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INTRODUCTION OF NUMERICALLY CONTROLLED MACHINE
TOOLS IN THE COUNTRIES OF THE REGION ^{1/}

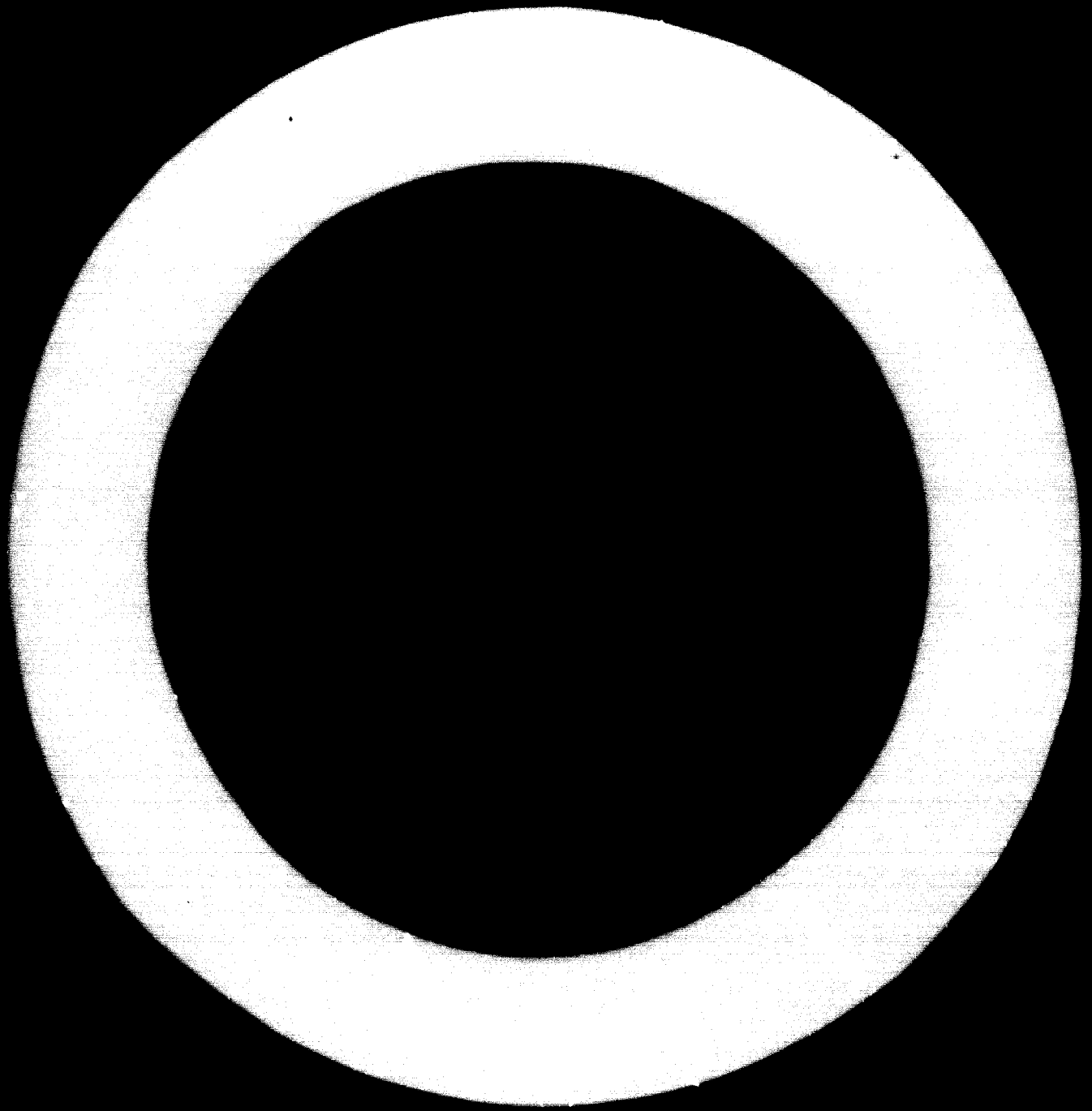
by

R. Chioccarelli
Olivetti Argentina S.A.
Buenos Aires, Argentina

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We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche.



