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N/C MACHINE TOOLS - KEEPING PACE 1/

by

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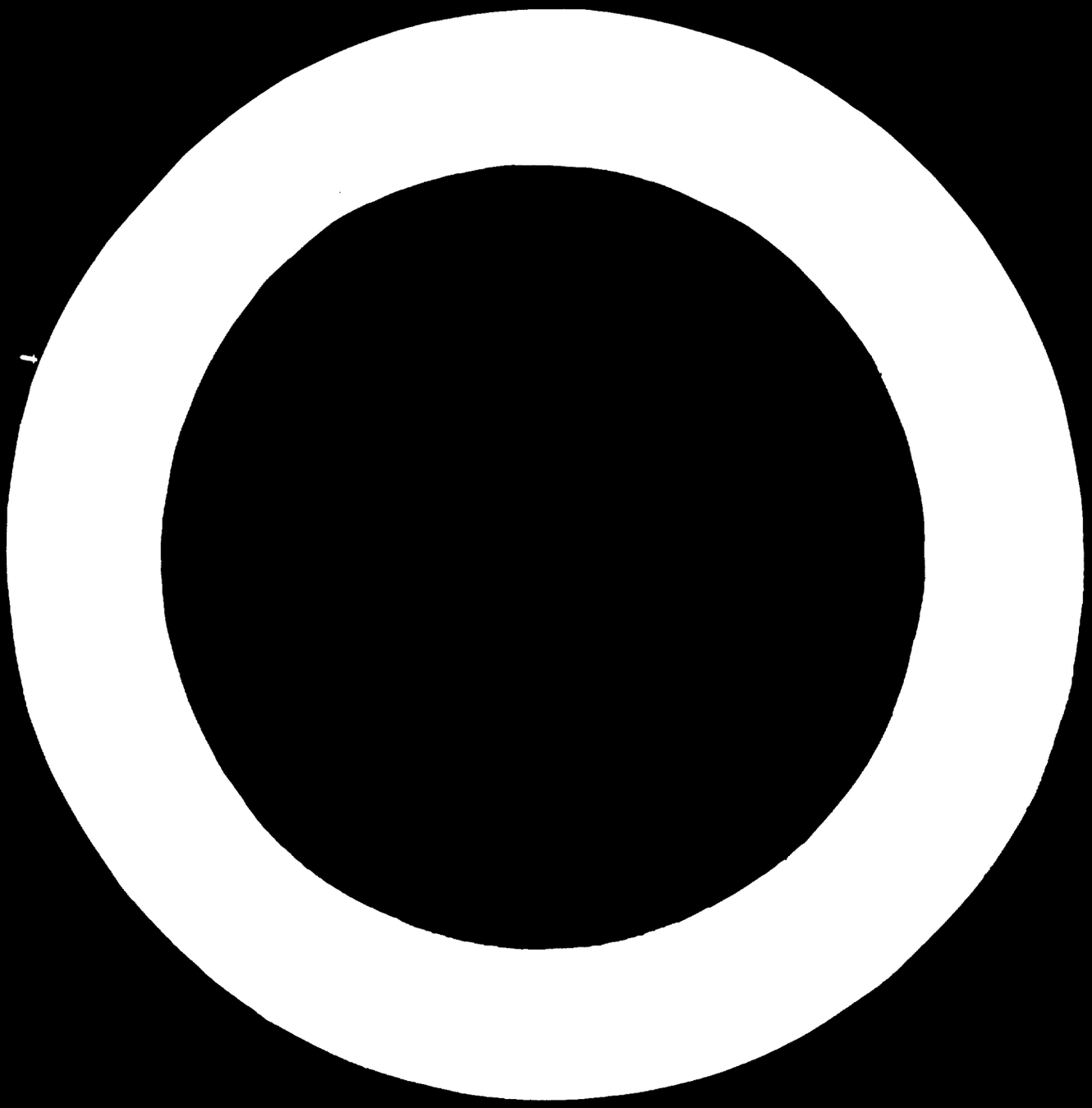

We here today are part of the greatest technological breakthrough in the history of mankind. We are confronted with this challenge - CAN WE KEEP PACE? The breakthrough is not only in machine design and the operation of the machine tool by numerical control, but in every phase of technology. Whether it be transportation, ordnance, communication, or whatever industry you look at - far more technological progress has taken place within <u>our lifetime</u> than has happened since man came out of the cave.

