ESTABLISHED TRADITIONAL MACHINING PROCESSES

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Abstract: *The development of machining technology has been driven by the application of CNC to base processes in conjunction with the high standards of machine-tool build accuracy and reliability that modern machines now possess. These factors, together with advances in the tools used to remove metal, have combined to deliver a range of capable, flexible, machining processes that in the majority of cases can deliver guaranteed results in terms of component quality without the need for primary skills.*

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Introduction

The trend has been to incorporate particular process parameters and skills into the machine-tool CNC system and this has enabled machining processes to deliver reliable, consistent, results to manufacturing industry. Spin-offs from this core capability have, for example, been the opportunity to run lights-out or twilight shifts, the raising of daily output, and the ability to operate in a more flexible manner and reap the associated benefits such as low work-in-progress and late customisation of products.

- **Turning Machines**

The lathe is a fundamental machine tool capable of being adapted to many different machining operations in addition to turning (milling, drilling, slotting, gear-cutting) given sufficient skill and ingenuity.

A variety of turning machine types have been developed to address the requirements of industry. Coupled with advances in machine-tool build quality and integration of CNC the following broad categories of capable, reliable turning machine are currently available, in addition to conventional, manually operated centre lathes.

- **CNC/Manual Conventional Lathes**

These machines resemble traditional lathes integrated with basic CNC systems, permitting a reduction in skill levels required to operate the machine through use of canned cycles (pre-programmed sub-routines for common tool movements, such as roughing-out, threading and finishing) and the capability to self-teach the control system by initial manual operation. This lathe type has emerged in recent years and offers a cost-effective, flexible turning capability for one-off and small-batch work.

- **CNC Turning Machines**

Fully integrated, purpose-built lathes capable of flexible manufacture of turned parts, in low, medium or high volumes, to consistent levels of accuracy. These machines are the mainstay of industrial turning production technology. For this type of machine in particular, powered tooling and the introduction of main and sub-spindles have extended

versatility, permitting one-hit machining of components with turned, drilled, tapped and milled features. This has the advantage of eliminating multiple set-ups between different machine tool types and increasing accuracy and functionality of machined components.

Figure 1 – Typical CNC Controlled Lathe.

Within this category are a wide range of lathe capacities and costs, but like CNC/manual lathes, capable CNC turning equipment can be acquired at reasonable cost with all the associated benefits of flexibility, accuracy and reliability.

- **Automatic Lathes – Conventional/CNC**

These machines were originally developed to address industrial needs for high volume production of repetition turned parts using single-spindle cam driven machines, followed rapidly by the introduction of multi-spindle lathes capable of enhanced levels of productivity. The advent of CNC turning machines detracted from development of automatic CNC lathes for a few years, although now CNC automatic turning technology is well established, delivering high volume capability with programming flexibility and hence batch flexibility, consolidating the position of this lathe type. A similar effect has occurred with high-precision sliding-head (Swiss) automatic lathes, where CNC has replaced the cam drives traditionally used, achieving flexibility coupled with the extreme precision that this machine type can achieve.

- **Vertical Turning Machines**

These machine types are designed for machining large rings or discs typical of the needs of the medium- to heavy-engineering sectors. CNC has enabled flexible one-hit machining of complex turned, bored and milled components, although attendant skills levels have not declined significantly due to the associated high component added value.

Figure 2 – Vertical Turning Lathe – DEFUM

Within the turning sector, a degree of overlap often occurs between capability of different machine types. One example is an emerging trend to smaller vertical turning machines which use the spindle to hold the component in the inverted position, in an opposite manner to larger vertical turning machines, achieving optimum swarf clearance, at the same time using the spindle to pick and place components within the machining cycle, thus easing handling.

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