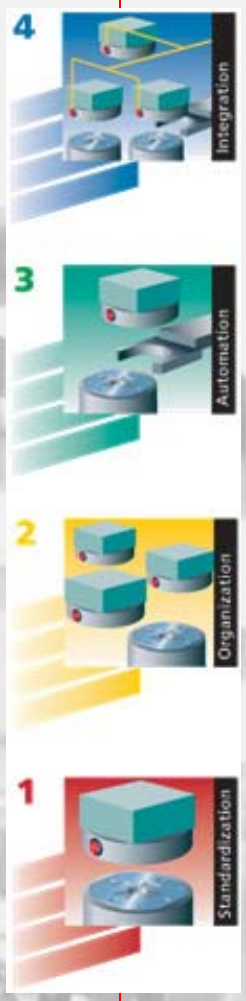
4 steps to machine tool productivity



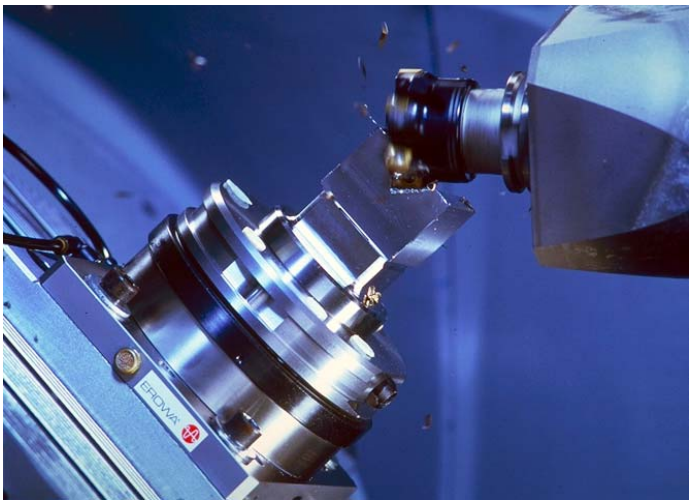
EROWA®

Only by making significant improvement in machine tool efficiency can real reductions in costs be made allowing companies to compete with low wage businesses

The Erowa Flexible Manufacturing Concept is tried and tested technology for reducing set times and running machine tools for extended periods unmanned.

Step 1 - Setup times virtually eliminated on your machine tool

The machining centre has been delivered and commissioned but now comes the task to keep that spindle turning for as many hours as possible. With large batch sizes, long cycle times and 24 hour manning this is not a problem. If this is *you* then you don't need to



read this. If your batch sizes are small, cycle times short or you work single shift then this is just for you.

This article will explain the Erowa way of achieving high utilisation from your machining centre. It is not the result of some bright spark having a good idea and flogging it the next day. Erowa have spent 30 years developing their ideas, using them in their own production shop and then offering the idea to companies with the same problems to resolve.

Erowa does not offer solutions for all aspects of machining but concentrates on a very important part of machine tool activity, namely workpiece handling.

So where do we start? We'll start where Erowa started many years ago.

Changing the machine set-up from one job to another can be a tiresome business, labour intensive and long-winded. (In fact, it is often avoided by dedicating machines to one job or by making more parts than you need.) Flexibility is non existent and utilisation drops through the floor.

The Erowa receiver, or chuck, was the breakthrough. For the first time, a precise datum or zero point was created on the table. Now a fixture could be reset in seconds with no rubber mallet and clock. If changeover was this quick then smaller batch sizes were a distinct possibility and the machine would do the jobs we needed now not for filling the stock shelves. If this mechanical datum point was also accurate and repeatable then other possibilities could be seen. Moving a job between one or more machines with no reset - offline preparation of new fixtures – transfer to a measuring station for QA – lower skill levels for loading and unloading jobs and automatic loading. Let's leave some of these for later, shall we..

Over the years Erowa have developed chucks for different applications so now there is a choice to be made and it is vital the right choice is made now to avoid redundancy later on. Pallet sizes from 30mm to 500mm are available. If all your jobs are roughly the same size then one size will suit, simple. If, like most, this is not the case then another Erowa development is required.

Many Erowa chucks are capable of accepting multiple pallet sizes. No longer do you have to mount a 50mm part onto a 500mm pallet. You would expect, the smaller the pallet the lower the cost and this is true for Erowa pallets too. Also, manual handling is easier and safer with smaller pallets. There are also considerations especially applicable for 5 axis machining. Most 5 axis jobs need to be raised off the table so that the machine spindle doesn't collide with the fixturing. Erowa chucks can be selected especially for this application and together with the small pallets give easier access for small cutting tools.

