# STATISTICAL TECHNIQUES AND INTERNATIONAL TRADE

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# STATISTICAL TECHNIQUES AND INTERNATIONAL TRADE*

We are in a new industrial age. Almost every type of activity in production and distribution has been remade several times over, during the past 10 or 12 years, by new uses of statistical theory. The same statistical techniques that have remade marketing research have helped industry to achieve great increases in output without capital expenditure for new machines or for additional floor space. They have saved scarce materials, and have brought forth quality and uniformity not dreamed of a few years ago.

Everyone knows the impact of new statistical techniques on marketing research, and on production, quality, and uniformity of product, but few people have seen the day ahead when marketing research must be considered an important part of the statistical control of quality. The reason is that good quality and the right uniformity have no meaning *except with reference to the consumer's demands.*

International trade is an essential component of prosperity, political stability, and peace. But international trade depends not only on a competitive price, but also on dependable quality and uniformity, which in turn depend to a large extent on intelligent marketing research.

As most of you know, the simple statistical techniques of the control chart have brought forth in recent Japanese experience increases in production that range from 5 per cent to 230 per cent, *without expansion of plant.* Some firms are saving 10 per cent of their raw material, compared with their performance of a year ago. In some cases, the savings are much greater. The Fuji Steel Company reported they were able to cut their fuel bill by 29 per cent over their performance a year ago. All these achievements, and more, were reported at the convention held in Osaka the 22d September 1951 at the occasion of the Deming Award. In the mill of the Toyo Cotton Spinning Company that I visited during my work here during the summer 1951, three quarters of the girls who had been engaged in re-work and repair a year before had been moved into production, because of the improved quality of the product. Result: increased production, better quality, greater uniformity.

The gain in production and profit, although considerable from such achievements, are the least of the gains. The

* Excerpts from an address delivered in Tokyo the 14th January 1952 at a meeting of industrial executives sponsored by the Nihon Kezai and the Union of Japanese Scientists and Engineers.

gains from a better competitive position through improved quality and ability to lower the price are much greater, though more difficult to measure.

In these ways, and in many other ways, statistical techniques help greatly to meet the requirements for increased international trade.

Moreover, I cannot emphasize too strongly that increased use of statistical techniques can contribute vitally toward the maintenance of private enterprise, which must depend more and more on the continual improvement of the efficiency of production and of distribution, and on the continual improvement of the design of product, in respect to both quality and uniformity, to meet the changing needs and the demands of the consumer, wherever he may be.

In any manufacturing plant, raw materials come in, and product flows out. The raw materials may indeed be raw, or they may be sub-assemblies or piece-parts from another manufacturer. Eventually, the product goes to people who will judge it. The finished product may indeed be finished, and go to thousands or millions of consumers, or it may be raw material for a relatively small number of other manufacturers.

Anyway, there will be a chain of production, as illustrated crudely by Figure 1. By the statistical control of quality I mean statistical work applied in all stages of production, from raw material to consumer, and back again (see Figure 3). *The statistical control of quality is the application of statistical principles and techniques in all stages of production, directed toward the most economic manufacture of a product that is maximally useful and has a market.*

### *Benefits of Quality Control*

Through the full use of the statistical control of quality, from raw material to the consumer, a manufacturer may expect to achieve in some measure the following advantages:

1. Increased production, without investment in capital equipment or expansion of plant.
2. Better quality at lower cost, and better suited to the market.
3. Better uniformity at lower cost, and better suited to the market.
4. Savings on raw materials and fuel (a