In 1914 a United States Government contract was awarded to the Wright Brothers for a plane that would fly 42 miles per HOUR, only 55 years later we were flying to the moon - and the same pace is true of all technology ---

We do not have to consider a time span as long as our life, but let us look at the last 15 years in the machine tool industry ... we have set a pace so fast that we are at the point that was originally used to describe the aircraft industry ... as soon as the plane flies it is obsolete ... as soon as you have ordered the machine tool and placed it in operation, the machine tool is obsolete

Or to describe it differently, as a phrase I read recently and is being proved every day in machine tools ---

the newer the machine tool, the more complex it is,
and the more complex it is,
the sooner it becomes obsolete.

Think about this for a moment ---

the newer the machine tool, the more complex it is,
and the more complex it is,
the sooner it becomes obsolete

-- if it does nothing else it should shock you into the reality as to what is taking place in your lifetime.

No "decision" is more important to the health of any industry than how to invest capital ---

Capital investment not only determines the rate of growth of a company or corporation ---

It goes hand-in-hand with national growth ---

Today we will be discussing trends now shaping up in the purchase of Numerically Controlled machine tools more commonly referred to as N/C machines ... to stop apathy ... and to help expand the growth and profit rate of your company thru the creative application of N/C machines and machining centers.

We will be discussing some important developments at Giddings & Lewis that have helped in isolating and reducing overhead costs in metal cutting operations ... by placing full responsibility for this metal cutting operation in management hands.

Some of you here know Giddings & Lewis as an old-line machine tool company whose history goes back to the almost forgotten past. But, I'm wondering how many of you know the NEW Giddings & Lewis, otherwise known as G&L.

Today G&L is one of the world's largest machine tool builders.....

... manufacturer of the World's most <u>complete</u> <u>line</u> of numerically controlled machine tools ...

... and one of only two builders that design and build their own numerical controls for their own machines providing single source responsibility.

Our history in N/C goes back to 1950 to a joint venture with the Massachusetts Institute of Technology in the design and development of the first numerical control for machine tools in the United States.

Slide #1 In 1955 we built the World's first commercially available N/C machine tool -- a skin mill for the aircraft industry. It was, and still is, equipped with magnetic tape numerical control of Giddings & Lewis design.

Slide #2 In 1957, G&L shipped the World's first 5-axis N/C profile milling machine for the aerospace industry and the first N/C horizontal boring, drilling and milling machine.

Slide #3 In 1960 we saw the introduction by G&L of the World's first
Slide #4 numerically controlled die sinker ... vertical boring mill ...
Slide #5 and vertical turret lathe.

Slide #6 1964 brought the G&L Bickford NumeriCenter-V Vertical N/C machining center with automatic tool changer -- the first heavy duty machine of its type ...

Slide #7 Early in 1965 came the announcement of the NumeriCenter - H heavy duty horizontal N/C machining center for large tools weighing 38.5 kgs., and 203 mm diameter x 457 mm long with 63-tool capacity.

In 1967 G&L-Bickford presented the NEW 15VF Numericenter
Slide #8 Floor Type Machining Center for GIANT workpieces ... and
Slide #9 followed up one year later with the NEW 10VFC NumeriCenter Floor Type machining center.

At the 1970 National Machine Tool Builders' Association
Slide #10 (NMTBA) Show in Chicago, Giddings & Lewis unveiled the Numeri-
Slide #11 Lathe H Horizontal N/C two axis and four axis turret lathe of computer aided, modular design, in three basic sizes incorporating five different machine types.

Slide #12 At the same show Giddings & Lewis introduced the first of a new family of servo-driven horizontal Precision Machining Centers, the PMC-35. This machine has a 90 mm diameter spindle, a tool changer, and a work changer. It comes complete with our all new numerical control system, known as the PCC-80 Process Computer Control, incorporating a mini-computer, which drastically simplifies programming for full N/C contouring.

Slide #13 Also shown was the larger 100 mm diameter spindle PMC-40 and the 125 mm spindle PMC-50, followed in 1972 by the
Slide #14 150 mm diameter spindle PMC-60 horizontal boring machine.

Slide #15 In addition, the first of the all new servo-driven floor type horizontals with a 125 mm diameter spindle, known as the G50-F, was introduced. It also incorporates the all new Process Computer Control. The largest of this series having a 150 mm diameter spindle, known as the
Slide #16 G60-F, followed in 1972.

Slide #17 1972 also brought the announcement of a new family of table type and floor type servo-driven horizontal Production Centers having 150 mm and 180 mm diameter spindles, known as the H60 and H70 series, respectively.

