creased, releasing idle capital. This capital invested in turn becomes more productive through more rapid use.

The experience of the Watertown Arsenal where, upon the development of the system, the savings in one year resulting from the use of *surplus* stock amounted to $122,789.61 is typical of many, many plants in this respect. Similar instances could be multiplied almost indefinitely.

Looking behind such conditions we readily see not only the general disorganization and lack of knowledge thus typified, but also the large amount of capital tied up, the inevitable depreciation and deterioration of stock, and the general interference with the flow of work in productive processing. Add to this the elimination of the generally rapidly disappearing annual or semiannual shutdown for inventory taking, and the sources of the large savings become apparent.

Similarly, lack of the proper material at the right time is frequently the cause of expensive delays, postponed delivery dates and even loss of trade. Here again a certain amount of lost motion is unavoidable; but that four-fifths of the current inconveniences and losses experienced in material handling can be eliminated by detailed knowledge and proper planning is proved by those scientifically managed plants which have systematically attacked and regulated stores problems.

4. *Routing.* The decreasing of costs through the full utilization of equipment, of men, and of materials has been discussed. Another of the means by which this reduction is secured is the broader use and correlation of the business as a whole, including both the physical layout and the administrative control of the various component parts of the business.

Just what is meant by this topic, as well as its significance, may be illustrated by an example. In modern or scientific management a factory is looked upon from the strictly production standpoint as comparable to an automatic machine. Just why this conception is necessary may be seen from considering a compound full automatic consisting of five successive components, A, B, C, D, and E. As a piece is completed in any one of these parts, it is automatically swung around to be further processed in the next, and obviously that next must be free of its previous piece and ready to receive the new. Properly to set up such a machine of course requires detailed knowledge of and strictest attention to the time element for each head.

Now, a great many plants are being run today without an appreciation of the fact that the various departments of the plant as a whole are exactly analogous to the various parts of the automatic machine. The result is very much like the result would be if the automatic were set up either by one man who lacked or disregarded knowledge of all parts except that he was working on at the time, or by two men working independently without the knowledge of what the other had done, was doing or expected to do. In the case of the machine its various parts simply must be correlated and brought into proper synchronism by one man or by concerted action if by more than one; the same thing is less obvious but equally true in the case of the interdependent departments of the manufacturing plant if equally satisfactory results are to be expected. The "set up" and regulation of the various departments of most factories is an exceedingly complex and technical undertaking commonly defined by the term "routing," and not for a moment can any one foreman be allowed to run his department as he sees fit regardless of its relation to other departments and to the business as a whole. Hence the insistence in scientific management on a somewhat elaborate Planning Department, or at least on a central control of all activities which in any way have an interacting effect, and conscious and constant effort is put forth to secure this central control. As perhaps the finest example of the practical application of what has here been incompletely described, reference is made to the work of G. D. Babcock in the plant of the H. H. Franklin Manufacturing Company.[1] Suffice it here to emphasize the point that such control is the cardinal aim of every scientific manager, more or less perfectly realized in the best shops and secured through the systematic collection of all relevant information and through the practical application of this knowledge through measures collectively known technically as "control." This control is established through the proper use of such measures as standardization, time study, logical layout, careful routing of work and first-piece inspection, mnemonic symbols, the Order of Work and the Bulletin Board or its equivalent—all mechanisms which, in one form or another, have become integral parts of modern management.

5. *The Regularizing of Production.* Perhaps nowhere better than in the elimination of seasonal production and its attendant evils is the fact illustrated that what is of permanent benefit to the management

[1] Babcock, G. D., The Taylor System in Franklin Management.

also benefits the workmen, and *vice versa.* It would in fact in this case be difficult to say to whom the larger benefit accrues—to capital and the consumer through full and continuous use of a minimum of plant, equipment and personnel, or to the body of employees through fulltime employment and regular wages. Operation under conditions of seasonal fluctuations is a direct economic waste to the community, and that in very many cases it is not an unpreventable waste has been amply proved by those industries which have attacked and eliminated the evil. It would of course be folly in this case as in so many others to claim any monopoly of effort along this line for scientific management plants—the case simply illustrates what may be accomplished along so many lines by what scientific management does make it a *definite policy* to do: a policy of conscious and continuous *taking thought* of the numerous economic and social factors which make for permanent success.

C. IMPROVEMENT IN OR MAINTENANCE OF QUALITY

Next to increased output and decreased cost, the question of quality of output deserves attention, for obviously, while in cases improvement in quality may be justified even with decreased production and increased costs, the reverse would infrequently be the case.

That the increases in production under scientific management have not been secured at the expense of quality would seem proved, if proof were needed, by the permanence both of those increases and of the firms which have secured them, and will be questioned by no one acquainted with the facts. As a minimum, the maintenance, at least of the engineer's "good-enough-is-best" quality, must be the first concern of those who expect fully and permanently to benefit by modern methods of management. It has remained largely for the time study man and the instructor, supported by proper quality bonus and thorough inspection, however, to prove that as between speed and quality there is not only no intrinsic irreconcilability, but indeed that with intelligent handling an improvement in quality usually accompanies increase in speed. Just why this is so may be left largely to the psychologist—we are here dealing simply with the abundantly proved fact.

D. SPEEDY PRODUCTION AND ACCURATE DELIVERY

It must never be forgotten that any industry, to remain in operation, must produce a profit. When it ceases to do so it loses the support of the investor and must perish. As a corollary to this it must be borne in mind that investments in plant, in materials, and in labor become bills receivable only when the finished product is shipped from the factory door. This shipment date then becomes one of the vital points of contact between seller and buyer—the earliest point ordinarily at which *expense* becomes convertible into *profit.*

The quoting of a minimum time necessary for delivery after the receipt of the order and the strict adherence to the specified delivery date are two commonly unappreciated factors in business success. From the buyer's standpoint they are outranked in importance only by quality, and oftentimes not even by that quite frequently intangible and relative characteristic. As between two reputable firms whose selling prices are not at too wide variance, the duration and definiteness of the time for delivery become governing considerations, and not infrequently indeed delivery outweights both quality and price. The firm which, on a basis of knowledge and through the systematic measures of control discussed above, can accurately predict and rigidly maintain delivery dates is not only in an enviable position from the buyer's standpoint but may claim a distinct contribution to itself, to the buying public, and to the community at large.

For every cessation of processing operations for lack of material, every delay due to machine breakdowns, every loss of production due to discontented or absent workmen—every interference with high production from whatever cause in our factory—is an economic loss; every failure to meet scheduled and attainable delivery dates (regardless of whether thereby the purchaser's schedule is also upset for in any event *our* turnover is less rapid than it should be and our costs must be higher than they should be)—every performance below a standard which, as gauged by current and freely available modern practice, may be reasonably expected and justifiably demanded, is an economic loss which must ultimately be paid for by the consumer.

The quickening of production and the consequent increase in rapidity of turnover, the informed and detailed control of work in process, and, resulting from these, the quoting of a quick and dependable delivery date—these factors characteristic of properly managed plants together constitute a decided antidote to the tendency for ever increasing costs of living.