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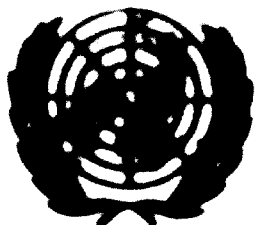
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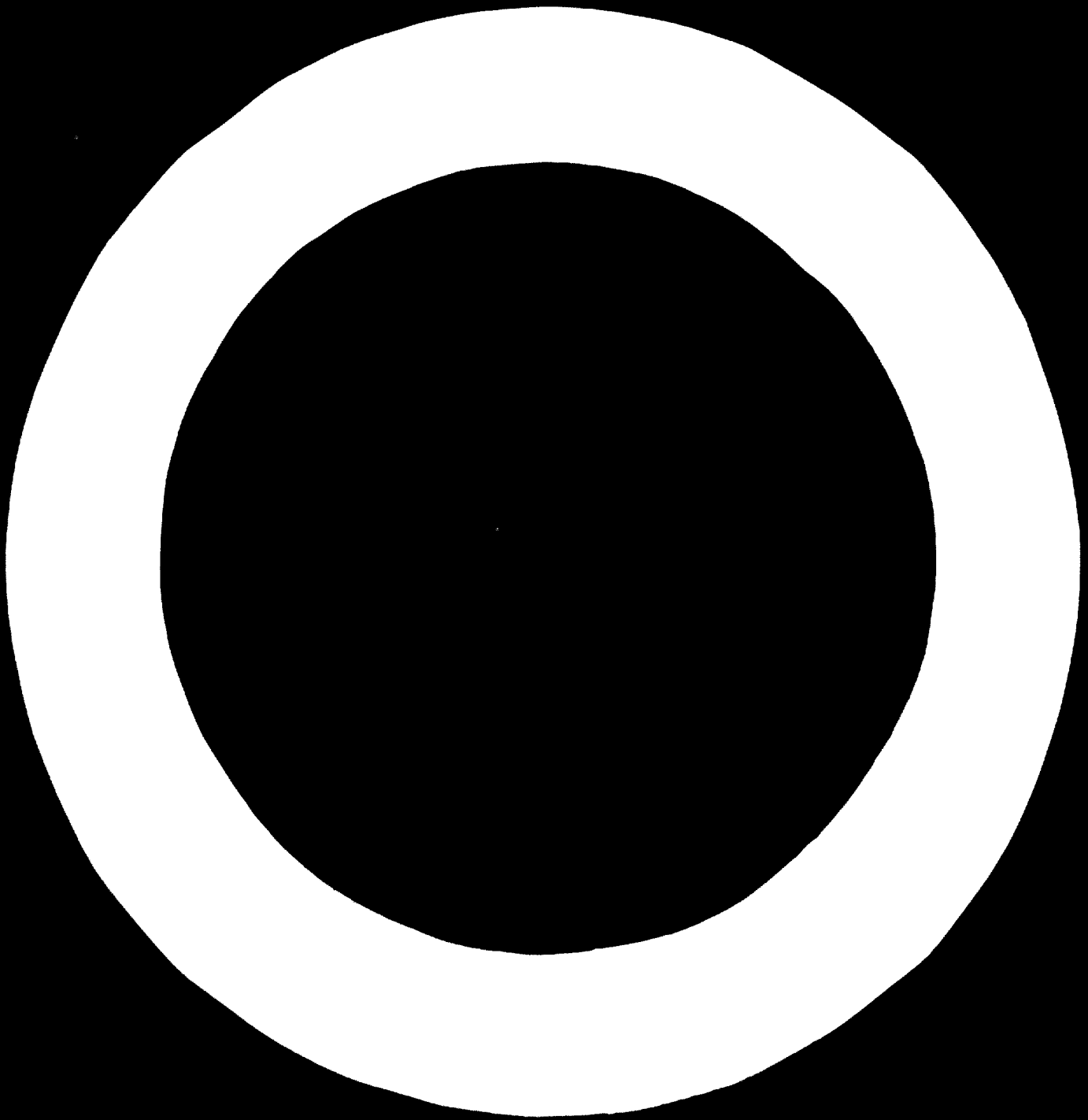
Training Workshop in Quality Control  
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**THE ROLE OF QUALITY AND QUALITY CONTROL  
IN INDUSTRIAL DEVELOPMENT**

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## 1. Historical

The majority of students of social sciences, whatever be their philosophical or political background, are generally unanimous on one point and that is that production techniques have been a primary factor in the development of any society.