Why servo-driven? Believe me, this implies several very important benefits upon which I must dwell for just a moment. It simplifies the headstock construction ... thus, fewer parts to wear out ... eliminates the need for clutches ... you are all aware of the constant maintenance problems in this area ... and most important to the N/C approach, it provides extreme accuracy in table and slide positioning vital to the accuracy and repeatability expected of a quality numerically controlled machine tool.

Slide #18 The all new Process Computer Control with integrated circuitry, circular and linear interpolation, and direct word address, the latter eliminating most coded instructions, thus greatly simplifying the work of the programmer.

This control meets all of the requirements of Precision Machining Centers and Production Centers, as well as turret lathes, both vertical and horizontal.

I am emphasizing Giddings & Lewis' role in numerical control for a good reason: Mass production as a lucrative area of profit improvement is reaching saturation. Attention is now being focused on cost reduction in the areas not subject to mass production. That of short run "Flexible Production".

Industry is shifting to shorter runs of an increasing variety of new products, built on shorter lead times, with tighter tolerances. And, this technological explosion is demanding products which are more sophisticated ... more complex .... and, in many cases, more difficult to manufacture.

It is our firm belief -- and has been for more than a decade -- that the productivity and flexibility needed to profitably meet these changing demands -- and thereby insure your company's future -- is best found in N/C machine tools ... and preferably with automatic tool changers.

The first sign that the change to N/C for short run flexible production is already occurring, is evident in the skyrocketing demand for numerically controlled machine tools. A survey by McGrawHill, publishers of "American Machinist" indicates that N/C sales of machine tool builders accounted for 10% of all machine sales in 1960; jumped to 30% in 1965, 50% by 1970, and they predict a staggering 80% by 1975.

Because of its early start and pioneering efforts in N/C, G&L has an even faster growth rate than the industry. Numerically controlled machine tools were 16% of our machine tool orders in 1960, in 1970 the figure rose to over 80% and the trend is sharply up for the future -- with definite preference going to N/C machining centers with automatic tool changers.

Many sweeping changes lie ahead ... changes that we are already seeing in the plants of customers who own our N/C machines and machining centers.

New concepts of the factory and its tools are being formed. The classic definition of "men, machines, and materials" is inadequate.

The essence of mass production -- breaking the manufacturing job into discrete functions performed on dozens of machines -- is being de-emphasized in favor of combining manufacturing operations on a small and highly productive group of automatic N/C tool changers.

I'd like to talk for a few minutes about a manufacturing fact of life. Loosely stated, it goes like this -- "the amount of overhead in the manufacture of a part is almost directly proportional to the complexity of the part's design."

As products have grown in complexity and demands have increased for more frequent introduction of new products, the number of workpiece operations have multiplied -- and by workpiece operations we mean the work that is done on a part at a machine before the part is moved on to a subsequent machine.

In many plants the number of workpiece operations has increased almost in geometric progression. As a result, manufacturing jobs have been broken down over and over again, and distributed to more and more machines. Lines of production have gotten longer and longer, or have been duplicated to meet growing demands.

Five years ago a lift truck manufacturer asked its manufacturing group what equipment they would require to increase their production 25%. The replies came back, more radial drills, more knee mills, more lathes, more vertical mills, etc. -- duplication of the equipment they were already using in a very successful operation ... now five years later they found with the increase of standard machine tools the needs have mushroomed for more cutting tools ... more fixtures ... more qualified machinists ... more inspectors ... more in-process moves, more in-process inventory - and more plant area ... always more ... more ... more ... and more.

Accompanying this expansion of manufacturing capacity to meet growing production demand has come an excess of overhead activities, such as ... more material handling ... more production inventory control ... more expediting ... higher tool crib expense ... greater inventory costs ... increased inspection and time study requirements, etc.

Today in some companies the growth of work piece operations and resulting growth in overhead costs have become almost a chain reaction with an accompanying drop in profits.

N/C machine tools can help to stop this chain reaction ... and then actually reverse it.

What actually is numerical control? It is <u>not</u> just a new way to control machine tools. It is an entirely new manufacturing concept whose main advantages are not only realized in the machine shop itself but in all the other departments of the company from purchasing to sales.

What are the advantages or the benefits of Numerical Control?

The most significant advantage of numerical control is that it provides management control over the production operation. For the first time in the metal cutting industry, the important decisions that affect the unit cost, delivery dates and product quality are in the hands of management and their professional employees; and not subject to the fluctuating abilities and whims of the machine operator. This means that you can accurately determine your cost, you can promise delivery dates with assurance, and you can provide repeatability that keeps your customer satisfied.