It seems to me that a discussion of the use of numerical control (NC) in the less developed countries can be based on the situation in Argentina, because the conditions of Argentine industry seem to be sufficiently typical of those countries which are seriously committed to the difficult task of industrial development.

To give a picture of the existing situation in the engineering field, we could divide up the various types of plants on the basis of the following illustrative outlines:

Plants which are subsidiaries of large international concerns;

Domestic plants which use know-how or licences from international concerns for production purposes.

Plants which have developed a production system of their own;

Workshops which produce parts or components of subassemblies for the plants mentioned above on a discontinuous and varied basis in line with the requirements of the market.

The plants in these categories work at every production scale from large series of thousands of units a day to the manufacture of single pieces.

Thus we have plants producing bolts or sealed units for refrigeration or calculating machines or clutches, alongside activities auxiliary to the automotive industry, the manufacture of finished cars, the production of combustion engines or of conventional machine tools and the production of dies or special machine tools, to give an idea of the range of activities and production scales.

This picture shows that all the alternative possibilities exist for the use of NC, since there is a practically complete range of engineering activities and consequently many of the conditions necessary for the introduction of NC exist.

In the case of other countries, whose industrial activities are less comprehensive and diversified, there are other factors which indicate the desirability of using NC.

The main factor is the production scale, because it is nearly always a question of small or medium-sized series, and this is the main economic consideration in favour of the use of NC.

Here I think it would be useful to recapitulate the advantages of NC in general terms.

The first advantage is the universality of its application. NC can be adapted very quickly from one type of production to another, without the need for much preparation of the machine and without the use of complicated devices. Consequently, the same NC machine can change continually from one type of production to another without any decline in economic efficiency. And each time the batch of pieces is repeated, there is the certainty that the new pieces will be the same as the preceding ones.

This fact, together with an accurate knowledge of production times, makes it possible, with suitable planning, to know beforehand when each batch of pieces will be finished, with great advantages from the point of view of fulfilling commercial undertakings.

Moreover, with the NC machine one can move very fast from the designing of a piece to the machined prototype and thence to serial production, thus permitting the production of new pieces to be begun without loss of time in the preliminary stages.

We must also stress that the NC machine remains productive even when the series of parts programmed have been completed. These parts may be needed as spares at any time, and the NC machine can begin to produce them very quickly.

These considerations, together with the smaller amount of space occupied (an NC machining centre replaces three or four conventional machines), the possibility of producing very small batches of pieces without the quantity effecting unit cost, and the facility of and reduced need for controls, are all advantages of NC from which the countries with which we are concerned can fully benefit.

There are also other indirect benefits derived from the use of NC.

We all know that the organization of production in small industrial concerns is generally rather rudimentary.

There are no time and method offices, quality control is improvised, and the whole system of production is organized on the basis of the drive and enthusiasm of those running the plants rather than on the basis of carefully considered norms.

The introduction of NC in a shop of this type naturally makes it necessary to approach the work differently, to consider times, to programme production, to concern oneself with the tools, etc., thus bringing a new element of order into production which will gradually spread to all the other sectors.

This means that for the new users of NC not only are there the advantages offered by the machine in itself but there is also the incentive to organize in a more modern and efficient manner.

Before giving some examples of points at which it would seem to us most desirable to begin introducing NC in the Latin American countries, we think it would be useful to give our opinion on the type of NC best adapted to industrial conditions in these countries.

We would begin by saying that, for the moment, it is premature to speak of NC machines on line with a computer (direct numerical control) or of adaptive controls. In other words, it would be best to forget, for the moment, the new developments displayed at the latest international machine tool fairs.

It is essential to combat the false notion that NC is extremely complicated, that only large enterprises can use it, and that it requires an infrastructure and an organization which is within the reach only of multi-national firms.

