Getting Started With Cycle Time Reduction Curriculum:

The need for cycle time reduction

Traditionally, CNC users have not had to run CNC machines at peak potential. The sheer productivity of CNC machines (compared to their manual counterparts) has thrilled many a CNC user. However, things have been changing in the manufacturing environment. Lot sizes are shrinking. Lead times are shorter. Quality expectations are higher. And of course, operating expenses must be reduced.

All of this requires CNC users to provide faster through-put for the workpieces they produce – and a big part of faster through-put is related to reducing the amount of time it takes to complete a production run, which of course, is the plays a big roll in the definition of cycle time.

All CNC users should have a strong interest in cycle time reduction. Even people with years of experience should be interested in finding new ways to minimize cycle time, meaning you should be able to draw from an entirely new student base, dramatically increasing the number of potential students for your CNC courses.

This course will allow you to relate the cycle time reduction from the ground up. The objective of this course curriculum is to help instructors relate concepts, techniques, and ideas that will help students go back to their companies and implement a successful cycle time reduction program.

The presentations of Cycle Time Reduction

We divide the curriculum into three presentations. Each has parallel material in the slide shows (your visuals) and the student manual. Students will be able to easily follow along in their student manual with the presentations you make. And the manual will make an excellent reference when they return to their shops and begin putting this new information to work.

Presentation one: Basic Premises (79 slides, about 1-1.5 hour presentation time)

This short, but important, presentation lays the groundwork for what is to come. Included are presentations that acquaint students with important needs of CNC using companies. We discuss application versus utilization and machine utilization versus personnel utilization to help them understand the reasoning behind improving CNC machine utilization. We also introduce the four CNC-using company types and discuss factors making up a company's corporate identity. And we discuss the importance of value added principles in the CNC environment.

We also include some preliminary information to be sure students understand your intentions. Included are presentations on the importance of reducing setup time, justifying expenses, just what is being reduced, and available resources.

Presentation two: Cycle time reduction principles (70 slides, about an hour of presentation time)

Here you provide a definition of cycle time, introduce the two task types related to running production, and describe the three basic ways to reduce cycle time. You also introduce a four-step procedure for reducing cycle time.

Presentation three: Cycle time reduction techniques (351 slides, about six to eight hours presentation time, depending upon students' level and interests)

In this lengthy presentation, you'll be suggestion countless techniques for cycle time reduction in the approximate order that production runs are completed. Main topics include preparation and organization, workpiece loading, program execution, workpiece unloading, offline tasks done during every cycle, sizing adjustments, and cutting tool replacement. In each main topic, you'll first present typical tasks. Then you'll make recommendations for eliminating tasks, moving tasks off line, and facilitating tasks.

We provide two presentations for some topics, one for machining centers and another for turning centers. During the slide show, you can choose whether you want to present one or the other, or both.

Presentation alternatives

We offer some suggestions about how you can best present this course.

In seminar fashion

As you've seen from the approximate presentation times, you'll be able to complete the lecture portion of this course in a relatively short time. When teaching public seminars, I commonly complete this course in one eight-hour day. But keep in mind that the entire course is lecture, with limited time for anything else. While I do encourage participation in the form of questions, comments, and suggestions, students are not working on any projects or exercises. I'm simply assuming students have a high enough interest to make special note of those principles and techniques that apply most to their CNC environments.

You too can, of course, present this material in seminar format, possibly as part of your continuing education programs. You can hold an eight-hour, one-day course, as I do. Or you can break it up into three or four sessions, over the course of a week or month. (Remember that you'll need to review more if there are long periods between sessions, which, of course, adds to presentation time.)

As part of another course

You may have current CNC-related courses that go beyond the basics. A presentation on cycle time reduction would work nicely in such a course. While we leave the timing to you, this series of presentations could form one of the modules in any advanced CNC course that strives to improve a student's ability to better utilize CNC machine tools. Note, for example, that we have other curriculums aimed at setup reduction, parametric programming, and advanced CNC techniques. These curriculums blend nicely into a more advanced course we call Maximizing CNC Utilization. Again, the eight hours or so needed to present the cycle time reduction material should be easy to incorporate into another, longer course.

