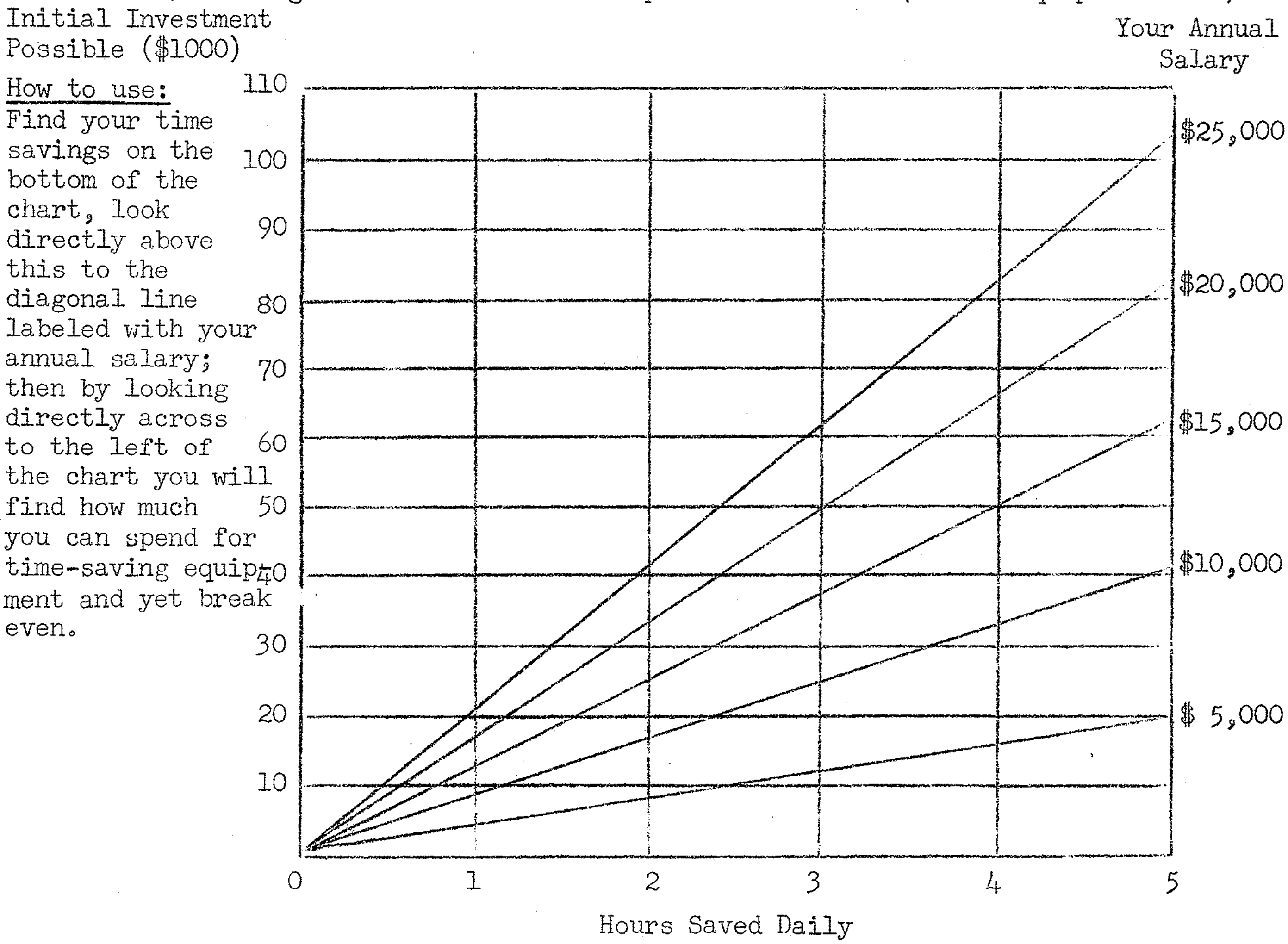
Chart 4. Bulk Tankulator--To Compare Farm Outlay for Bulk Tank Against Savings



How to use:
Locate at bottom the savings you expect and then look directly above to the diagonal line marked with your average daily production (in parenthesis) and then by looking across to the left side you will find the amount you can spend for your tank system and break even.

Source: Purdue University Extension Circular 421, 1956.

Chart 5. Management Time Saved vs. Capital Investment (10 Yr. Equipment Life)



How to use:
Find your time savings on the bottom of the chart, look directly above this to the diagonal line labeled with your annual salary; then by looking directly across to the left of the chart you will find how much you can spend for time-saving equipment and yet break even.