Welcome to NTC 2019 and Cleveland, Ohio
High Speed Machining, Part II

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Modern Machining Platforms & the Power of Parallel
Building on CDA Data

• Bar feeds with 12 foot bars may limit the highest surface feet, but speeds and feeds could be increased on most CNC equipment
• Opens the door on non-lead brass sfm
• Combine this new research with overlapping tools on CNC platforms to maximize productivity
Power of Parallel

• Simplest version is this: the more tools in the cut at one time (parallel), the shorter the cycle time

• Multi-spindle machines are a great example of overlapping tools

• With these machine you can get 16 or more tools in the cut simultaneously
Power of Parallel Multi-Spindle

- Cam-operated multis have long setup times and are not economical for smaller lot sizes.
- They require a lot of expertise to setup and maintain.
- When using high speed form tools, overlapping sfm is frequently limited.
- CNC multis can use standard carbide tools and adjust sfm for each spindle, but remain rather expensive.
Power of Parallel Single Spindle

- Cam-operated Brown & Sharpe, Traub, Index can overlap 2, 3, or 4 tools at once
- Setup time is less than multis, but still require several hours to setup
- When using high speed form tools, overlapping sfm is frequently limited
- Require extensive knowledge to setup and maintain
History of CNC Turning
Single Spindle, Single Turret

- Use standard carbide inserts
- Very versatile (programmable)
- Excellent size control and finishes superior to form tools
- One tool at a time, whether turret or gang style lathes
- Cannot always drop parts complete
Paradigm Shift

I'll tell you what this means, Norm -- no size restrictions and screw the limit.
History of CNC Turning
Twin Spindle, Single Turret

• Use standard carbide inserts
• Very versatile (programmable)
• Excellent size control and finishes superior to form tools
• One tool at a time, whether turret or gang style lathes
• Can drop many parts complete, but not fast
History of CNC Turning
Twin Spindle, Twin Turret

- Use standard carbide inserts
- Very versatile (programmable)
- Excellent size control and finishes superior to form tools
- Two tools at a time (main & sub), whether turret or gang style lathes
- Good for parts with relatively equal amounts of machining on each side
History of CNC Turning
CNC Screw Machines

• Index and Traub made several versions of CNC screw machines throughout from the 1980’s to present day
• Traub made both fixed headstock and Swiss-style machines
• Index made fixed headstock CNC screw machines
• Capable of overlapping 2 or more tools at once
• Very capable machines, lots of live tool options
History of CNC Turning

CNC Screw Machines

- Index and Traub were among the earliest builders to employ CNC drives on fixed headstock screw machines.
History of CNC Turning

CNC Swiss

• Almost at the same time, CNC Swiss machines were developed
• Lighter duty, with only two tools overlapping, they were also less expensive than the larger, fixed headstock machines
• CNC Swiss machines became the standard in the USA for CNC screw machines
• Exceptional for long length to diameter ratios and smaller parts with lots of live tool needs
History of CNC Turning
CNC Swiss

• With success in the smaller diameter machines, the screw machine industry wanted answers for larger diameter work.
• Responding the Swiss manufacturers made larger diameter machines and made guide bushings optional.
• When machining larger diameters, the fixed headstock machines are more rigid and can remove material faster.
• Many Swiss users admit they could run some of the parts faster on a fixed headstock, but the expense is too much and the technology is different.
History of CNC Turning

CNC Swiss

Sliding headstock companies were the first screw machine builders to embrace CNC technology.
History of CNC Turning
CNC Screw Machines

- LICO began making Traub-style cam screw machines in the late 1970’s
- Building on their knowledge of slides and spindles, they began work on a CNC screw machine early 1990’s
- The first version was an LNTS and they introduced it into the USA in mid-2000’s
- Since then they introduced the LNDD machine platform in 2012
Fixed Headstock Multi-Axis, Multi-Slide Machines Arrive

• As stated, Traub & Index began making this type of machine in the 1980’s
• In the 1980’s, Brown & Sharpe made a CNC screw machine, limited to single axis slides
• DMG made a multi-slide machine, but no longer sells it in the USA
• LICO started the LNTS model in the 1990’s and brought it to the USA in mid-2000’s
A new customer referred to the LNTS as a ‘Brown & Sharpe on steroids’. All slides and turret are two-axis and all can operate simultaneously – or in parallel.
Power of Parallel !!!

Serial Machining Cycle Time is $34.7 + 15.1 = 49.8$ seconds

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<th>Feed Bar</th>
<th>Drill</th>
<th>Rough Turn</th>
<th>Finish Turn</th>
<th>Chf ID</th>
<th>Sync &amp; Chuck</th>
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<th>Face/Turn</th>
<th>Chf ID</th>
<th>Form Tap</th>
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Customer part cycle on a twin spindle, single turret CNC lathe. Cutting parameters have been optimized.
Power of Parallel !!!

Serial Machining Cycle Time is $34.7 + 15.1 = 49.8$ seconds

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Subspindle = 15.1 seconds

Twin Turret Parallel Process Cycle Time is 34.7 seconds

Main Spindle = 34.7 seconds with overlap of subspindle

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Subspindle = 15.1 seconds with overlap (parallel)

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Cycle time is reduced by 15.1 seconds (30%)
Productivity is increased by 44%
Power of Parallel !!!