Let me point out that the degree of management control provided by N/C depends on the type of N/C control that is purchased - how many or how few of the machine tool's functions are controlled by N/C. Management can have little control or complete control - and you get just what you pay for.

In its simpliest form numerical controls can be used for a 2 or 3 axis readout system only. Obviously this will simply speed up the operators manual positioning of the machine tool, and we will depend on the operater for speed and quality.

An improved form of N/C provides dial-in positioning, enabling the operator to actually dial in his next position, and the machine automatically follows these instructions. Still, very little management control.

We now advance to the N/C control which merely positions from tape or punched cards. Here we have management control of the positioning function, but all other functions of speed and feed selection, coolant on and off, and spindle cycling modes are still up to the operator. Here, however, management has attained a greater degree of control - let me point out that many N/C systems are just as this one is described, although they lead you to believe that they completely control the machine tool.

We now progress to the complete N/C control for the conventional machine tool. Here we have positioning of 2, 3, 4 or even 5 axis under tape, speed and feed selection, coolant on and off, spindle modes, and rotary table indexing or rotary motion in milling feeds. As applied to turret lathes, we have two axis and four axis slide motion of turning and end working turrets indexable under tape control. All that is left to the operator is the setup, tool procurement and changing.

Now we come to the true management machine. For the first time management can control the performance of its largest single item of capital expenditure, its machine tools; and this is made possible thru the numerically controlled tool changing machining center, where every motion and function mentioned before, is in the hands of the professional manager or engineer ... the position ... the speed ... the feed ... the spindle cycling ... coolant, and even the setup with palletized work loading, work changing stations ... and in addition the storage, selection and changing of the tools themselves is determined by the tape.

And we can go a step further - adaptive controls are now available. These are controls that are so arranged that pressure or heat sensing device, embedded in the cutting tool or operating from the machine spindle pressures will automatically select correct speeds, correct feeds, and proper cutting tool depth.

And more is to come.

So N/C is a control that doesn't notice girls with swinging hips, doesn't fight with his wife, doesn't drink too much, never comes in late, and never stays home for illness.

N/C brings to management control of its investment --- lets see what other benefits we can find - and all of these factors are of vital importance when justifying N/C.

The traditional three, direct labor, setup costs and tooling are usually the only ones considered, and yet if you fail to look further than this, you are overlooking more than 1/2 of the total benefits of N/C.

Slide #19

1. Direct labor - N/C will ultimately reduce the number of machine tools required, and most certainly reduce the level of skill required in the operator. If it doesn't require the number of machine tools, it most certainly will reduce the number of man hours required for a fixed work load.

2. Setup costs - less machines required, less setups, particularly true in the case of the tool changing machine.

3. Tooling costs - N/C eliminates the need for complicated and precise jigs and fixtures. Therefore, fixture maintenance is eliminated. Fixture storage areas no required. Longer cutting tool life due to tool always approaching work piece in same manner at optimum speeds and feeds. Traditionally the machine operator has been the worst enemy of the cutting tool.

   The N/C concept encourages the standardization of hole sizes, and, therefore reduces number of tools required.

4. Equipment Investment - substantially reduced thru N/C. One of our customers replaced 2 milling machines, one jig borer and 5 drilling machines with one N/C tool changing machining center. More operations completed on one machine - less downtime, due to setups handling, inspection, and operator need or fatigue, providing more efficient use of company capital.

5. Reduction in lead time - have you ever lost an order because competition could deliver the finished product faster than you?

6. Inventory Costs - here we can save in four areas:

   1. Tooling inventory - reduced.
   2. In-process inventory - reduced by performing more operations on one machine with N/C equipment.
   3. Raw material inventory - can be reduced because it is now possible to manufacture smaller lots economically with N/C and with shorter lead times.
   4. Finish stores inventory - is reduced as N/C economically produces smaller lots, and many jobs can now be made to order rather than for inventory.

   What is your cost of carrying inventory?

7. Material Handling Costs. Vance Rogers of Boeing Aircraft has said you can expect N/C to reduce material handling costs by 30%. Less machines, less piece part operations - less piece part movement.

8. Machining to engineering specifications - Very often under normal controls, a piece part will not be machined to engineering specifications due to human error. The piece part though usable, is a compromise - N/C reproduces faithfully to engineering drawings- time after time after time.

9. Inspection Costs - N/C permits more operations in one setup, thereby reducing the number of inspections required.

Only the inspection of the first piece part is now required and perhaps less detailed inspection of every 10th or 20th piece as tape reproduces faithfully.

