The point I wish to emphasize here is that, even when difficulties of inspection are surmounted, it costs money to do it, and there is, comparatively speaking, no way to get that money in the case of a hand-made, competitive product. If 500 workmen are employed where only 50 were formerly, then productivity increases approximately only in the ratio of 1 to 10, and the managerial overhead, for the function of inspection alone, increases in some greater ratio. It is manifestly more per workman employed, or per unit of product, if the explanation of the situation advanced above is sound.

But the business which is predominantly machine using (even a large and formerly successful one, too) often meets with serious difficulty on the score of inspection if it seeks to expand rapidly or, more especially, undertakes the manufacture of a new product. It is well known in engineering circles that it was precisely from this cause that many of the recent rapid expansions in war-order work resulted in small profits or no profits at all. Most concerns of all sorts and sizes are weak in the matter of dealing systematically with specifications, and there can be no proper inspection without an adequate handling of specifications. Specifications is a long word, and it is a long job getting them to meet fully all requirements. Having full specifications means deciding most searchingly, down to the minutest detail—nothing overlooked—all the questions pertaining to what you are going to make. Incredible as it may seem, this first question of all in production is frequently left unanswered before the task of production is begun. Men enter into contracts for millions of dollars' worth of shrapnel, for example; start the work, and even complete the shells, and *then* find out what are the specifications. This sort of thing both in peace times and in war times, is the reason for many a failure large and small in manufacturing.

Before leaving this topic it is to be observed that, on the other hand, it is waste, and great waste, to have specifications which are too fine. Only men of wide manufacturing experience can fully appreciate the extent of the loss, for example, from working machined metal parts to limits of a thousandth of an inch when limits of a hundredth of an inch would amply suffice. And in general there is great loss from over-elaborated and over-specific requirements. The purchaser should state clearly in his order the purpose of the product and the essential tests to which it must conform, and leave to the judgment of the experienced manufacturer the non-essential details of construction and methods of manufacture. There can be no proper economy in production otherwise. Governments are especial offenders in this particular matter, but it is common throughout all industry. This topic has such a direct bearing upon the leading idea of this article, the determination and observance of the does-not-pay point, that if space permitted it might well be elaborated. In passing, however, I will merely state that it is indeed a profound truth (the principle applicable to all the arts) that "Good enough is first-class engineering."

But to return to the case of Professor Dewing's small hand-product shoe manufacturer who undertook to swell like the proverbial frog and burst. What really happened that caused the catastrophe? Besides troubles connected with inspection resting on omitted or incomplete specifications, he also doubtless had his troubles with "control of materials." As long as everything goes on under the eye of the master, he keeps track well enough of stocks of materials which are getting low, both raw materials and partly manufactured parts. If a particular customer's order calls for an exceptionally large quantity of a certain material, he anticipates that irregularity in the "usage" and orders a sufficient supply in time; but once his shop grows into several semi-autonomous departments or "rooms," and he continues his old methods (as he usually does), he never again knows how he is situated. Each foreman has his own stock or reserve of materials, raw and partly finished, and even he usually knows only approximately what is in that stock. Things are constantly being bought or made which are on hand already. Moreover, there is loss from jobs being held up and from deliveries delayed by reason of every now and then being out of this and that material. If interruptions of production are avoided by carrying larger stocks, and at least knowing where things may be found, it means a greater investment for a given volume of output, and diminished profits. Under unsystematized control of material and inadequate routing the amount of "work in process" also, as distinguished from materials proper in stock, grows amazingly, and, in turn, makes the turn-over slow and lessens the profits. If our small manufacturer who has expanded into a large manufacturer intelligently seeks to avoid bankruptcy from this set of causes impelling toward bankruptcy, it can be only through installing a proper stores system with written "issues," "balance sheets," and "apportioning" (the device of stock room "limits" will not answer if there is irregularity in the usage). All of this

costs money, means a considerable increase of managerial overhead; and where is the money to come from to pay for it? So, unless he reverses his policy and curtails operations, bankruptcy is apt to come anyhow.

And the large business has this same sort of resistance to contend with also. The present writer knows of a large clock manufacturing concern which at one time had somewhere around a million dollars invested in stocks of material and parts (a large proportion junk) and yet was constantly making up fresh quantities of things it had already. The stores of this concern were scattered in all sorts of places, with no proper records of them, and many of them were, consequently, for all practical purposes lost or non-existent, except for the burden of investment. The "work in process" in some of the work rooms was piled to the ceiling and so congested the place that the workmen could hardly get in or out. In every manufacturing concern, old or new, large or small, the problem of control of material in its entirety—having things dependably where wanted at the time they are wanted—is far more difficult than the layman conceives. It is difficult to preserve a proper balance between different sorts of material, proper to varying usage and varying supply periods, that is, varying conditions of delivery by the suppliers. As regards specific "worked material," it is difficult to strike the balance between direct, technical economy in production and the indirect economy of the usage requirements. It is difficult beyond the imagination of the layman, even when the general balance of stores is economically maintained, to get the stores from the stores room to the machines regularly and without fall-down. There is the great problem of waste and the handling of necessary "excess issues" of all sorts, moreover, but I have no space to go into that.

Finally, let us consider briefly what happens with respect to the system of manufacturing orders and the hiring and discipline of the help, and the "organization" generally, when a small concern with hand-made product or machine-made product grows into a large concern. As long as the shop remains small, a crude system of command suffices. Most of the orders are given orally and executed by rule-of-thumb as to sequence and quantities. But what is chiefly before us now is the matter of organization, delegation of duties, placing of responsibility, the seeing to it that responsibility and authority coincide—the whole subject of control of men.

In most old-fashioned shops, large and small, the supreme government does not obey its own laws. An order, perchance reduced to writing, defining functions and responsibilities so that friction may be avoided and team play secured, is hardly issued before it is disregarded by the boss himself. The only way such a system works (and it does work in a small shop) is that despotism is tempered by disobedience all along the line. Much of what the "old man" orders is treated by his subordinates "with a wise and salutary neglect." They know the old man and they know the relative importance of things—what must be done and what need not be done. Contrariwise, the old man knows his men, and as long as he can directly oversee them, makes allowances for excusable fall-downs. He has, of course, at least fairly good judgment about men and processes, else he would not be the proprietor of even a small shop. He does not accordingly, discharge a man without sufficient cause, knowing well that, as a rule, the man he will get in his place will have the same or other natural failings, and, besides, there will be the time and cost of breaking him in to a useful knowledge of the habits and kinks of the shop.

But as soon as our benevolent and sagacious despot has to trust to lesser despots (often not so benevolent and sagacious) and cannot, because of the general growth of the business, directly supervise things as before, the whole crude scheme of organization and control of the human element falls to pieces. The loss from excessive labor turnover presently becomes very great; or, on the other hand, the labor turnover may continue small because bad workmen are allowed to stay under poor discipline. From excessive zeal for discipline (supported by absurd rules) or from undue slackness, either way the master is badly served by his subordinates, foremen or department heads. Foremen very often are foremen primarily because of their expert knowledge of some technical process (this, again, growing out of the old-style way of having such knowledge in people's heads instead of upon paper) and have little ability in handling help; and they have troubles of their own all the time from conflicting orders, from instructions misunderstood because inadequate, from all the many things that ever make the coöperating activities of men at best difficult. In a word, the crude, traditional system of command works as long as a shop is small, because of the accommodation from subtle understandings and personal adjustments, and because of the sheer driving force of one man, and he the proprietor. But