As a more traditional course – including exercises and activities

It is possible that you're trying to incorporate this material into a more traditional course for setup reduction. In this case, you'll probably want to include lectures, exercises, and lab work in the course. This curriculum material will, of course, work nicely as the lecture portion of the course. But you'll be on your own to develop exercises, lab work, and group activities – filling in the rest of the time students will be in class.

We have some suggestions for these additional activities. Admittedly, most technical schools have limited resources when it comes to CNC in general and cycle time reducing accessories specifically, but this may actually work to your advantage when it comes to develop cycle-time-reducing activities. Since your school's lab probably lacks in the way of the most up-to-date equipment (as is the case in most companies), you can easily supply some real-world scenarios that allow great room for improvement.

We recommend stressing at least two different approaches to cycle time reduction – one

aimed at people working for a company with limited resources (like most job-shops) and another for companies that have the resources to engineer most aspects of their CNC environment (commonly the case in product-producing companies).

Note that most technical schools tend to stress techniques used by job-shops for several reasons. First, like most job-shops, schools have limited resources. It can be difficult to demonstrate techniques that require greater resources if you don't have the resources in the first place. Second, since most students attending basic courses have no experience, you must stress easy-to-understand ways to accomplish tasks. While this may be great for beginners, the easy way to accomplish a task is seldom the most efficient way.

Again, you probably have some pretty good scenarios to improve upon. You'll be able to help students compare entry-level methods to more advanced methods – with the goal being to improve cycle time.

We recommend that you have students take a hands-on approach. For each major cycle time category, have students practice cycle time reduction using the four-step setup reduction approach given during setup reduction principles. Have them use the cycle time reduction form (a printable handout on the CD-rom disk in the "written documentation" folder).

If your students are coming from industry and they currently work for a CNC using company, we recommend having them use their own company's methods for exercises. If they're not coming from industry (at least not currently working for a CNC-using company), have them work on projects in your school's shop.

With each major cycle time category, have them go through the entire process of reducing cycle time, including the videotaping of each task to be able to evaluate current methods. Here are some specific suggestions for each major category.

Preparation and organization (general)
Use your own shop to show organization techniques. Are hand tools conveniently stored? Where and how are cutting tools stored? What about workholding devices? Would your school's storage and organization methods be appropriate for a manufacturing company? What improvement could be made give better resources? Does everything have a place and put back in its place?

As a specific exercise (possibly a group activity) have students design an operator's work area. Set some criteria (number of workpieces required per day or week, typical lot sizes, typical cycle times, typical workholding devices and cutting tools, etc.) and see if students can come up with appropriate decisions based upon the criteria you set.

Preparation and organization (for a specific job)
Confirm that students can tell when an operator is truly ready to run production. The operator must, of course, have everything needed to run out the job. This involves a lot

of gathering, including raw material, gauges, cutting tool components, and so on. See if students can develop extensive production run documentation to allow all components to be labeled and stored.

Again, be sure students understand that companies have dramatically different needs. If the related tasks cannot be done off line, all of this gathering must, of course be done while the machine is down. In this case, students must be able to design a very efficient storage and retrieval system – keeping everything very convenient to their CNC machine tools. On the other hand, companies that have ample time to perform these tasks off line may want to centralize their storage and retrieval, possibly doing so with a tool crib.

While the time related to having your students design an efficient tool crib may be excessive, be sure they understand the impact of preparation on cycle time. At the very least, assign a project that has them determining the various items that must be gathered.

Workpiece loading
Using one of your own workholding devices, have students videotape loading and unloading workpieces and go through the entire four-step process to reduce this time-consuming task.

Program execution
Run programs that students have written in basic courses and have students come up with suggestions for improvements. Since these programs have been written by entry level programmers, there should be lots of room for improvement!