10. Assembly costs - N/C brings savings in assembly as we now have repeatability previously unattainable in the manual operator. Parts are no longer similar, they are identical, thus eliminating costly re-work, scraping, hand fitting and mating.

11. Scrap Costs - The old rule "The tighter the tolerances, the higher the reject rate" does not apply to N/C. Here with the machine control taken from the operator, and provided with quality equipment properly installed, and provided the tape is correct, N/C will produce the same tolerance every time.

Scrap due to setups or tape is also eliminated as tape can be dry run before actual machining.

12. Floor Space Savings - One N/C machine does work of several conventional machines, therefore, saves floor space - not to mention floor space saved by less jigs and fixtures storage and less in-process inventory.

13. Freedom of design or design changes. Engineering is no longer hampered by costly jig and fixture changes for new or altered designs.

Path controlled N/C machines cut piece part configurations that were impossible a few years ago, or required costly assembly operations to fabricate.

A bi-product of N/C in engineering is Standardization. It has forced a review of many companies engineering drawings, calling for datum line dimensioning, which brought an up-dating of the drawing, and greater standardization of piece parts and machining dimensions.

14. Flexibility of Production - Shorter lot runs are more economical with tape. Jobs of the future, with new shapes, tolerances and materials present fewer problems to N/C equipment. A new tape is simple and economical to produce and to store.

15. Secondary operations - Users state N/C machining cut deburring costs in one plant 25%. In another plant, polish times cut 62%. It's commonly known that N/C cuts hand finishing on forging dies by one half.

16. Repeatability - especially valuable in job shop operation dealing with repeat orders or repair orders. Identical parts obtained from tape whenever run across the N/C machine. N/C reduces the setup time on the repeat order, enabling you to keep price down lower than your competition without tape.

17. Company owned skill - N/C is the skill of the machine tool. It cannot get up and quit for a better offer but it can be shipped by plane or mailed to another plant to reproduce the skill.

18. Accuracy - N/C will not make an accurate machine out of an inaccurate one. But it will put the responsibility for accuracy in the hands of the engineering and programming personnel rather than the operator - and as a result we are manufacturing machine tools to produce higher accuracies.

19. Savings in paper work - With N/C you need fewer route sheets, fewer methods and time studies, fewer instructions and blueprints, and less scheduling, payroll and cost accounting paper work.

20. Prototype Production - Engineer has ability to talk to machine in N/C language. Can run different prototype parts as easily as lot production runs.

21. Advantage N/C brings to customer - your ability tc produce accurate identical parts for your customer with shorter delivery time is difficult to put a price on, but invaluable to your customer.

22. Psychological Sales Advantage - when your company has N/C and your competitor does not.

23. The Future - Will your company have the ability to go into computer controlled manufacturing when the situation warrants. Your experience in N/C will permit you to go into adaptive controls and computer controlled manufacturing with little adjustment.

19 OFF

Up to this point we have shown you some of the N/C machine tools that are rapidly becoming the standard production tools of industry replacing the old line standard upright and radial drills, milling machines, lathes, horizontal boring machines, etc. We have discussed the advantages both economical and physical but here is the proof that numerical control and the new machine tools designed to utilize this control can do what we have claimed.

Throughout the Giddings & Lewis development of numerically controlled machine tools we have constantly been confronted by the skeptic. As recent as two years ago I have heard responsible management personnel state that they questioned the economic feasibility of numerical control and whether it was here to stay. Giddings & Lewis has not only proved this by utilizing their advanced development of numerically controlled machine tools to become one of the largest builders of machine tools in the world today, but also has the testimonials of customers throughout the world in all types of industries verifying the information we have passed on to you here today.

Slide #20

Slide #21

For example a manufacturer of plastic molding machinery previously manufactured a moveable platen 1118 mm wide by 1194 mm long by 178 mm thick utilizing three Radial Drills and one Horizontal Spindle Jig Borer and layout with a production time of 9 hours in 4 setups.

Slide #22 The new method utilizes one NumeriCenter 15V NC Machining Center with a production time of 3.4 hours in one setup.

A food machinery manufacturer had the problem of producing
Slide #23 a machine base plate 915 mm wide x 1,245 mm long x 203 mm thick re
quiring 71 drilling operations, 54 tapping operations, 12 boring operations, 12 reaming operations, 8 milling operations and one counterboring operation on a milling machine, two radial
Slide #24 drills and a horizontal boring machine with a total production time of 6.5 hours in three setups.