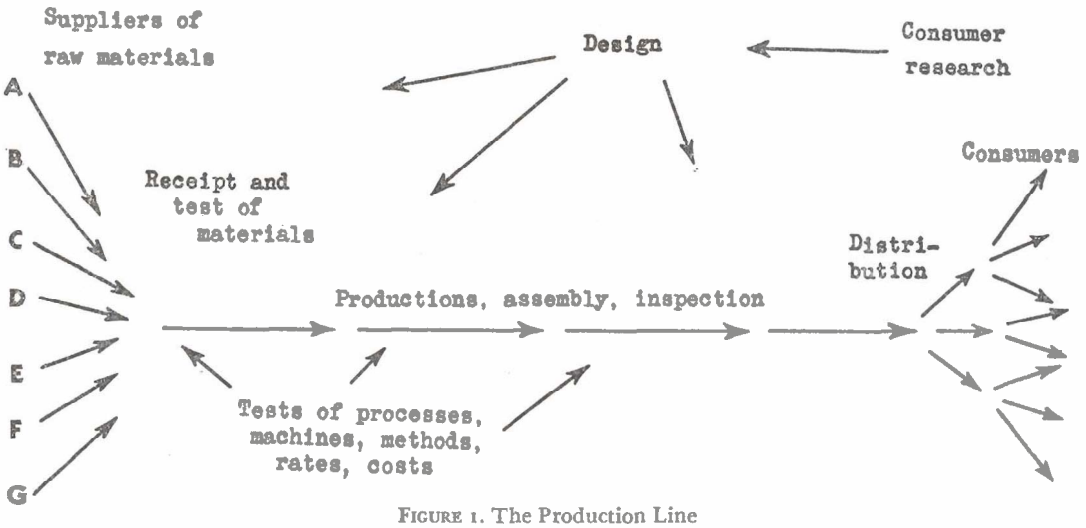


FIGURE 1. The Production Line

particularly vital advantage when scarcity of materials threatens production).

5. Better operating efficiency: (a) idle time of machines decreased; fewer rejections; less scrap and re-work; (b) better prediction of the market, through consumer research, by which the purchase of materials, and the expansion and contraction of the plant are carried out rationally, resulting in better economy than would be possible otherwise.
6. Decreased inspection, but with increased assurance of dependable quality.
7. Greater precision of dimensions when required (as when parts are to be interchangeable).
8. Design, better suited to the market, through consumer research, carried out by modern methods of sampling and design of experiment.
9. Stronger competitive position, through ability to meet world requirements in price, quality and uniformity.
10. Use of an international language by which to furnish statistical proof of quality and uniformity.

I must now ask you to think with me in broad terms just what good quality and economic production really mean. Some people think in terms of price alone. Others think in terms of quality alone. Some people think of economic production as saving 10 per cent in the cost of some operation. All these ideas are important, but we must go deeper.

In the first place, *price has no meaning except in terms of the quality of the product.* But that is not enough. *"Good quality" and "uniform quality" have no meaning except with reference to the consumer's needs.* This is why I must speak to you in terms of the entire production line, which begins with the producers of your raw materials, and ends with the consumer—the man who uses your product.

Incidentally, the consumer is more important than raw material. It is usually easier to replace a supplier of raw material with another one than it is to find a new consumer. And a non-consumer, one who has not yet tried your product, is still more important to you, because he represents *a possible additional user of your product.* For this reason I shall speak to you of *consumer research,* because I believe in the importance of consumer research to Japanese industry, particularly for its export trade.

*Importance of Consumer Research*

Some manufacturers think of consumer research as analysis of complaints from purchasers and users. Certainly, no one can deny the great importance of the analysis of consumers' complaints. No matter how silly and unjust a complaint may be, it is still important to a manufacturer, because it shows him *where he has failed in public relations*—that is, failed to make clear to the public just what quality they have a right to expect when they buy his product. A legitimate complaint helps the manufacturer to improve his quality, provided he has real quality control, and can be used by the manufacturer in tracing the cause of trouble all the way back to production and raw material.

But complaints are only a part of the problem of public relations. Complaints come from a very biased sample of consumers. Complaints do not provide communication with the other consumers nor with the non-consumer.

For reliable and economical communication with the consumers and non-consumers of a product, it is necessary to communicate with all users and non-users, through the medium of statistical tests and surveys. The aim of this particular aspect of quality control is *re-design* of the quality of your product (Figure 3); also *adjustment* of your plant, and *contraction or expansion* of the output of

particular products *to meet rationally predicted changes in demand.*

As the consumer has been left out of the chain of production in many parts of the world where industry needs expansion, I shall go into more detail on the subject.

The main use of consumer research should be to feed consumer reactions back into the design of the product, so that management can anticipate changing demands and requirements and set economical production levels. Consumer research takes the pulse of the consumer's reactions and demands, and seeks explanations for the findings.

Consumer research is not merely selling. Real consumer research, geared to design and production, is an indispensable modern tool for modern problems.

Consumer research is *communication* between the manufacturer and the users and potential users of his product, like this:

Manufacturer ⟶ ⟵ { The user and the non-user

This communication may be carried out reliably and economically today only by sampling procedures and tests designed according to modern statistical procedures. Through this communication the manufacturer discovers how his product performs *in service,* what people think of his product, why some people will buy it, why others will not, or will not buy it again, and he is able to redesign his product, to make it better as measured by the quality and uniformity that are best suited to the end-uses of the product and to the price that the consumer can pay.

Consumer research acts as a governor or servo-mechanism which by probing into the future market regulates both the design of the product and the amount of production.

In the olden days, before the industrial era, the tailor, the carpenter, the shoemaker, the milkman, the blacksmith knew his customers by name. He knew whether they were satisfied, and what he should do to improve appreciation for his product. With the expansion of industry, this personal touch was lost. The wholesaler, the jobber, and the retailer have now stepped in, and in effect have set up a barrier between the manufacturer and the ultimate consumer. But sampling, a new science, steps in and pierces that barrier. The manufacturer of today, but for sampling, would be out of touch with the people who use his product, or those who might use it.