Weight is also an important criteria for saftey reasons but there are some clever design points built into the Erowa system. The chuck or receiver is fixed to the machine table so presents no real problem but the pallets need some careful thought if the weight is not to cause handling problems. The Erowa precision location underneath each pallet can be purchased separately and mounted directly into the fixture. The pallet and fixture are then one piece with no significant additional weight being added.

At this first stage we have introduced a common pallet receiver, the Erowa chuck, reduced set times to a fraction of conventional methods, introduced multiple pallet sizes and produced a pallet system with easy access for 5 axis machines. We can now take this precise pallet system and expand the Erowa technology into off-line presetting, automation and cell control software. And all for the manufacture of precision parts in small batches.

Step 2 - Flexible machine tool productivity with Erowa presetting

For many applications, making a dedicated fixture for each component is a standard requirement for machining activity. When the batch size is significant this is the optimal way to go but let's consider the scenario of very small batch sizes or even one-off jobs. Manufacturing a fixture to precisely locate the workpiece is expensive so let's consider an alternative method of working.

If the workpiece is clamped onto an Erowa pallet then it can be moved around, with precision, from one Erowa chuck to another. This gives us the opportunity to measure the exact location of the workpiece on, say, a CMM or similar device. The datum point for this location is, of course, the Erowa chuck or receiver. This measured location, or offset, can now be transferred to the machine tool. So when the pallet is loaded onto the machine table the machine will know the precise location of the job in X, Y, Z and C rotation.

Over the past few years Erowa have turned this procedure into a very slick operation.
The job can be clamped simply by screws up through the pallet into the job, or with a simply vice or standard clamp. The “preset station” now measures the workpiece offset position, relative to the Erowa chuck, and the offset data is stored as raw data, not attributed to any machine. When the job is allocated to a particular machine then the offset data is translated into a form that can be read by the machine, let’s say a short NC program.

To run the offset program and machining program they are just a call-up from a basic structural program with a simple naming rule to avoid errors. The machining program is now offset to the correct position on the workpiece and is always *right first time*.
Presetting not only guarantees that each job is correct but allows the process to be extended further. The automation of small batch or single part manufacturing now becomes a reality with high machine utilisation and unattended, lights-out operation.

Step 3 – Significant increase in utilisation aids competitiveness

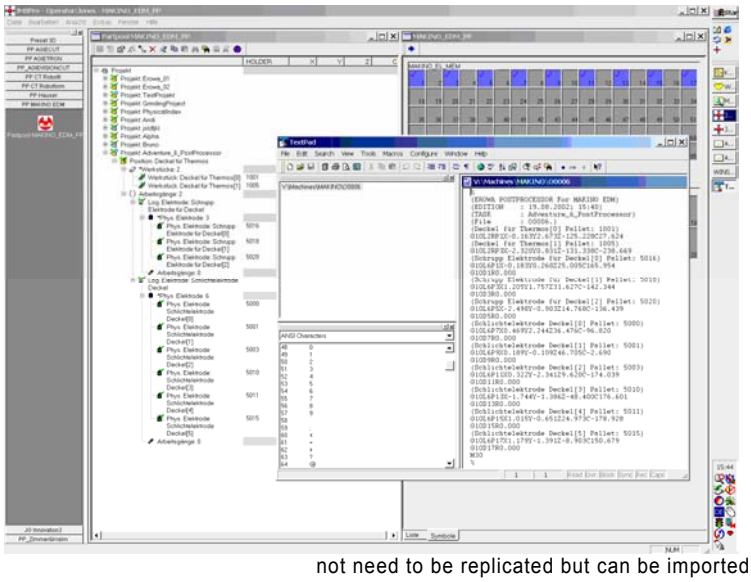
The third step, automation, now becomes quite easy. Standard Erowa pallets, with parts clamped and set, are loaded into the magazine ready for machining. The automation unit simply loads pallets into the machine and so extends the productive hours into the night and weekend. Erowa’s handling systems can even operate during the day to leave the operator free to do something else.

Now I hear the call – “but we don’t do large batches .. we make parts in five’s or ten’s .. we’re not a production shop”. Most Erowa customers make parts in small batches and that’s why Erowa automation has been so successful in tool and die shops – the ultimate small batch *production* shop. This type of automation is designed specifically for this purpose.