Serial Machining Cycle Time is 34.7 + 15.1 = 49.8 seconds

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LICO Parallel Process Cycle Time is 22.6 seconds

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<tr>
<th>Feed Bar</th>
<th>Drill</th>
<th>Finish Subspindle Work</th>
<th>Chf ID</th>
<th>Sync &amp; Chuck</th>
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Subspindle = 15.1 seconds with overlap (parallel)

Cycle time is reduced by 27.2 seconds (54%)
Productivity is increased by 83%
• Both the LNTS and LNDD are capable of putting up to 5 tools in the cut simultaneously.
Modern Machine Tools Available Today for High Speed Machining

- CNC multi-spindles and rotary transfer machines are tops for high volume
- They can produce almost any product bar to box
- They can make those products very quickly
- Expensive, but for high volumes, they are the most productive option (lots of parallel)
Modern Machine Tools Available Today for High Speed Machining

- For single spindle production, the multi-slide, multi-axis machines yield cost-effective production
- On repeat work, setup between 20 and 40 minutes
- Economical (3 or 4 of these machines compared to one CNC multi-spindle)
- Run without the extreme mechanical knowledge required for cam machines
- Fast, due to the overlapping of tools
Modern Machine Tools Available Today for High Speed Machining

• Parts can be machined from any of the cross slides and the turret (LICO), or turrets (Index) simultaneously
• When multiple tools are employed, the cycle time is reduced
• Number of slides depend on part configuration
• Using carbide tools for overlapping, the average sfm will be greater on CNC machines than with high speed forms on screw machines
Modern Machine Tools Available Today for High Speed Machining

• Expect improved surface finishes versus form tools, sometimes eliminating a grind
• Ability to hold tighter tolerances
• Live tool capability to increase your part portfolio
• Improved throughput over other single spindle machines (CNC or cam)
Four tools in the cut, three cross slides and the back work
High Speed Machining Economics
Cam Multi-Spindles

- Short runs are practical without sacrificing too much cycle times because of setup time
  - 4 – 12 hours versus 20 to 40 minutes
- Throughput can be faster when considering machine utilization
- Improved surface finish, tolerance, and ability to drop parts complete
- Run lightly-tended/lights-out
High Speed Machining Economics
CNC Multi-Spindles/Rotary Transfer

• Changeover time can be long versus CNC single spindles
• Multiple single spindle machines may be more economical than one CNC multi
• If one machine goes down, you are still making most of your production
High Speed Machining Economics
Cam Single Spindle

• Reduce setup time
• Cycle times similar or shorter
• Average machine utilization is 90%, so even longer cycle times may have greater throughput
• Ability to run lightly-tended/lights-out
High Speed Machining Economics
CNC Single/Twin Spindle, Single Turret

- Cycle times are much faster on multi-slide/multi-axis machines
- Cycle times are shorter due to overlapped tools
- Drop parts complete that these machines cannot complete
High Speed Machining Economics
CNC Twin Spindle, Twin Turret

- Two tools in the cut versus 3 or 4 tools
- When most of the work is done from one end, multi-slide, multi-axis machines are faster
- When work is evenly balanced, the tool advantage is lessened
High Speed Machining Economics
CNC Swiss

• When you have Swiss work to do, nothing else will work
• Large parts, with a lot of material removed will run faster on fixed headstock, multi-slide machines
• More rigidity means faster feed rates
• Larger IC tools for deeper cuts
• Shorter bar ends for less scrap
High Speed Machining Economics
Customer Examples – CNC Brownies

• Replaced CNC ServoCam UltraTurn Brownies
• Setup time reduced 75%
• Cycle times reduced or similar, 3X faster than CNC lathes
• Increased machine efficiency
  – Brownies at 70% to 75%
  – Average 93% efficiency on LICO machines
High Speed Machining Economics

Customer Examples – CNC Brownies

• Summary
  – Average 20% to 25% total production over ServoCam Brownies
  – Average 77% cycle time improvement over CNC lathes
  – Finishes and tolerances clearly superior over form tool finishes
  – All tooling is standard, no special form tools
High Speed Machining Economics
Customer Examples – Cam Multis

• Acme setups average 6 to 8 hours versus 20 minutes
  – Some machines tooled for multiple jobs, 5 minute changeover

• Cycle times on Acmes 9 seconds, on LICO 12 seconds

• Machine efficiency under 50% for Acmes, hand deburring parts

• 90% efficiency on LICO machines
High Speed Machining Economics

Customer Examples – Cam Multis

• Summary
  – One person per machine with Acmes, now one person runs three machines
  – No secondary handling, run and wash
  – With machine efficiency, each machine outperforms the multis
  – Triple the production per person
High Speed Machining Takeaways

- As always, the right machine depends on material, tolerances, lot size, production frequency and part configuration
- In the CNC world, overlapping tools is clearly the path to productivity
- Combined with some of the new speeds/feeds developed by CDA, faster production rates should be attainable
High Speed Machining Takeaways

• Come see for yourself
• Absolute Machine Tools will have a variety of production equipment running parts on the PMTS floor
• Booth number 3050