Tool maintenance
You should be able to come up with lots of ideas related to helping students understand the real-world problems related to cutting tool maintenance. Major topics could include sizing adjustments, dull tool replacement, and minimizing trial machining after tool replacement.

About the student manual
Again, the student manual includes all three presentations. It should make for excellent homework reading assignments, and should provide a good reference for students when they actually start applying the techniques they've learned.

Take it on the road!
This material can, of course, be taught on an in-plant basis. There are many portable projection systems available. See the various methods to display the slide shows later in this document. The least expensive way (if you don't have a portable projector) is a laptop computer with TV-out and a television.

Instructor materials

This curriculum truly minimizes the preparation you must do to get ready to teach! Here's what's included:

Microsoft PowerPoint slide presentations

PowerPoint is becoming the presentation software of choice by most presenters. These presentations total over 450 slides to provide your visuals for the course. Note that they're developed in PowerPoint 2000 (which is part of Microsoft Office 2000). We actually offer two sets of slide shows, one with audio guidance and the other without. Audio guidance will help you understand how to present material in the course. On selected slides, you'll find an instructor icon (as well as a stop-play icon) that, if clicked, plays an oral description of what you're supposed to be doing at the current point in the slide show. Note that the slideshows with audio guidance are quite long and will take a long time to load (distracting during a class), so we provide another set of slide shows without guidance that will load much faster. The two sets of slideshows are provided on the CD-rom in aptly named folders.

Guidance during slide shows

Again, one set of slideshows includes audio narrations (we call guidance) to help you understand how to make your presentations. Note that these narrations are not intended for your students. Each is directed at an instructor getting ready to teach the course. A special icon on selected slides can be activated to play the related narration.

Microsoft PowerPoint Viewer

Though we highly recommend that you have the actual PowerPoint software, we do include the PowerPoint Viewer. It does allow you to display the slide shows, but you'll have no way to modify them. Additionally, the slide shows are quite long (one over 300 slides). PowerPoint Viewer does not allow you to move around in the slide show nearly as easily as the actual PowerPoint software.

Ability to print slide show hard copy

PowerPoint allows you to print a hard copy of each slide show (Microsoft calls this printing *handouts*). This may help you prepare if you don't have the computer available. You can include 4, 6, or 8 slides per page.

Free phone assistance

Again, there's a lot of information in this curriculum. If you have questions about any topic, we welcome your phone calls (847-639-8847). Or email us at lynch@cncci.com.

Student materials

While your presentation is an extremely important part of the learning environment, your students must have reference material.

135 page student manual
This extremely comprehensive manual follows along with your presentation step-by-step. Though we don't recommend actually reading from it, students should be able to easily follow along in the manual. It will make for excellent homework reading assignments. And, it's an excellent way for students to review material once the course is finished. Because there is so much information in the book, we recommend that students have some way to remember key pages (a highlighter pen or post-it notes to act as tabs in the book work nicely).

What you still need

In order to show the PowerPoint slide presentations to a group of people, you need the following items.

A computer with Windows 98 (or higher) - Just about any current model computer will work. For best results, Pentium class is recommended (minimum 64 megs internal). If using a desktop computer, you can easily watch the monitor of the computer (facing your audience) to see the slide show as slides are displayed behind you by the projection system. Since the left mouse button advances the slides, you even have a remote slide advance button (as is commonly used with a 35 mm slide projector). If portability is an issue, keep in mind that many of the notebooks and sub-notebooks have ample power to run the presentation software. However, be careful in your selection. Many notebooks do not allow you to send data out through the VGA port *and* see the slide show on the LCD screen of the notebook at the same time. Without this ability, you may have to turn around to see your slides, which can be distracting to your audience. Also, for maximum flexibility, look for a laptop that has the TV-OUT feature. This lets you send composite video to any television that has a TV-IN port with a simple RCA cable.