Slide #25 By utilizing one NumeriCenter 15V Machining Center, the production time was reduced to 1.2 hours in two setups.

A metalworking machinery manufacturer had the problem of
Slide #26 producing a hydraulic valve body 150 mm x 150 mm long by 100 mm thick. This part required 83 drilling operations, 49 spot drilling operations, 59 tapping operations, 7 milling operations, 6 boring operations, 6 reaming operations and 15 forming operations with all holes chamfered.

Slide #27 The old method utilized a lathe, a milling machine, a boring machine, a drill press and a 6 spindle automatic drill press with a production time of 5.1 hours in 5 setups.

Slide #28 The new method utilizes a NumeriCenter 15V NC Machining Center with a production time of 58 minutes in one setup.

Slide #29 One of the most outstanding examples of time savings is in a part manufactured by a data processing equipment builder where an aluminum tape transport housing 485 mm wide x 650 mm long x 100 mm thick required 113 drilling operations, 93 spot drilling operations, 8 boring operations, 32 milling operations plus countersink and deburring of all holes.

Slide #30 The old method used a numerically controlled Jig Borer, a vertical spindle numerically controlled profiler, a vertical spindle numerically controlled drilling machine and a horizontal boring machine with electronic readout. Production time was 26.2 hours in 9 setups.

Slide #31 The new method utilizing a NumeriCenter 10V NC Machining Center produced this part in 2.5 hours in one setup or a production increase of more than 10 times.

When you remember the points we have discussed of savings in equipment, floor space, inventory on process, etc., and consider the fact that this part was already using three pieces of NC equipment under the old setup ... it drives home the fact that not only numerical control but the management control made possible by NC machining centers has obsoleted

developments that have come about in only the last 5 to 10 years.

Slide #32 A paper machinery manufacturer had the problem of producing cast iron main frames 915 mm x 1,45p mm x 100 mm thick. There wer boring operations ranging from 365.12 mm to 209.55 mm in diameter, 74 drilling holes and 28 tapped holes.

Slide #33 The old method utilized radial drilling machines and a horizontal boring machine with production time of 17 hours.

Slide #34 The new method utilizes the NumeriCenter 15VF NC machining center with a production time of 3 hours.

Slide #35 From a standpoint of size, one of the most outstanding applications of numerically controlled machine tools is in the manufacture of rolling mills.

E. W. Bliss previously manufactured major rolling mill components requiring rough and finish milling, boring, drilling and tapping
Slide #36 which required layout work, a planer mill, a 6" horizontal boring machine, 4 setups on a radial drill and all of the work handling between these pieces of equipment.

Slide #37

With the new method all of these operations are accomplished in one setup on a Model 25H NumeriCenter NC Machining Center at a time savings reported by the customer of 75%.

Under the circumstances, those of youutilizing machine tools ranging from 10 to 20 or even 30 years of age can appreciate that modernization does not mean buying a new machine with more horsepower, broader speed and feed ranges, higher accuracy and the other features described by those who would replace your existing machine tools with a so-called updated version.

This is like replacing an old horse and wagon with a younger horse and rubber tires instead of wooden wheels for the wagon ... possibly even throwing in a few springs to improve the comfort of the ride. Such a change compared to jet aircraft transportation, modern automobiles with automatic transmission and even the possibility of making a trip to the moon is the comparison we are talking about in up-dating manufacturing facilities from the 10, 20 or 30 year old machines to the modern numerically controlled machining centers of today.

The parts we have mentioned are only a few of the examples our company has obtained from its thousands of users of NC equipment. Some are more simple and some are more complex. However, all agree that the points we have brought out in this discussion have improved their competitive position in their particular industry. Their planning for the future specifies NC as they realize they cannot afford to do otherwise.

Here in Latin America the outstanding rate of development of industry will go forward even more quickly as more and more of the companies utilize NC equipment. One point should be clearly understood ... numerical control is not for high production work. Its greatest benefits come when used for relatively low rate production on broad varieties of work.

You cannot possibly put a value on all of the factors as ... until such equipment is put into use in your facilities you can only estimate the overall effects. However, numerical control is in extensive use throughout the world today so that our estimations are based on intelligent judgement. Obviously those companies that move forward first will be in the strongest competitive positions. The question now is ... gentlemen, can we keep pace.

The machine tool industry has answered this challenge and is capable of placing in your hands the tools of production that will enable you not only to keep pace but to go ahead of your competitor.

The rest is up to you.

Thank you.

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