



Single Second Exchange of Workholding and Workpiece (SSEWW)TM

author(s)

JOHN RIBIC
RIMECO Products
Willoughby, Ohio

abstract

Single-second exchange of workholding and workpiece (SSEWW) is a system that focuses on getting the most utilization out of existing capacity. SSEWW is not only based on a single-minute exchange of die but is also directly related to the operation of machining centers. It was created to eliminate wasted time and effort and focuses on the benefits of quick changeovers. Benefits include increased productivity, decreased scrap, reduced lead times, reduced inventory and reduced space requirements. SSEWW is made possible by quick-change workholding, external setups and successful planning.

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terms

Quick Changeovers
Manufacturing
External Setups
Productivity
Workholding
Lean

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SINGLE SECOND EXCHANGE OF WORKHOLDING AND WORKPIECE (SSEWW)TM

Written by: John Ribic

RIMECO PRODUCTS—KWIK-CLAMPTM DIVISION

Single Second Exchange of Workholding and Workpiece (SSEWW)TM is the newest technological advance sweeping across the machining industry. This concept is revolutionizing machining much the same way Single Minute Exchange of Die (SMED) revolutionized the auto industry. Many domestic and foreign products are flooding into the market to accommodate manufacturers move towards modern day efficiency. With different products come different advantages and disadvantages. It is not only important for each manufacturer to embrace this new technology, but to also choose the one that best fits their needs.

SSEWWTM emerged after years of built up capacity that led to massive overcapacity and the inevitable layoffs and bankruptcies that followed. The machining industry has begun a metamorphosis that no longer includes purchasing a new machining center every time a large contract is received. Manufacturers have learned the hard way that it is of the utmost importance to get the full value out of every machining center inside of their facility. As longer production runs with dedicated tooling continue to be phased out or shipped overseas, it is imperative that every shop have the flexibility to move from one job to the next with shorter lead times. With shrinking margins maintaining large inventories is a dream of the past. Embracing SSEWWTM along with other lean manufacturing concepts is the only way to survive in the machine shop of the near future.

The main advantages of SSEWWTM are Less Inventory, Shorter Lead-Times, Less Material Wastes, Fewer Defects, Lower Space Requirements, Higher Productivity and Greater Flexibility. All of these advantages can be realized without significant capital investments. SSEWWTM increases productivity without increasing capacity. This paper will outline all of the advantages of SSEWWTM and describe in detail steps that can be taken to make the move towards greater efficiency inside of any manufacturing facility.

REDUCING INVENTORY

Just-In-Time (JIT) is the customers requirement to have their parts in small quantities exactly when they need them. There are two alternatives for the company producing the parts. Set-up one time, run a large production run and then maintain large quantities in stock, delivering on demand. This alternative allows the manufacturer to by-pass the costly set-ups associated with the manufacturing of each new part. However it requires him to invest the capital for the material and the machine time to produce the parts. He has made the investment in material, labor, tooling, rust preventive preservatives, etc. Also there is always a chance that the customer may discontinue the product, leaving the manufacturer with worthless inventory. SSEWWTM allows machine

shops to reduce inventory and offer their customers Just-In-Time delivery by drastically reducing the cost of set-ups.

Unfortunately, customers looking for Just-In-Time delivery are looking to receive the product for around the same price they were paying for large quantity orders just a few years back. Less inventory is realized by having the ability to perform shorter set-ups. SSEWW™ allows manufacturer's to perform external set-ups, greatly reducing the time machining center's stand idle during set-ups. External set-ups will be covered more thoroughly later on in the paper.

SHORTER LEAD-TIMES

The next advantage follows closely on the last, shorter lead times. By using the principles of SSEWW™, machine shops can turn around jobs quicker than ever imagined. In order to remain lean customers are requesting turnarounds of as quick as 1-5 days. Five years ago turnaround times matching this would have required working around the clock to perform the necessary teardown of the existing set-up and replacement with the new set-up. Today, as long as all of the necessary equipment is in stock these turnarounds have become an everyday reality. SSEWW™ has shortened lead times to the point that it is now possible to changeover at the end of first shift, allowing second shift to run more of the less complicated piece work, while first shift can concentrate on the more complicated work. This allows any machine shops QA department the ability to get a better nights rest, knowing they are not going to come in the next morning, only to find out 2nd or 3rd shift has been making scrap all night.