Manufacturers used to think of manufacturing in three steps, as shown in Figure 2. Success depended on guess-work—guessing what type and design of product would sell, how much of it to make. In the old way, the three steps of Figure 2 are completely independent.

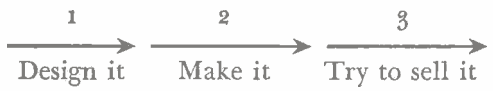


FIGURE 2. The Old Way

In the new way, management introduces, through consumer research, a 4th step, and runs through the four steps in a *cycle,* over and over as in Figure 3, and not in the line of Figure 2.

1. Design the product (with appropriate tests);
2. Make it; test it in the production line and in the laboratory;
3. Put it on the market;
4. Test it in service; through market research, find out what the user thinks of it, and why the non-user has not bought it;
5. *Re*-design the product, in the light of consumer reactions to quality and price;

Continue around and around the cycle.

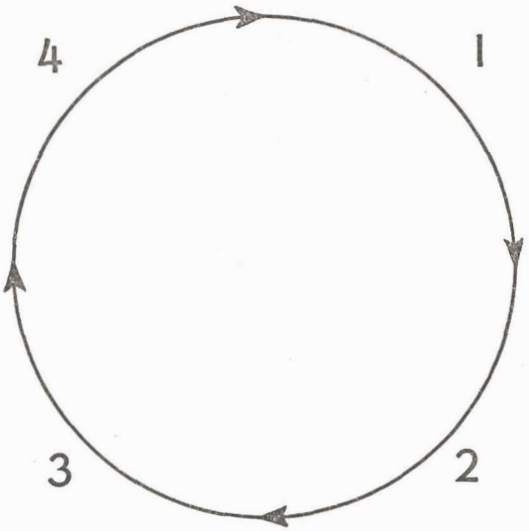


FIGURE 3. The New Way

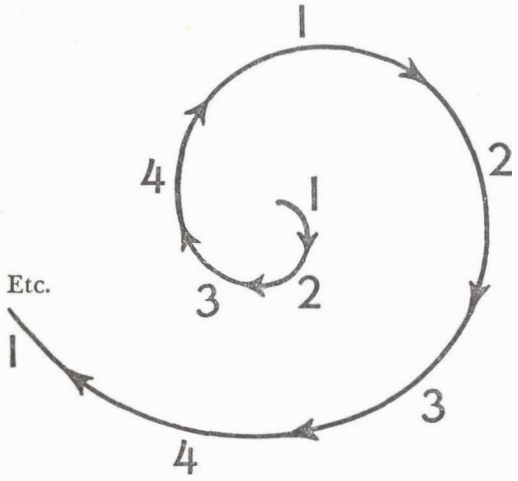


FIGURE 4

This 4th step in Figure 3 was impossible until recently—i.e., it could not be carried out economically or reliably. Intelligent manufacturers have always been interested in discovering the needs and the reactions of the user and of the potential user, but until recently they had no economical or reliable way of investigating them.

The 4th step, communication between the manufacturer and the user and the potential user, gives the public a chance. It gives the user a better product, better suited to his needs, and cheaper. *Democracy in industry,* one might say.

A still better way is to begin the manufacturing and marketing of a product on a pilot scale, and to build up its production on a sound economic basis, only as fast as market conditions indicate, re-designing the product from time to time in the light of consumer needs and reactions. The cycle is best taken on a spiral, as in Figure 4.

It is not to be supposed that the first three steps are the same in the figures that display the old and new ways. Consider, for example, design in step 1. Proper design today means not only attention to color, shape, size, hardness, strength, and finish, but attention also to a suitable degree of uniformity. Paradoxically, through the statistical control of quality, great uniformity often costs less than nonuniformity without statistical methods. However, with some products, extreme uniformity may be costly, and the manufacturer must be careful and not price his product out of the market. In consumer research, the 4th step, the manufacturer studies the requirements of uniformity, as well as of color, shape, size, hardness, etc. Then, through statistical procedures he achieves the required uniformity with economy, and his *control charts furnish proof of the uniformity achieved* in an international language, known and studied now the world over.

Consumer research is a continuous process, by which the product is improved continually and modified to meet changing abilities of the manufacturer and changing requirements of the consumer. Consumer research, used intelligently, enables the manufacturer to run his factory on an even keel, neither

greatly over-producing nor under-producing. He is not likely to let out 300 men one month and then try to recover them the next. Consumer research used to smooth out production is a powerful factor in economical production. Again, it is only one of the indispensable statistical tools of production.

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