The use of an NC machine is never more complicated than the use of a conventional machine tool carrying out the same operations.

And to demonstrate that NC is in practice within the reach of the industrialists of our countries, the most appropriate course would be to begin with point-to-point NC machines or continuous-control machining centres, programmed manually.

For the moment, to speak of languages, software for the use of a computer or NC machines on five axes for milling in space might perhaps frighten the Latin American industrialists.

Programming must be seen as what it really is, namely just another type of activity within the reach of any technically trained person working in a time and methods office.

Or a new way of handling a machine which any operative who wishes to learn can master.

In other words, we must show with facts that the use of NC is simple, and we shall be able to do this by teaching technicians to programme, a task much more simple than teaching an operator to use a jig boring machine.

Once the fear of programming has been dissipated, the battle for NC, it seems to us, can be considered practically won.

The technicians, production chiefs and managers of engineering concerns will then begin to consider the possibility of replacing their radial drilling machines equipped with guards and devices by a point-to-point NC machine. And those with pieces to be machined on several faces, with various operations, will consider the desirability of employing, instead of a boring machine, a milling machine and a drilling machine, an NC machining centre which can bore, mill, drill and thread without the piece needing to be moved.

And those who work with centre lathes, using various devices to ensure that all the pieces remain within the required tolerances, will begin to consider the desirability of using an NC lathe.

Once interest in NC begins to take hold among industrialists, other changes which NC brings with it will gain ground.

It will be possible to organize the production of the NC machine in liaison with the person who will be responsible for the programming.

The work of this machine will thus be organized methodically and, as a result, the work of other machines which carry out operations preceding or continuing the NC operations will also be systematically organized.

In consequence, accurate data will be available on production times, rejects, controls and, hence, costs.

All these improvements are achieved without additional investments and without new staff, simply as a result of the stimulus provided by the NC machine in the direction of systematic organization.

Another positive consequence of the use of NC in a shop relates to the tools.

It is the NC machine which removes stock during the greatest amount of time, because positioning and tool changes are very rapid.

Thus the active work of the NC machine represents 70-80 per cent of total machine time.

The importance of this time factor, together with the factor of repeatability (all pieces produced with the same programme differ from each other in dimensions to a practically insignificant degree), makes the tools extremely important.

For the choice of a suitable tool, together with its correct setting, means optimizing advances without interruption during the work cycle.

While it is true that with any machine care of the tools is important, this is particularly so in NC machining centres because the operations are many (milling, boring, threading, etc.) and because positioning time is minimal, as has been mentioned.

This will lead to greater care with tools, or rather tools will be given the importance they should have, and an effort will be made to keep as up to date technologically in this engineering sector - normally somewhat ignored in our countries - as in others.

The time has come to explain where we think it appropriate to begin the use of NC - in other words, in what type of undertaking.

We shall begin with concerns operating with large or medium-sized series.

It would seem at first sight that the production scale would not justify NC because the large series requires specific transfer machines or production machines designed and constructed to carry out exclusively the operations required.

However, the NC machine can be used in these plants as a sort of "joker" machine.

For prototypes, for the preliminary series before the special machines arrive, for critical operations, for variants, for spare parts for models no longer in production, and to assist the line in emergencies, NC is really what is needed. Flexibility and the speed with which it can begin production make the NC machine an essential feature even in mass production concerns.

Certain well-known car manufacturers have had to use NC, when the delivery of the transfer equipment for the machining of a particular part was delayed, for the production of the units of the first series; they were thus able to complete the productive cycle without major difficulties and to bring the new model on to the market in time.

Where NC has its natural place, however, is in precision engineering, where products are repeated in small or medium-sized batches (from 5 to 1,000 pieces per batch, depending on the operations to be carried out).

We have for example the mother industry - the machine tool industry.

This is an appropriate sector for the use of NC.

It is a question of machining small batches of parts, with very strict tolerances, parts which must be assembled afterwards, thus limiting the problems of adjustment.

NC, with its lathes or machining centres or borers, can solve the problem of quality and interchangeability as well as reduce the costs of the majority of pieces.

The boxes, slides and headstocks of a lathe, the spindle guide plates of a fixed-centre multiple driller and the head and cases of a milling machine are parts which, in view of the precision of the wheel bases and the tolerances of the bores, are most reliably and economically dealt with through NC.

Other activities where series are small are the production of road machinery, marine engines, combustion engines for various uses, die-sinking plants with a production volume suitable for the standardization of the various components, the production of compressors, textile or printing machinery, rotary engines for railways, reducers, pumps, etc.

Finally, one may mention everything relating to strategic needs, where independence of production or the possibility of self-supply in regard to certain spare parts are arguments which outweigh other considerations.

All these potential users of NC machines have one argument against such machines, namely their price.

It is true that the prices are high, but they are not much higher than those of top-quality traditional machines. If the cost of an NC machine is compared with what it costs to tool a set of traditional machines for a particular small-series or medium-series job, there is no doubt that the feasibility study will give a result favourable to NC.

There are other solutions, too, to the cost problem regarding NC, especially where there exist industrial promotion areas, development poles or industrial estates.

This is the sharing of an NC machine between two or more enterprises.

It would seem useful to make a brief comment on an actual situation existing here in Argentina.

I refer to the city of San Francisco. It is a major industrial centre: it produces machine tools, electric motors and agricultural machinery, and provides an example of productive activity and progressive attitudes.

In view of the type of production, the quality of the products and the competitive enthusiasm of its entrepreneurs, NC is bound sooner or later to become a necessity for many of the firms based in this city.

A question then arises: would it not be desirable to consider the possibility for two or three enterprises to acquire an NC machining centre jointly?

They could study together the critical parts produced by each factory, so that NC could begin to provide a solution to the major difficulties; this co-operation would benefit firstly the industrialists themselves, then San Francisco and ultimately the country as a whole, because an event of this nature would pave the way for many other similar initiatives.

We believe firmly that a solution of this type is feasible here or in other countries of the region; we are convinced that NC is an essential factor for the technological development of Latin America.

The technical personnel to operate and use the machines exist, production scales are those typical for NC, an infrastructure different from what already exists is not required and consequently this new tool, which is in use in all the most advanced countries, would enable us to compete on equal terms with the industrialists of other countries.

Since the production scale is similar - because, we repeat, NC is suitable in small and medium-sized series - and since the means of production are also similar (always NC), the quality of the products, the skill of the technicians and the imagination of the commercial sectors will be the weapons permitting the conquest of other markets or the replacement of many imports.

In other words, NC will make possible competition on equal terms in regard to the means of production and, economically speaking, NC will have justified the effort represented by the initial investment.

The technological arguments in favour of the use of NC are also many. Apart from those already described, in relation to tools or quality control, there is one fundamental factor: the constant challenge.

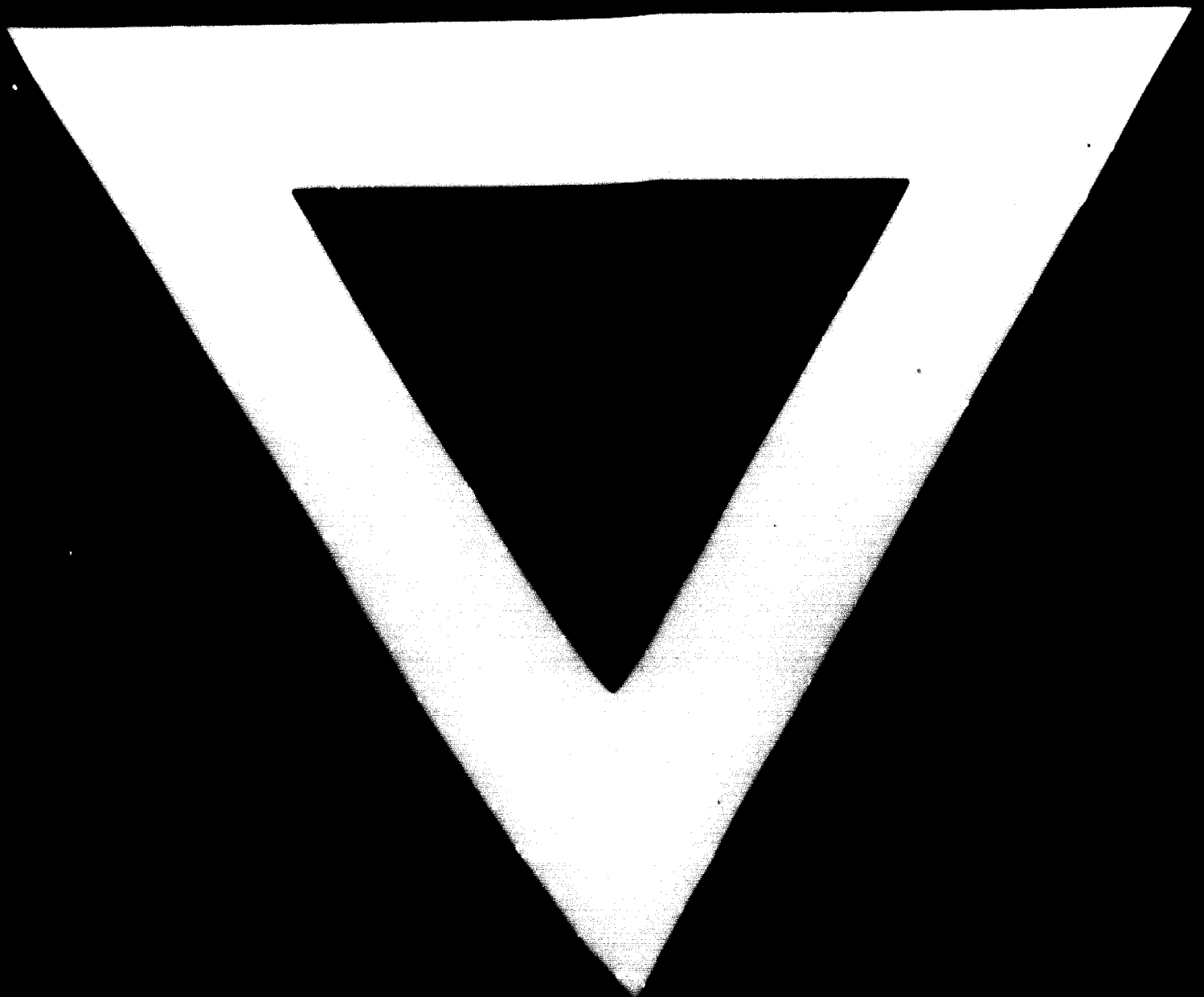
With the use of such an up-to-date system of production, there is a constant technical motivation to improve productivity. From programming methods to ways of fixing work-pieces, the possibility of adding new and more difficult operations to the original operations, and the optimizing of the use of the machine within the system of production of each enterprise, the development process takes place completely autonomously, relying on the determination and intelligence of the technicians themselves, without any need to seek instruction from outside, because NC makes it possible to develop a technology of one's own.

Lastly, if our technicians enter this new field of production methods as soon as possible, the whole engineering industry, through a process of assimilation and emulation, will adapt itself to the new machines and there will consequently be an immediate response in the form of a demand from technicians for training and of changes in school curricula.

Thus the use of NC will not only lead to visible benefits in regard to productivity, as has been mentioned, but also the level of professional training attained will oblige all those concerned with engineering to keep abreast of technological advances in the highly developed countries.

In other words, NC will make those connected with it feel that they are in the vanguard of progress in a steadily advancing world.

To conclude, I hope that these remarks have made a modest contribution to bringing about an awareness that NC is no longer a difficult technique which we could not hope to adopt, but rather an up-to-date and highly modern method of production, within reach of our industrialists, technicians and operators - a tool capable of bringing about an immediate improvement in the productivity of our engineering industries and raising them, in a very short time, to the technological level which the future of the Latin American countries requires.



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