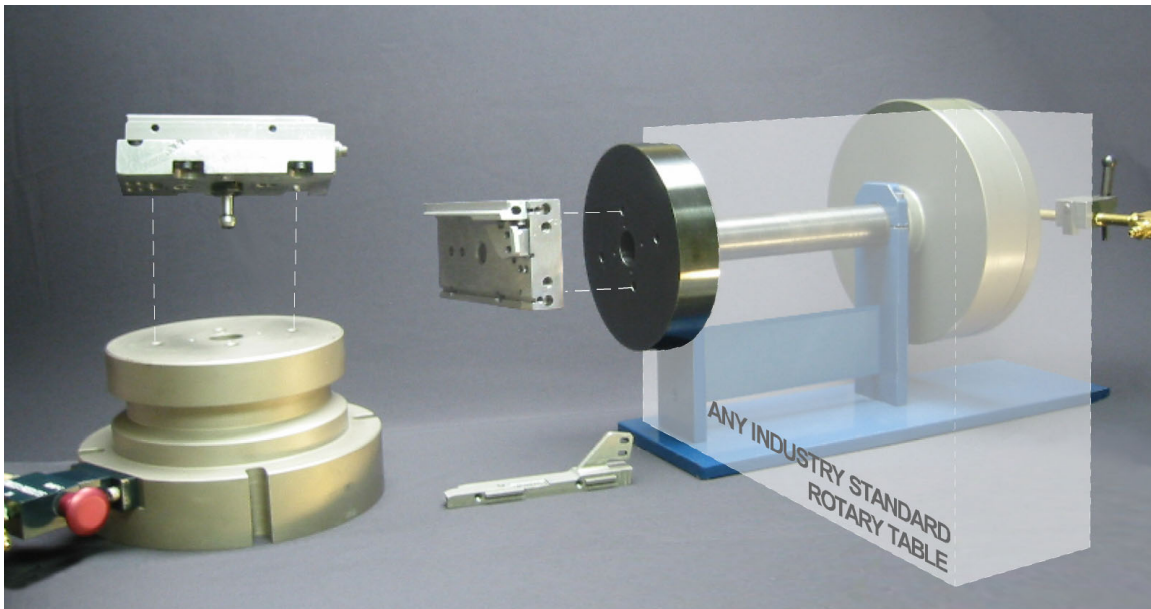
As SSEWW™ becomes industry standard, customers will no longer request shorter lead times, they will expect them. Manufacturers will be required to offer these lead times while offering prices formerly associated with longer production runs. Soon SSEWW™ will not be cutting edge technology, but a requirement for survival in this industry. It offers manufacturer's the ability to quickly mount parts of all shapes and sizes and can be used from one job to the next.

LESS MATERIAL WASTE & FEWER DEFECTS

The only word more dreaded than rework in any machine shop is remake. Preventing material wastes and machining parts with fewer defects may be the largest advantage of SSEWW™. Machining a part from bar stock to completion is always the best preventive action for reducing the chance of scrap. SSEWW™ allows companies to combine multiple operations into one program, thereby reducing the percentage of scrap. It offers the ability to perform quick quick set-ups and also gives its users the flexibility of extra workholding devices.

One example of a part being machined from bar-stock to completion is shown below. The part is first machined in a vice, while this is ongoing inside of the machine; the finished part from the vice is being transferred into the fixture outside of the machine. When the vice operation is complete, the fixture is transferred to the Vertical Kwik-

Clamp™ (RIMECO PRODUCTS patented fixture quick-change system) and the part is removed from the vice. The machine continues to work on the part and when complete, the fixture is transferred to the rotary table and clamped in seconds, for finish machining. The advantages to this process are as follows. First by completing the part in one operation, the risk that one of the operations was completed improperly is eliminated. When a process is originally designed, there is always the risk that a dimension was left out, or even worse not enough stock was left over to complete the next operation. Secondly, the KWIK-CLAMP™ SYSTEM allows the part that has been machined in the vice to be bolted onto the fixture from the backside of the fixture and then clamped on the KWIK-CLAMP™ unit. The part is located on a finish-machined dimension. This greatly aides in the true positioning requirements. Having the ability to transfer the fixture from the vertical position to the rotary table for further machining without removing the part from the fixture also greatly aides in the true positioning requirement. The third advantage is the larger set-up itself. The same tools can be used two or three times inside of the same operation eliminating the need for excessive amounts of tools and tool holders. Finally the combination of operations prevents large amounts of work-in-process inventory from crowding the shelves.