So how does Erowa automation differ from FMS type systems used on machines for many years. Firstly, Erowa chucks, or receivers, can accommodate different sized pallets – for example 400mm pallets and 148mm pallets can be loaded from the same robot magazine – so the pallet size can be matched to the workpiece size. This reduces the space

required for the magazine and so the footprint of the machining cell. Secondly, pallets are not loaded into the magazine and left there indefinitely – only pallets that are required are loaded into the magazine for an unattended run. Thirdly, pallet costs are low with the cost normally dependant on size. Fourthly, smaller pallets make for easier cutter access particularly on five axis machines.

Erowa make a series of standard handling systems which are configured for various applications and various pallet sizes. Erowa automation units differ mainly on the magazine capacity required. Selecting the correct unit is down to a combination of workpiece cycle times and how long the cell is required to operate unattended. For example, a machine cell required to run for 10 hours unattended with a part cycle time of 30 minutes would require a magazine capacity of 20 pallets.



In summary, Erowa automated loading systems are very affordable, very flexible and very compact. 6000 hours run-time per year is not unrealistic for a machining centre manufacturing small series parts with single shift manning. That’s competitive!

Step 4 - Complete safety and control in production

The final step to fully automated small batch production is *integration*. So far, we have seen the development of a fully automated machining cell that is capable of running for long periods without attention – managing such a resource is critical. Making sure the right NC program runs with the right job on the right pallet is so important if we are to avoid producing scrap. Erowa Job Management System, JMSPro, is the control and management software that holds everything together.

For a milling application, a job consists of a number of workpieces and cutting tools. Some jobs may have more than one operation and so have several NC programs. Erowa JMSPro allows the job to be planned and organised even before machining starts. Activities such as set up and QA can be entered into the JMSPro job so that all activities are carried out in the correct order. Some job information has probably already been generated, say in CAD/CAM or ERP programs – this work does not need to be replicated but can be imported into JMSPro. Worksteps are added so the that the whole process, or workflow, is entered for each job. Each activity can now be completed in order.

Inductive chips are attached to each pallet and the data for each workpiece is recorded in a database. The correct NC program is recorded against each workpiece and offset data can also be recorded to give the position of each

piece. All this can be achieved well in advance while the machine is working.

When all the preparation work has been completed the job is ready to run. The pallet can be placed in any position in the Erowa Robot magazine – when the doors are closed the inductive chips are read so the JMSPro software knows where the jobs are. At this stage, Erowa JMSPro checks each job for an associated NC program and any offset data. With some machines it is also possible to read the NC program and check for the required cutting tools. Only then does JMSPro define the job as “ready”. The final operation is to prioritise the job in a list with all the other jobs in the magazine. It is now certain the job will be completed right-first-time. Jobs can be loaded and unloaded at any time while the machine is running thus providing a continuous production process.

Additional features allow the machining cell to be monitored (alerts can be sent by SMS or email) and full records, including machining times, are available for production analysis.

That completes the process - so what do we have? A machine tool production cell capable of running small batch jobs 24/7 with only single shift manning and with complete safety. More importantly, we have created a cell able to compete with low wage economies and make a serious contribution to the bottom line.

Erowa automation has delivered lights-out, high-performance milling at Cosworth.

The name Cosworth is synonymous with high-performance engines. For many years Cosworth has provided the power to take so many great names to Formula 1 success.

In today’s fiercely competitive market such performance is not just required on the track. The same level of performance is required in the manufacturing processes too. So, in 2004 Cosworth (formerly Cosworth Racing) installed an Erowa Robot PX for the "lights out" manufacture of high-performance pistons.

"The requirement we had was that in order to release the full potential of one of our new 5-axis machines manufacturing pistons, we had to be able to run un-attended or "lights-out" for as long a period of time as possible” says Phil Harpham, Cosworth’s Head of Manufacturing. “We considered many different handling and loading systems, but to be honest, there was only one clear leader, Erowa. The simplicity and flexibility the system brought with it made the whole installation a dream. It has certainly met and exceeded the strict requirements we specified and the integration with the machine tool was seamless."

The Robot was installed with a Deckel Maho DMU50v and was configured with 60 pallet positions. Half of these 148mm diameter pallets are fitted with special purpose fixtures. The remainder are fitted with 3-jaw chucks.

From day one, Cosworth were achieving 13 hours unattended running through the night. Today they can run this machine unattended from Friday night right through to Monday morning.

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