a general or master chart, and then sub-charts executed for each general function or part of it. Figure 5 is a detail of general function No. 9 shown in Figure 4.

The sequence of passes or subdivisions thus determined would constitute the length of the path; this is conceived as taking place in a horizontal plane. The number of times the path has to be negotiated in its different phases is the frequency of the path; this assumes a vertical dimension in contrast to the horizontal reaches of its length. For example: The order for 12,000 units is decided and forwarded only once; therefore, the line of the path for this part of process would be a single line and its frequency would be equal to one. If, however, these 12,000 units are sold in dozen lots, then that part of the path portraying sales would be followed 1,000 times, and if they should be sold in single units, then the path would be negotiated 12,000 times. If each unit had 12 separate identical cylinders, then that part of the path portraying the boring of cylinders would be negotiated 12 x 12,000 or 144,000 times. The frequency or vertical dimension of the path at this point would be high when conceiving each negotiation, or traveling over it, as an addition to its height.

We understand that while the length of the path is constant, its frequency changes for its different functions. In order to audit process these entirely technical dimensions of its path must be found. Although the mere plotting of the length of the path produces clear visualization and is likely to show up duplication, looseness or unnecessary steps, the real interpretation is gained through the frequency, which has the greater significance. The path is therefore plotted in such a way that an entry of its frequency can be made for every function, and we may reflect that no clear conception of the path's frequency can be had unless the length is first established as a basis.

All the foregoing is only the method of establishing the facts, a segregation of the items involved in the process path, to make it ready for interpretation and measurement.

This record or plan of the path is something permanent; excepting improvement and development, it pictures the life of the institution. It shows where the path is straight, simple and direct; also where it is involved, joint and complicated. It provides an opportunity to find whether or not simplicity of path in one phase with a low frequency is being achieved at the expense of aggravated complications of the path in another phase with a high frequency. In other words, it affords an opportunity to judge the equitable division of responsibilities and establish the fact whether or not the path has bottle necks or represents a cylinder of even contour.

Furthermore, where a high frequency obtains, the length of the path—the distance between operations—should be short. Where operations are taking place infrequently, distance may be sacrificed. In order to gain concrete values in this respect, the floor plans and the plant plans must be consulted in conjunction with the chart of the path. It is cheaper to go the distance of 10,000 feet once than it is to travel 10 feet 144,000 times. Therefore, the balance is found between the distance traveled and the number of times it occurs (frequency) with due recognition of the prevailing circumstances. This applies to interplant shipments as well as to the trips a sales girl may make to the packing counter of a department store.

Also the path of process serves as a basis for ascertaining to what extent the best possible turnover is being achieved. Turnover means the time required for a manufacturing cycle to fulfill itself, and is the object of analysis from several angles. While other elements have their bearing on turnover, we hold that the path is the primary consideration, and that for best practical results other conditions should be regarded as secondary. As described above, the path is in one dimension a record of the chronological sequence of operations and in another a record of their geographical location. Referring to Figure 5, locations are shown from left to right, while time is considered to elapse from the top down. Where divisions in the process cause several operations to be done simultaneously, these appear in the same line, and where they are consecutive they are shown as progressing in time. Thus the process path assumes the proportions of a general route chart, presenting clearly to what extent operations overlap and offering the opportunity for summing up the time required for the entire performance with due allowance for these overlapping or simultaneous operations. While this element is usually pertinent to the work of the planning department, stores department and shop departments, where the product may be set in motion before all preparatory steps have been fully completed and where many parts can be worked on simultaneously, it may also apply to the major functions of advertising, selling and purchasing.

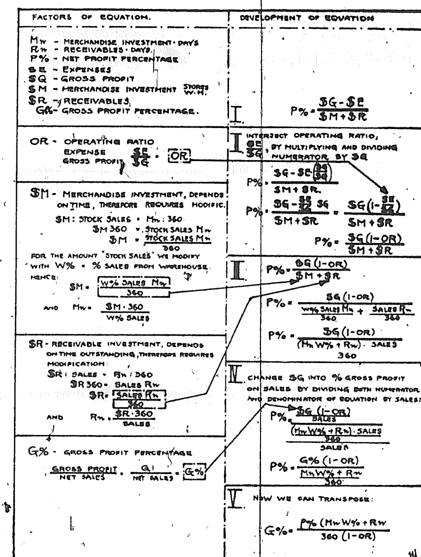

ILLUSTRATION NO. 6. SWOPE FORMULA. GEN. ELECTRIC CO.

One of the important aspects of process is the degree of specialization, that is, the number of divisions made in office and in shop. Sometimes lack of specialization proves bad economy and sometimes overspecialization of an industry has a ruinous effect. It would be folly to expect absolute accuracy in determining the appropriate degree of specialization of a business, yet the process path in its two dimensions—frequency and length—is the logical avenue of approach to this problem and secures tangible results without difficulty.

Specialization is primarily a condition of the length and the frequency of the process path; the modern conveyorized, highly dynamic methods of production and the development of special machinery demand it; economic interests always concentrate on a short broad path, in which as many operations as possible are carried on simultaneously for a quick turnover; they recognize the economy of small specialized operations against the complication of long, manifold operations. The frequency of the path decides how broad the path dare be in its horizontal reach, that is, the frequency of an operation justifies the degree of specialization provided for its performance on *the basis of the path in its entirety.* In order to gain concrete values in this respect, time studies are consulted and the frequencies of operations are multiplied by the times of their duration. In balancing, say, a high frequency of many small operations with a low frequency of a few long operations, specialization is either adopted or rejected. This applies to operations in the office and planning department as well as in the shop.

To sum up: the length and frequency of the process path are balanced in actual distance traveled and actual time consumed through turnover and specialization.

III. The Balance Between Static and Dynamic Elements

Just as the balance between organization and business problem reduces the conflict between the two dimensions of the process path, so the harmonies and balances created by the process path simplify the problem of finding the balance between the *static* and *dynamic* elements in a process. The method of attack for audit of process is such that that step or problem is first solved which means partial or entire solution for as many succeeding steps as possible. While this is true for audit of process in general, it is true for the balance between static and dynamic in particular, as their development depends entirely on the preceding steps developed.

We are aware that the terms *static* and *dynamic* in connection with a process of human activity sound difficult and abstract, but no other terms seem to express quite so accurately what we wish to set forth.

Let us reach a very clear understanding of the terms. In a water system the pipe lines, pumps, fixtures, etc., are the static element; the water flowing through them is the dynamic element. In a transportation system the tracks, bridges, stations, locomotives and cars are the static element; the passengers, the coal, ore and merchandise passing over them are the dynamic elements. In a factory, the buildings, machine tools, benches, forges, conveyors, trucks and chutes are the static element; the materials produced, worked and transported are the dynamic element. While these examples seem perhaps superfluous because of their self-evidence and simplicity, they are enumerated to make us understand clearly one complication involved; namely, that static and dynamic elements are found in relative stages, one within the