LOWER SPACE REQUIREMENTS

SSEWW™ helps to lower space requirements inside of any facility in three ways. First by reducing inventory, space requirements are automatically reduced. Second, by combining operations the need for work-in-process inventory space is decreased. Finally Single Second Exchange of Workpiece reduces the need for large complex fixtures and workholding devices. In the past in order to prevent wasted time in tool changes, high density workholding devices were used. With the technology that currently exists tool changes are performed in less than 2 seconds chip to chip. It is now efficient to build small less complex fixtures and exchange them more frequently. This also decreases space requirements by reducing the amount of area required to maintain fixtures and other workholding devices.

Using the SSEWW™ system, productivity is greatly increased without a need to increase capacity. As competition becomes fiercer, it is important for every company to examine any current inefficiency in their processes. This examination led RIMECO to develop SSEWW™ and the KWIK-CLAMP™ SYSTEM to make SSEWW™ possible. Lean manufacturing implies a need to decrease set-up time and to use clamps and quick-change devices to change set-ups and individual parts. It is important to choose a system that incorporates a standardized system that is not specific to just one job or one application, but can be used in some way on nearly all jobs inside of any manufacturing facility. It is also important to choose a system that can be easily incorporated into your current system and can be done so effectively and cost efficiently.

HIGHER PRODUCTIVITY AND GREATER FLEXIBILITY

SSEWW™ increases the productivity of any machine operator in several ways. First, allowing the operator the ability to clamp a workholding device to a rotary table or machine table with the flip of a switch, decreases the effort needed and allows him to maintain his energy for deburring and inspection of the parts being manufactured. Reducing scrap increases productivity. Loading the material to be worked on into the fixture outside of the machine gives the operator the ability to visually examine the device and insure that the parts are properly located. RIMECO'S CNC Turning and Milling Division ran a job using the KWIK-CLAMP™ that had previously been run using just a vice to clamp the part. By examining the set-up externally prior to being machined, the process went from a 6% scrap rate to a scrap rate of less than 1%.

By externally setting-up the tools and the fixture, insuring that all the tools have enough clearance and that there is no interference with any of the devices using the external set-up shown earlier, most of the actual set-up can be performed by the machine operator. This can aid in the training of the machine operator to eventually becoming set-up personnel. Finally taking the strain off of the operator will increase worker morale and therefore create a more productive work environment. Instead of stretching into the machine to load parts and set-up fixture's, set-ups and part loading are accomplished outside of the machine on a work bench.

Greater flexibility is realized through SSEWW™ specifically when one system is used throughout the facility. Even though machine tables may be different sizes and rotary tables may be different models, having the same fixture quick-change system on every machining center standardizes the way a workholding device is attached to be processed. A fixture containing a casting that needs to be machined in several different operations can be transferred from a HAAS Machining Center with a HAAS Rotary Table to a HARDINGE with a Troyke Rotary Table and even to a turning center if needed. This allows for the easy formation of cells to complete jobs quickly and efficiently. Jobs can easily be transferred from large machines to small machines when the larger machines are needed to perform new jobs on larger parts.

EXTERNAL SET-UP'S

We have referenced external set-ups throughout this paper and will now cover how they can actually be performed. An external set-up is a cost effective alternative to performing a set-up at the machine while the machine stands idle. A workholding device is one that holds a workpiece or workpieces while they are being worked on inside of the machine. Using external set-ups the workholding device can be set-up outside of the machine. Using a replica of the inside of the machine with a generic fourth axis or indexer and the fixture quick-change system, the workholding device along with the tooling can be qualified before ever entering the machine. There are several factors that prevent set-ups from proceeding smoothly. Nearly all of these factors can be spotted and corrected before the machine is prepared for the new set-up.