Microsoft PowerPoint Software (PowerPoint 97 version was used to create the slide show) - Though you can display all presentations with PowerPoint Viewer (included with this curriculum), you will need Microsoft PowerPoint if you intend to modify the slide shows given in this curriculum (and to easily get around and start the slide show from any slide). We highly recommend that you have this ability. This software can be found in any computer store for a price of about $250.00 (it also comes with most editions of *Microsoft Office*). You will find this to be a very powerful presentation-generating program; one you can use to develop your own slide shows for other courses (or of course, modify those in this course curriculum).

A way of displaying the slideshows - You have several alternatives in this regard. Most involve using a device that takes data from the VGA port of your personal computer. First, many schools already have a projection system that can display information from a personal computer. Basically, anything that can be shown on the computer screen can be displayed through the projection system. Second, you can use a device that sits on top of an overhead projector to display your screen shows. In essence, this device makes a transparency of what ever is on the display screen of the computer (I don't like this kind because the light from the overhead is very bright and hurts my eyes). Third, and

especially if price is a concern, you can use a simple scan converter (about $200.00 - $300.00) and display your screen show on any television that has a *video in* connector (as most do). Note that many laptops are now coming with a TV-OUT port, having this scan converter built in to the computer. If you must use the RF connector of the television (where an antenna plugs in), an RF converter must be purchased. Since there are so many alternatives for displaying your slide shows, we welcome phone calls (847) 639-8847 if you have questions about your alternatives.

A note about the students you'll attract

In my experience, experienced CNC people have a rather narrow focus. They know a lot about the things they must do every day, but little or nothing about other important CNC-related topics. I'm always amazed by how surprised experienced CNC people are about many relatively basic features they just haven't been exposed to. For example, a person that does general purpose CNC machining will know little about five axis machining – and vise versa. Be sure to take advantage of your students' strong points. As you present the course, be sure to solicit questions and comments each step along the way. We encourage student participation quite often during the slide presentations (at the end of each major topic in setup reduction techniques, for example). The more you can get people to contribute during the class, the better the class will be. And you may be able to collect ideas for future classes!

Remember that your students for this course may have (possibly extensive) CNC experience. I've found that most catch right on to the presentations being made, even for those topics that they've never been exposed to. With the exception of techniques that require parametric programming, you can minimize the tutorial method you're probably using to teach your basic CNC courses. While reviews are still helpful, they can be minimized. Instead of lengthy reviews at the beginning of each session, I simply poll the class for questions. When students have questions, I'll dig back in as deep as necessary to make sure they understand. And I will, of course, bring everyone up to speed on where we left off in the last session, but I do minimize review time.

Putting It All Together

Getting Ready To Teach

As stated earlier, though these course curriculums dramatically reduce the amount of preparation you must do, they do not eliminate it completely. And as any experienced instructor will agree, the key to successful presentations is in becoming comfortable with the material you present. And the only way to get comfortable is through adequate preparation.

Before your first course:

Skim the entire curriculum (at least those modules included in your current course) - Though you do not have to be perfectly comfortable with every detail of the curriculum to begin teaching, you will at least need to understand where the course is going. You can use the course outline, guidance in the slide shows, and student manual to gain an appreciation for the material being presented.

Before beginning each module:

Get comfortable will all discussions in the presentation - While some presentations are relatively short, most are lengthy. Be sure you feel comfortable with all points you need to make before you begin teaching. Again, use the course outline and student manual to increase your comfort level with the entire module.

Before you deliver a session:

Get ready to teach! - Study the lesson plan, guidance, and slide presentation in order to gain an understanding of key points that must be delivered during your presentation. Because modules vary in length, be prepared to review material covered in previous sessions if appropriate.

During your presentation of each session:

Tell them what you're going to tell them - The lesson plan (key points in the slide show at the beginning of each module) will help you prepare your students for what they will be learning. While you don't have to dwell on this slide too long, it will help them know what is coming up.