Early forms of social organization had primitive forms of production, capable only of maintaining a subsistence level for the family or tribe. The gradual discovery of more advanced tools and simple machines and the corresponding division of labour led to a gradual increase in amounts of goods produced per head and, combined with other historical factors, to the development of later social forms based on slave labour and then on feudal production relations.

That quality control was not unknown to the ancient cultures we have evidence in the forms of drawings on papyrus, dating from the 15th century BC, showing how the blocks of stone hewn for building the pyramids were checked for dimensions and shape by kneeling Egyptians measuring with knotted string. In a sense, we might consider it a paradox of history, that today we are returning to this subject, no less pressing but with a completely different orientation, after thousands of years.

The technical developments of the middle ages (in printing, metallurgy, mining, metal-cutting, textile spinning, weaving and dyeing, in optics and fine mechanics, in power generation using water and wind mill and its use for grinding grain, wood-sawing, paper making, etc., in navigation and many other fields) led directly in Europe to the industrial revolution and to changes - over several centuries - from feudal to capitalist forms of social organization.

The twentieth century has been characterized by an unprecedented development of science and technology and corresponding revolutionary changes in methods of production. New inventions of science and technology have made possible the meeting of higher requirements of users and consumers especially with respect to reliability and performance of complex products such as aircraft, power plants, television, computers, space vehicles, etc. The expenditure involved is often of such a magnitude that much of it has had to be taken over, even in capitalist countries by the state (see e.g. [1]). Under these circumstances and by means of taxation and other fiscal measures, the rate of development of production and consumption is directly influenced by government policies.

This is no less true under conditions of newer forms of social organization, i.e. of socialist planned economies, where private ownership of the means of production has been replaced by some form of social ownership, either state or cooperative.

We shall now examine in more detail the effect that all these changes have had on the role of quality and quality control in modern social and economic life.

## 2. Changes in size and complexity of industrial enterprises and in economic organization

The changes in size and complexity of industrial enterprises and in economic organization which have taken place with the development of human society are directly linked with the changes from small-scale production for individual consumption to mass production for mass consumption [2].

The earliest industries and especially the crafts produced specific goods for specific customers or for direct consumption by the producer.

Gradual division of labour and specialization has led to a situation where the producer may be several stages removed from the consumer with wholesale and retail marketing organizations in between.

In addition, the modern industrial factory is a complex organization, often employing thousands and tens of thousands of workers, in which research and development, designing, process engineering, manufacturing, inspecting and controlling, selling and after-sales servicing are all separate organizational groups with corresponding difficulties in mutual communications and often with conflicting local goals and objectives.

This increase in division of labour and specialization has played a decisive role in the development of written specifications and standards, production and inspection procedures, job descriptions, etc. in order to ensure better communication. It has also necessitated the establishment of a delegated function of management, namely Quality Control, in order to synthesize and coordinate the efforts of all groups involved, so as to achieve production of goods and services ensuring full customer satisfaction at optimal social costs.

### 3. Specialization, technological progress, increase in productivity

We have noted how, throughout history, there has developed constant division of labour, from the separation of agricultural production into grain cultivation and animal breeding during the early stone age of nomadic tribes and early tribal settlements (ca. 10000 - 5000 BC), through the specialization of individual crafts from the iron and bronze age (ca. 4000 BC) right up to the middle ages, i.e. pottery, carpentry, spinning and weaving, building, black-smithing, shoemaking, printing, lock- and silver-smithing, clock and watch making, etc., etc.

Cooperation of merchants and craftsmen in the middle ages led to the first manufacturing industries and to the beginnings of the private ownership of the means of production based on the possession of capital, advancing finally to modern large-scale capitalist, cooperative or socialist production concerns.

The most significant aspect of the division of labour is its contribution to the increase in the productivity of labour, i.e. the amount of a product which can be produced per head of worker in unit time.

A special feature of industrial development in the 20th century and especially since the end of World War II is the tremendous technical improvement of production equipment, the investment of large sums of money into technical research and development, the discovery of new materials, new products and the increased mechanization and automation of production processes. These changes also have contributed to a greatly increased productivity of labour, to the reduction of much physical and manual labour and its replacement by skilled operators, supervising automated machines.

To demonstrate how division of labour and technological progress have both influenced the productivity of labour and the attitude to product quality, consider for instance the master boot-maker of a century or two ago, who performed all the tasks necessary for the production of a pair of boots for a specific customer. He decided on the shape and style, material, durability, how to manufacture, price and actually himself manufactured (cut the leather, sewed the boots, measured and inspected his own work), test fitted on the customer and conducted the sale of the boots. The productivity of labour was perhaps one pair of boots per week. There was no complicated problem of quality control. The craftsman took pride in the high quality of his work and showed a personal interest in the development of the art/craft.

Compare this example with the situation in the second half of the 20th century, when an operator sits at his machine on the production line in a shoe factory and performs monotonously one single operation necessary for the production of a pair of shoes. Combined with modern production equipment, a group of 20 operators can produce on such a



production line a minimum of say 4000 shoes per week, i.e. 100 pairs of shoes per operator per week. It is clear that specialisation together with new technological equipment raises labour productivity by several orders.

From the point of view of quality control, the operator on a mechanised shoe production line still has an idea of how his work influences the performance of the final product, the pair of shoes. But in the case of many other products, the operator on the assembly line or in the machine shop, supervising a row of automatic milling machines, has very little idea of how his work contributes to the performance of the final product. As a result of high specialisation and division of labour, there has unfortunately been a gradual decline in the interest of the operator in the quality of his work. This has presented one of the sociological problems of modern quality control.

The higher productivity and higher quality of products in large-scale as compared with small-scale agricultural and industrial production is a well-known fact in the developing economies of the African countries. This will be demonstrated by some examples.

#### 4. Mass production of goods and services

The great increase in productivity brought about by specialisation and technological development has naturally led to the possibility of mass production of consumer goods at prices which are within the reach of the majority of the population. The result in many countries of the world is now mass consumption. For the producer of a particular product this entails the need for market research studies in order to make correct decisions on what grade and how much to produce for specific consumer groups.

Further problems have arisen in connection with mass distribution especially in the field of advertising, packaging, instalment-buying and after-sales service.

The uncontrolled efforts of industrialists to produce goods in ever increasing quantities have tended to jeopardise a harmonious development in some capitalist countries. In the case of many products, a saturation point has been reached. At the same time there has arisen a growing need for various "non-manufactured" goods - for social services such as housing, public transport, power, health and education services, etc. These fields are demanding a higher and higher proportion of a country's gross national product and generally fall under the state administered sections of even capitalist economies.

Part of a modern state's government policy must be to decide on the extent of social services as compared to mass-produced consumer goods and ensure the stability of the economy by taxation, interest rate, state planning and other means.

With the extension of mass production and mass consumption, not retail price but quality and reliability of products become the decisive factors in successful invasion and maintenance of a certain market /see also [3]/.

### 5. Interchangeable manufacture and flow of goods between manufacturing economies

A further result of technological progress is the increasing complexity of industrial goods and equipment, higher technical parameters, greater precision and accuracy and higher degree of automation.

Meeting these demands under conditions of mass production processes requires larger and larger sums of money for capital investments and long time commitments. This in turn has led to an ever increasing concentration of capital and as we saw above to an increasing size and complexity of individual industrial concerns. At the same time, specialisation has gone so far that in large corporations one central plant is often assembling the final product and is receiving the component parts from a number of auxiliary divisions or sub-contractors, all of which

must deliver parts manufactured to specified tolerances, which will enable interchangeable manufacture. This tendency has even over-stepped national boundaries and has become a common practice in international cooperation and economic integration.

This development has benefited smaller firms in the sense of stabilising their sales forecasts and has done much to improve quality by the need for clear, scientifically-based specifications. It has also given impetus to the development of statistical sampling inspection schemes which have greatly raised the efficiency of vendor-vendee relations.

The ultimate aim of the manufacturer is to maintain his competitive position and extend his market without endangering it. He can do this only by devoting increasing attention to the quality and reliability of his product while at the same time reducing losses due to scrap, defectives, repairs and customer complaints.

#### 6. "Quality makes sales - sales make jobs"

The above quotation from J.M. Juran [2] was one of the slogans used in an employees contest in the Highland Sanford Carpet Company in 1948. J.M. Juran mentions it under one of the headlines of fundamental changes which are necessary in modern industry if quality is to be achieved at economic costs.

In this connection, it is essential that every employee understand the importance of the quality of his company's product for his own well-being. If he works carelessly, the company loses - to his own detriment. He may tomorrow, as a consumer, buy the inferior product for which he was personally responsible today as a producer. More serious is the loss of reputation which his company suffers due to his low standard of work performance and the inevitable consequence of a decline in the economic prosperity of the company.

The question of personal motivation in quality performance is one

of the key problems of modern quality control which will be dealt with in one of the later lectures. In essence, it requires that each employee understand the job that is required of him, and participate in the setting of specifications for the job and is provided with the knowledge and the means for carrying out the job. In the case of difficulties arising, he should have the opportunity and be encouraged to investigate and remove the causes of the trouble insofar as they are within his control. Typical motivational forms are the quality control circles in Japan, the Zero Defect movement in the USA and the Karatov system in the USSR.

#### 7. development of quality control with industrial development.

A.V. Reigenbaum [4] characterizes the development of total quality control as having taken place roughly in five stages from the end of the 19th century /see Fig. 1/.

As we saw earlier, certain elements of quality control are to be found in the simple production activities in antiquity /e.g. inspection of blocks for the pyramids/.

P.S.P. Lerner [5] has made an interesting study of the inspection of quality of textiles in mediaeval pre-industrial times. It follows from this study that, in the textile industry at least, quality control developed as part of a series of regulations with political and economic aims relating to town life /collection of sales taxes, fines for faulty fabrics, regulation of number of craftsmen, number and size of individual work-shops, etc./.

According to W. Juran [6], interchangeable manufacture of machined parts is traceable to the end of the 18th century (ca 1769), which means that at that time measuring instruments were already in current use. The micrometer screw was developed in 1817. Up until the World War I was there a marked increase in the precision of measuring instruments.

We may turn now to the evolution of quality control in the 19th century. In the 18th century, a craft quality control was prevalent in manufacturing shops. This was the case since generally one worker or a small number of workers was responsible for completing the manufacture of the whole product. The operator therefore checked the quality of his own work.

In the first two decades of the 20th century, we have an advance to foreman quality control. During this period, a new factory organization was developing fast with considerable numbers of operators performing similar tasks grouped together into shops, supervised by a foreman who was responsible for the checking the quality of their work.

In the 1920's and 1930's, we see the development of a special profession of inspectors checking product quality against specifications during and mainly after the completion of certain phases of the manufacturing process. These inspectors formed a special organizational group in industrial enterprises under a chief inspector. They generally worked on the basis of 100% inspection of manufactured products.

With the mass production requirements of World War II, statistical methods were introduced on a wide scale in order to improve the efficiency of previous inspection methods. Statistical quality control provided inspection staff with the means of verifying the quality of batches of products on the basis of a small sample instead of using 100% inspection, and also of statistical process control during production which is highly preventive compared even with sample inspection of whole manufactured batches.

The effectiveness of statistical methods in quality control was further improved by the new concepts of total quality control formally propounded by A.V. Feigenbaum in the early 1960's and essentially implicit in the previous theoretical work of other specialists, as for instance

of J.M.Juran and also of the founders of statistical methods of quality control, e.g. W.L. Shevhart, Dudding, Deming and others.

The above-outlined development of quality control does not mean that each phase superseded the previous phase. On the contrary, each new development improved the efficiency of the previous activity. Present concepts of total quality control put into proper perspective each of the earlier phases. Present trends, in fact, indicate a return to the concept of operator self-control and motivation in quality which lead to a reassessment of the importance of operator control.

Mr. J.D.N. de Fremery has proposed a different classification of QC activities. He suggests that the period till 1960 was devoted mainly to methodological problems of QC. From 1960 till 1965, the attention turned to organizational and management problems and from 1965, he believes the main trend to be motivational.

A further development of the past decade in all countries of the world is the increasing extent to which state authorities are intervening and influencing the QC policies of industrial enterprises. We shall examine this trend in more detail in the next section.

#### 8. Survey of development of quality control in different countries

We shall now look briefly at some of the most characteristic features of quality control development and practice in different regions of the world.

Best known is the situation in the United States of America where the American Society for Quality Control (ASQC), founded in 1946, has helped to create a strong concept of professionalism among QC specialists. Educational and training programmes of the ASQC and also of universities and technical colleges have concentrated on the formation of Quality Control and reliability engineers, with much less emphasis on the training in QC methods of managers, supervisors or specialists of other functions. In industry, there tends to be a strong, central QC department

with highly trained specialists, but difficult to coordinate with the function of other departments.

There is no doubt that a very positive role in the introduction of modern QC techniques into American industry was played by various government organizations (mainly military) through their standards, specifications and conditions for allocating contracts to industry.

In Japan, on the contrary, the success in product quality has been due in the main to a mass educational programme of training, organized by the Japanese Union of Scientists and Engineers (JUSE) for all functions (Marketing, Technical, Manufacturing, etc.) in the concepts and tools needed to achieve quality. This training has not been limited to QC specialists, but has been extended to all levels of managers, supervisors and right down to workers on the shop floor.

A special feature of QC in Japan is the wide-spread QC Circle movement, involving the whole of factory personnel in quality problem solving. In industry, no strong QC department exists. Instead, coordination of QC activities is attained mainly by line supervisors and managers through the regular chains of command. The role of QC specialists is one of auditing and consulting. In Japan, the Japanese Standards Association has also cooperated with JUSE in introducing modern QC methods into industrial practice.

In Western Europe, formal training in QC methods has not proceeded as far as in the USA or Japan. neither has the total quality control concept, apart from a minority of progressive industrial firms. Despite the very valuable work of the European Organization for Quality Control and the corresponding national organizations, much emphasis is still placed on the role of inspection departments and the use of statistical methods. J.M.Juran has stated that the prevailing co-ordination is effected by experienced and (usually) dedicated amateurs [6].

Since the 1930's, national standards organizations in Western European countries have been active in propagating and recommending scientifically based methods of specifying, testing and controlling quality characteristics of manufactured products.

A new element has entered into European QC practice in recent years in the direct interest and participation of state authorities in improving the quality of products manufactured within their country. This is particularly evident in the planned economies of Eastern Europe including the Soviet Union. Recent economic reforms in these countries are aimed at supporting a progressive technical policy, improving the role of central planning and creating more favourable conditions for the activity of industrial enterprises, especially with respect to improved technical level and quality of products.

In order to implement the national quality policies, a central body has been formed in most countries of Eastern Europe. One of its main functions is the testing, approving, evaluating and marking of selected products with regard to quality and price-setting. In most cases this body is closely connected to the standards and metrology organization, so that an integrated approach to the specification of parameters of key products, their attainment in production and measuring and testing is ensured.

Some details of the state quality control systems in operation in the USSR, GDR, Poland and Czechoslovakia will be given.

The situation in the developing countries such as India, Africa, South America has no uniform pattern. The QC methods adopted reflect to a large extent the experience of QC experts invited as lecturers or consultants and the practice of industrially advanced companies which have established branches in the developing countries.

There is evidence, for instance, of considerable success in raising



the productivity of Indian industry (by 10 to 40 percent) through the introduction of statistical methods of quality control. This experience has been gained due to the pioneering work of the Indian Statistical Institute, supplemented by United Nations Technical Assistance Programmes in 1952-3 and 1958-9 [1].

The industrial branches which have gained from the application of modern QC techniques, according to W.R.Pabst, Jr. [1] include the production of sewing machines, jute products, foundry castings, bicycles and accessories, glass, pharmaceuticals, pottery, shoes, aluminium plating, electric lamps, cigarettes, biscuits, soap, cement, textile machinery, telephones, typewriters and others.

If a similar improvement in the productivity of industry in the African countries resulted from the seeds of knowledge planted during this training Workshop in quality control, then it will certainly have fulfilled its purpose.

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### Evolution of Quality Control

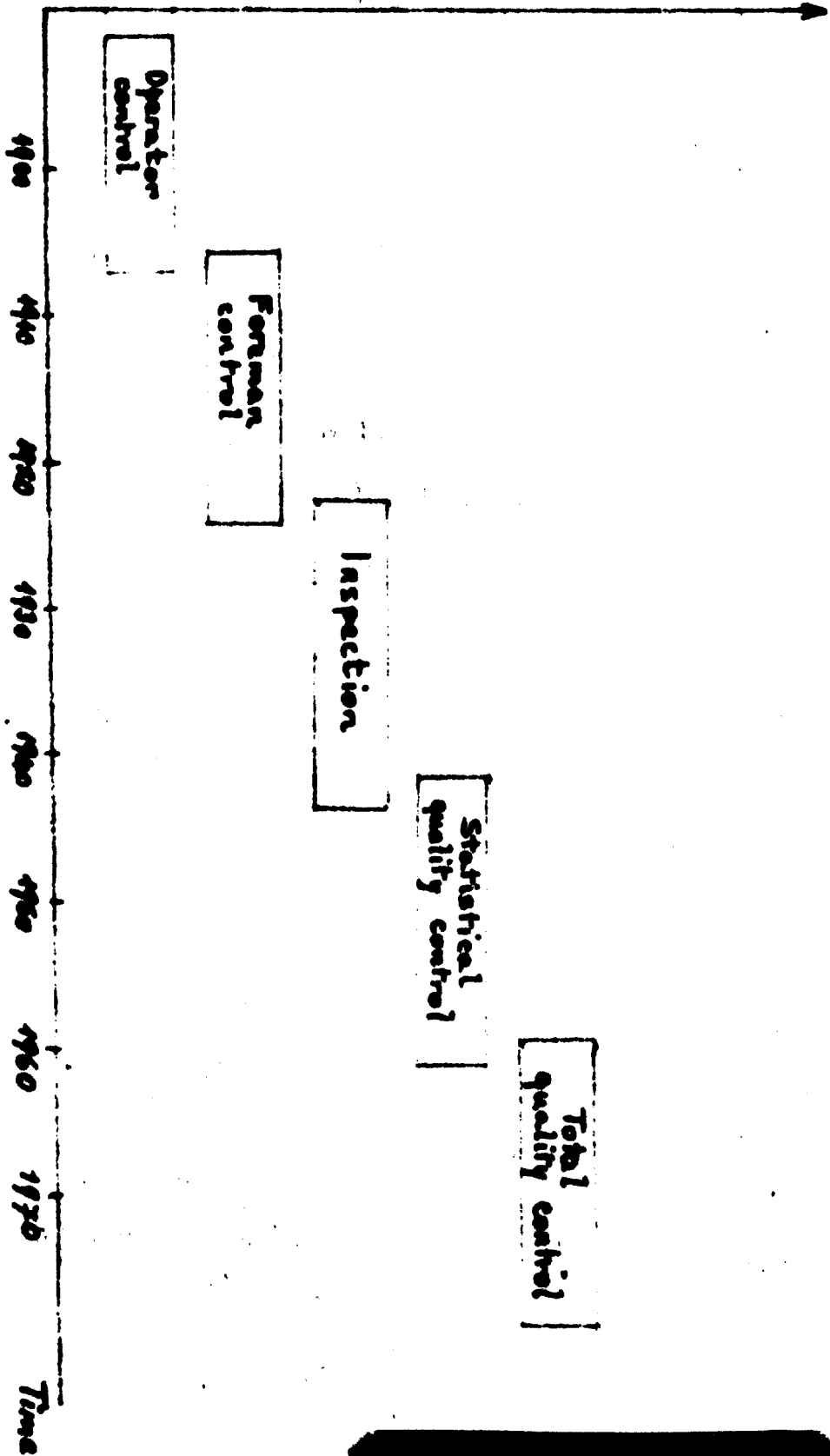
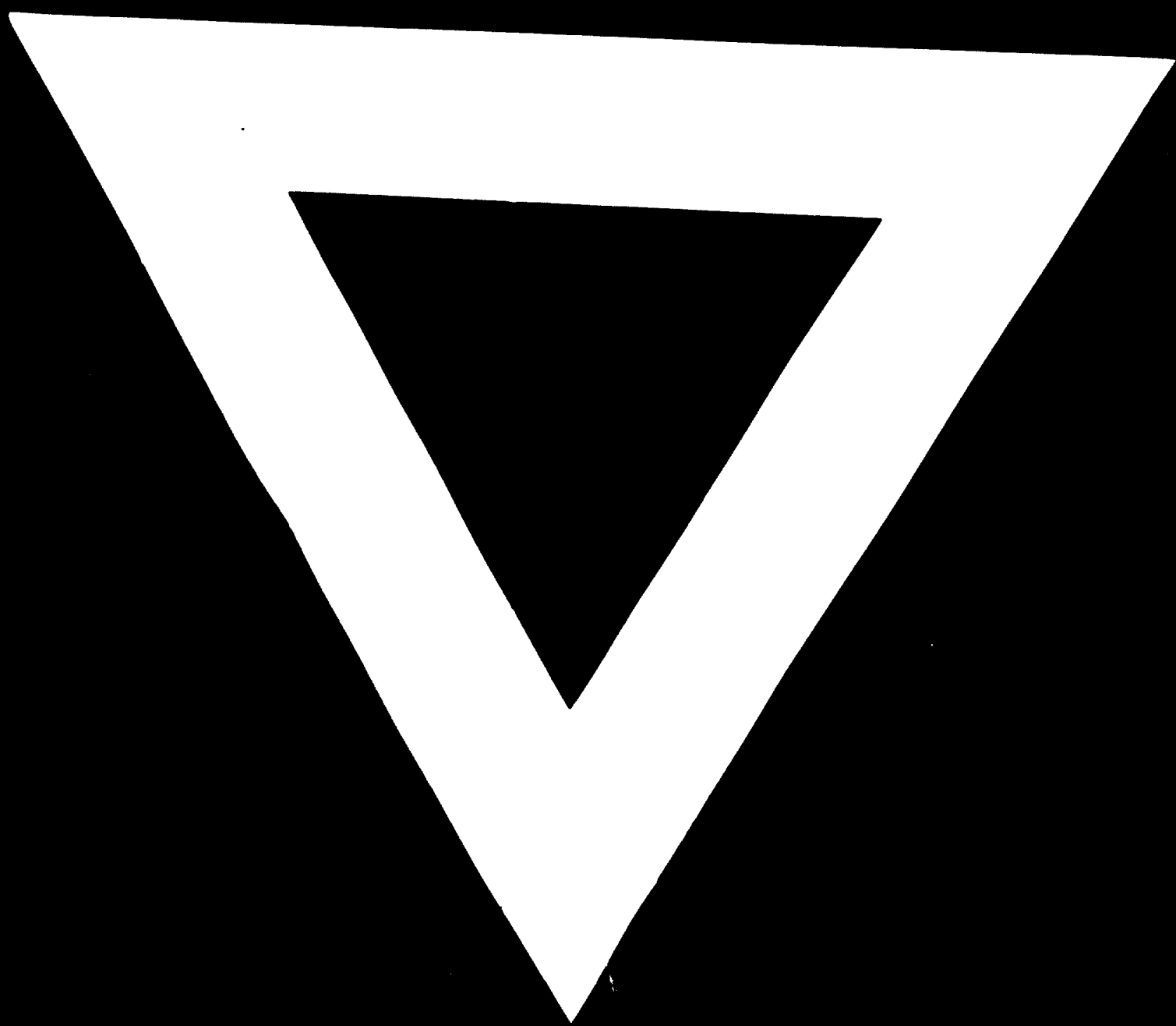


Fig. 1. Schematic representation of evolution of quality control.





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