I have performed hundreds of set-ups over the past 7 years and no matter how small or large the process, there are always problems that occur during the set-up. One of these problems is the length of the cutting tools. A set-up technician may set-up an entire job only to find out he has not left the tools out of the holders far enough and now all of them have to be pulled out further and new offsets must be made. For jobs that are being run for the first time a common problem that occurs is the interference of the workholding device with the toolpath. By having the ability to review the tool movements outside of the machine potential accidents and time consuming mistakes can be found before the machine is made to stand idle. The more time spent on the external set-up the less time the machine will spend idle during the set-up. With SSEWW™ the external set-up can be transferred to the machining center in minutes, rather than hours. So the premise is to offer Just-In-Time to your customers without maintaining inventory by eliminating lengthy set-ups. This allows every machine shop to increase efficiency and profits by reducing labor costs, reducing inventory investments, decreasing the chance of being left with worthless inventory and competing in markets that had been unattainable due to competitive pricing. One final advantage of the external set-up made possible by SSEWW™, is that the actual set-up can be performed by the machine operator. All of the qualifying has been accomplished externally. It is now a matter of attaching the workholding device in less than five seconds, inserting the tools already located in the tool holders and making the tool length offsets.

For jobs that are ongoing the same work offsets will be used time and time again, because the fixture quick-change system will remain a constant fixture on the machine table and rotary table. The clamping of the fixture will repeat to the same location within .0002" as it did last week or last year. One simple way to maintain the offsets is to write them in parenthesis inside of the program or to always attempt to program from the center of the fixture quick-change system. This way there is no chance the information will ever be lost. One of RIMECO'S customers has taken this a step further. They run the same 500-part product line and prefer to keep their inventory at a bare minimum. They built a fixture for each individual piece and put a different size bore on each fixture to give it an individual identity. When a work order is placed for any of the individual parts, the fixture is identified and set-up with the proper size material externally. When the machine is ready for changeover, the machine operator attaches the fixture to the KWIK-CLAMP, in less than five seconds. A probe comes down, measures the bore size and automatically calls the proper program. This is an incredibly efficient system that allows the company to maintain next to zero inventory on any of their products as well as reduces operator error.

Although the above example is one that would take many months of planning and preparation, SSEWW™ and external set-ups can be put to use immediately. A new job is received that requires the drilling of two holes and the milling of one end. It is a longer production run, so two fixtures will be used to decrease part loading time. The parts are 1" in diameter and 2" long. The fixture is designed to hold four parts at a time, two on each side of the fixtures and the fixtures are to be held on the machining centers rotary table. The fixture is designed and built prior to the set-up and the program is written off-line. The program is written from the Y zero and Z zero of the fourth axis and the X zero is written from the face-plate of the KWIK-CLAMP. This eliminates the need for any offsets to be made. One to two days prior to the set-up all of the tooling is gathered to insure that it is in stock. One day prior to the end of the current running job, all of the tooling is placed in the proper tool holders and qualified using the external set-up shown earlier. With approximately 4 hours remaining in the current process, the new set-up is performed complete in less than 30 minutes. The previous fixture is again put into place and the remaining 4 hours of the process is performed. During these four hours the set-up pieces just processed, are examined and any changes that need to be made can be done in the background edit of the control. A set-up and first article test that used to take 4-8 hours can now be done in less than 30 minutes. This timesaving of 3 ½ to 7 ½ hours can be realized nearly every time a set-up is performed. Assuming that one set-up is performed per week per machine, nearly 300 hours per year can be saved using the SSEWW™ method. This only accounts for the time saved using the Single Second Exchange of Workholding, the Single Second Exchange of Workpiece can add 100's of hours of savings also. This savings is added directly to the bottom line and can equal 10's of thousands of dollars per machine per year, and can only be realized using the SSEWW™ method.

In summation, SSEWW™ is a new concept, but a concept that is here to stay. Those companies that stay on the cutting edge are the ones embracing the technology. They have seen that in order stay competitive today a manufacturer must offer their

customer's better quality, shorter lead times and of course competitive pricing. They have found that in order to offer competitive prices they must reduce their inventory, prevent material waste, decrease set-up times and part loading times. They have lost contracts by pennies and are taking a stand to prevent it from happening again in the future. It will not be long before SSEWW™ is no longer cutting edge, but everyday practice. The sooner every company accepts and adopts the system the sooner they can get ahead of their competition. It is important to choose the right system to aid in the conversion to SSEWW™. Choose the system that is easiest to use, easiest to set-up and the most cost efficient in retrofitting new and old fixtures to work with the system.