Tell them - Go though the session, using your slide show as a guide. Be sure to point out the page numbers and sections in the student manual where the information is also included for their own independent study. Be sure everyone is catching on. Encourage participation, questions, and comments. In fact, some of the best suggestions for future additions to your class will come from students. You'll be getting some pretty high level attendees, so take advantage of this opportunity. Have a blackboard or overhead available for making special points.

Tell them what you told them - The lesson summary (included in the slide show for each module) will let you summarize the key points of each lesson.

As you get deeper into the course:
Review often - No student will retain every word of every presentation you make during a course as lengthy as these. On average, you should spend about 10% to 20% of your session time in review, depending upon how well your students are doing. The more problems they are having, the more time you should spend on review.

Let students know where they stand - Be sure everyone knows how they are doing as they progress through the course.

Cycle Time Reduction Planning

Part name:	Part #:	Process #:

Step One - Evaluation of current cycle

Program run time:	Button-to-button time:	Throughput time:

Workpiece load

On-line tasks		Off-line tasks	
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
	Total:		Total:

Program execution (all on-line)

Tool 1:	Cutting time:	Non-cutting time:
Tool 2:	Cutting time:	Non-cutting time:
Tool 3:	Cutting time:	Non-cutting time:
Tool 4:	Cutting time:	Non-cutting time:
Tool 5:	Cutting time:	Non-cutting time:
Tool 6:	Cutting time:	Non-cutting time:
Tool 7:	Cutting time:	Non-cutting time:
Tool 8:	Cutting time:	Non-cutting time:
Tool 9:	Cutting time:	Non-cutting time:
Tool 10:	Cutting time:	Non-cutting time:
Tool 11:	Cutting time:	Non-cutting time:
Tool 12:	Cutting time:	Non-cutting time:
Tool 13:	Cutting time:	Non-cutting time:
Tool 14:	Cutting time:	Non-cutting time:
Tool 15:	Cutting time:	Non-cutting time:
Tool 16:	Cutting time:	Non-cutting time:
Tool 17:		
Total run time:	Total:	Total:

Workpiece unload

On-line tasks		Off-line tasks	
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
	Total:		Total:

Cycle Time Reduction Planning

Workpiece inspections and SPC reporting

On-line tasks		Off-line tasks	
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
	Total:		Total:

Workpiece sizing (offset adjustments to allow for tool wear)

On-line tasks		Off-line tasks	
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
	Total:		Total:

Cutting tool maintenance

On-line tasks		Off-line tasks	
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
	Total:		Total:

Machine cleaning and preventive maintenance

On-line tasks		Off-line tasks	
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
	Total:		Total:

Secondary operations (hopefully all off line)

Task:	Time:	Task:	Time:
Task:	Time:	Task:	Time:
	Total:		Total:

Totals

Total time for on-line tasks:	Total time for off-line tasks:

Cycle Time Reduction Planning

Step Two - Brainstorming for improvements Based on your evaluation, list potential areas of improvement.

Eliminating tasks:

Related task:	Idea:	Cost/Difficulty	Gain:

Moving tasks off line:

Related task:	Idea:	Cost/Difficulty	Gain:

Facilitating tasks:

Related task:	Idea:	Cost/Difficulty	Gain:

Cycle Time Reduction Planning

Step Three – Prioritize and assign responsibilities

Using ease of implementation, cost effectiveness, and the potential for return as your guide, prioritize your ideas for improvements.

Priority:	Improvement:	Assigned to:	Completion date:
1			
2			
3			
4			
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25			

Step Four: Gauging success	Original button-to-button time:	Original throughput time:

With each major improvement (or group of improvements), you'll want to confirm that the improvement had the expected result. What you'll likely find is that by implementing one improvement, another will occur to you (this is quite common in any continuous improvement program). By repeating step one (the evaluation step) at regular intervals, you'll be able to gage the true effect your improvements have had on cycle time.

Date:	Improvements since last evaluation:	New button-to-button:	New throughput: