T-SIM SOLUTIONS

Unlock the Highest SPM from your Servo Transfer Press

Prepared for:

Mark Hansen – Transfer Simulation & Optimization

T-SIM SOLUTIONS

division of 3D

Providing Software, Engineering, and Technical Services to the Metal Stamping Industry

- 15 years in business
- OEMs, Tier-Ones
- Build & Design Shops

- Automate Die Design
- Transfer Simulation
- Full Optimization

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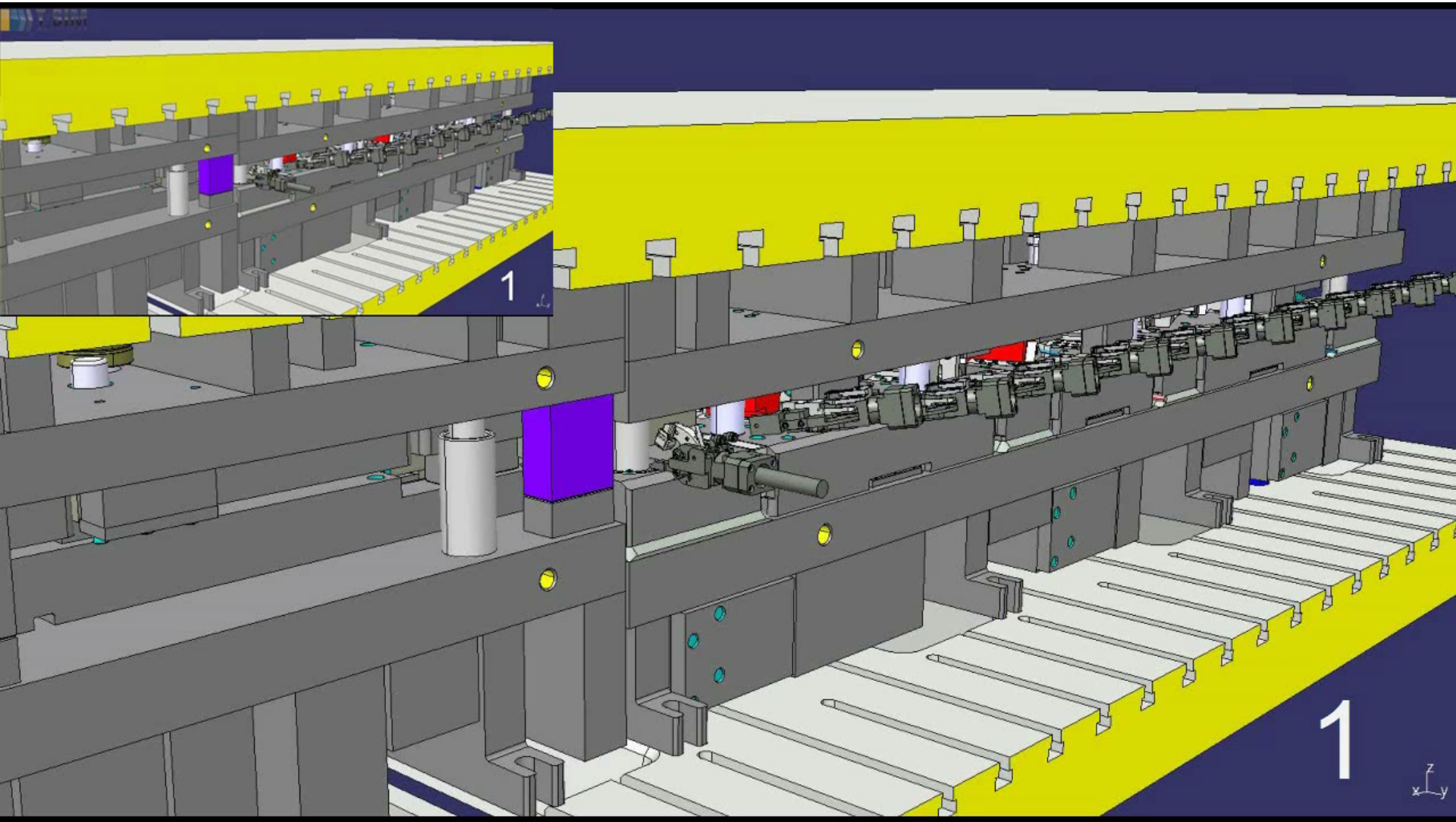
Topics we will cover:

1. Why SPM is important to Stampers and Build shops
2. Fix the information disconnect between die build and production stamping
3. Find and remove bottlenecks that limit servo press and transfer system speed
4. Add value to your transfer dies by designing and building for production
5. Get your servo press in sync with the transfer system and the transfer die
6. Recommendations for transfer simulation and optimization

1. Why SPM is Important

T-SIM (case study): Actual before and after transfer timing – SPM improvement



1. Why SPM is Important (case study)

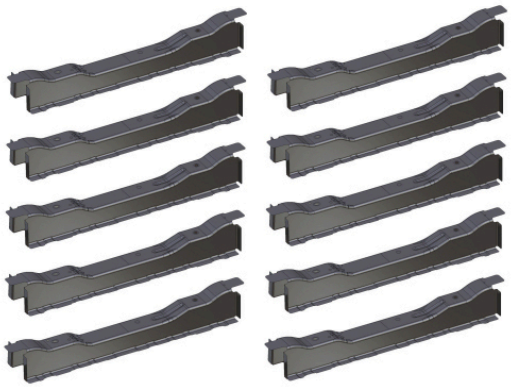
One minute of production:

Mossini 1100 servo press, Norda servo transfer

7 station one-out transfer die in production.

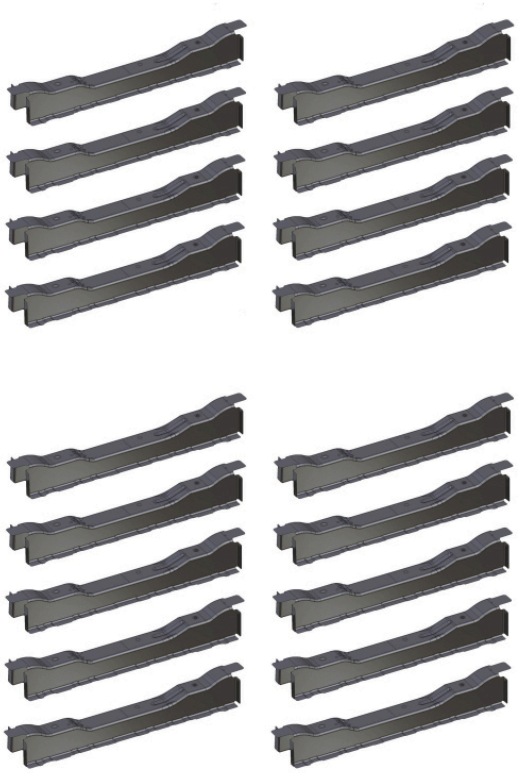
Minor changes to die, ram & transfer timing.

Before: 10 SPM



After: 18 SPM (80% increase)

T-SIM Simulation/Optimization



1. Why SPM is Important (case study)

Annual production = 218,000 parts required

Before = 420 net hours press time required

After = 246 net hours press time required

174 production hours saved annually

Press production cost = $600 per hour

Annual press savings = **$104,400**

Press savings 5 years = **$522,000**

And… 174 hours of press time available annually to run other dies

1. Why SPM is Important

- More SPM = Higher revenue in production
- Increase ROI time on existing equipment
- Ability to better balance current workload
- OEM customer demands are met on time
- More time for scheduled maintenance
- Increase capacity for existing press lines
- Opportunities for future business growth
- More competitive in pricing and production

WHY DO SO MANY TRANSFER DIES HAVE POOR SPM RATES?

WHY DO TRANSFER DIES & FINGERS TAKE SO LONG TO SET UP?

2. Information Disconnect - Problem

Problems:

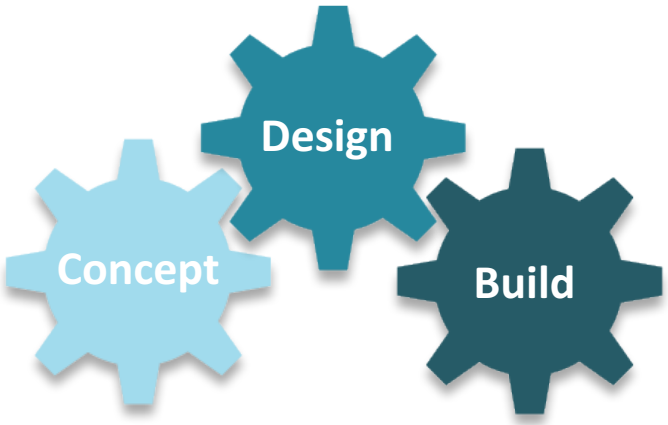
Dies arrive at stamper without instructions

Press operator guesses at finger placement in the die

Dies not designed for production – problems, headaches!

Trial-and-error method used to develop transfer timing

Unable to properly sync servo ram and transfer



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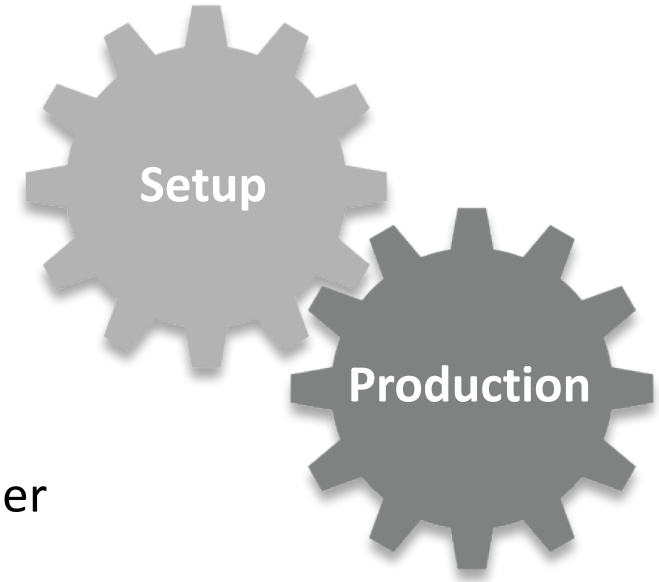


Die only has to make minimum SPM required

More back-and-forth between build shop & stamper

2. Information Disconnect - Problem

Risks:

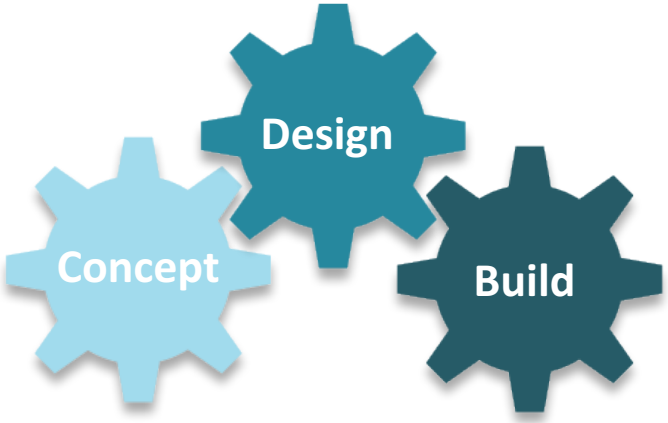
Expensive rework to clear finger locations

Additional hours required getting dies up and running

Strained relationship between build shop and stamper

Servo press & transfer ran like a mechanical press

Dies achieve a dismal SPM rate



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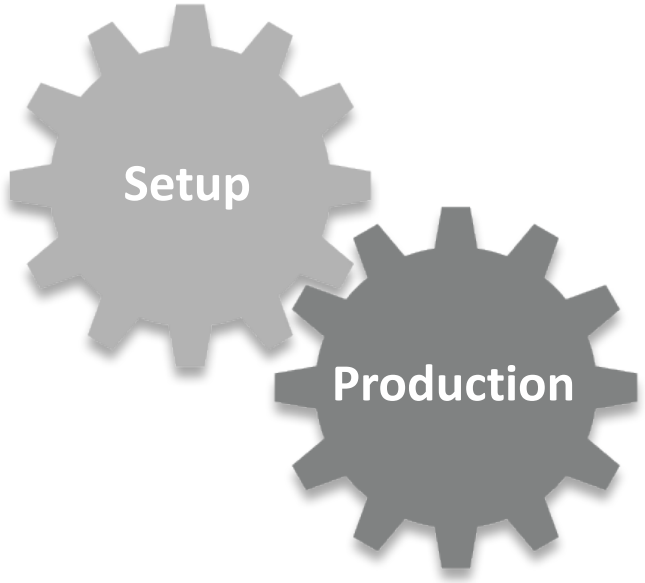


Loss of profits for everyone

Loss of opportunity for future work

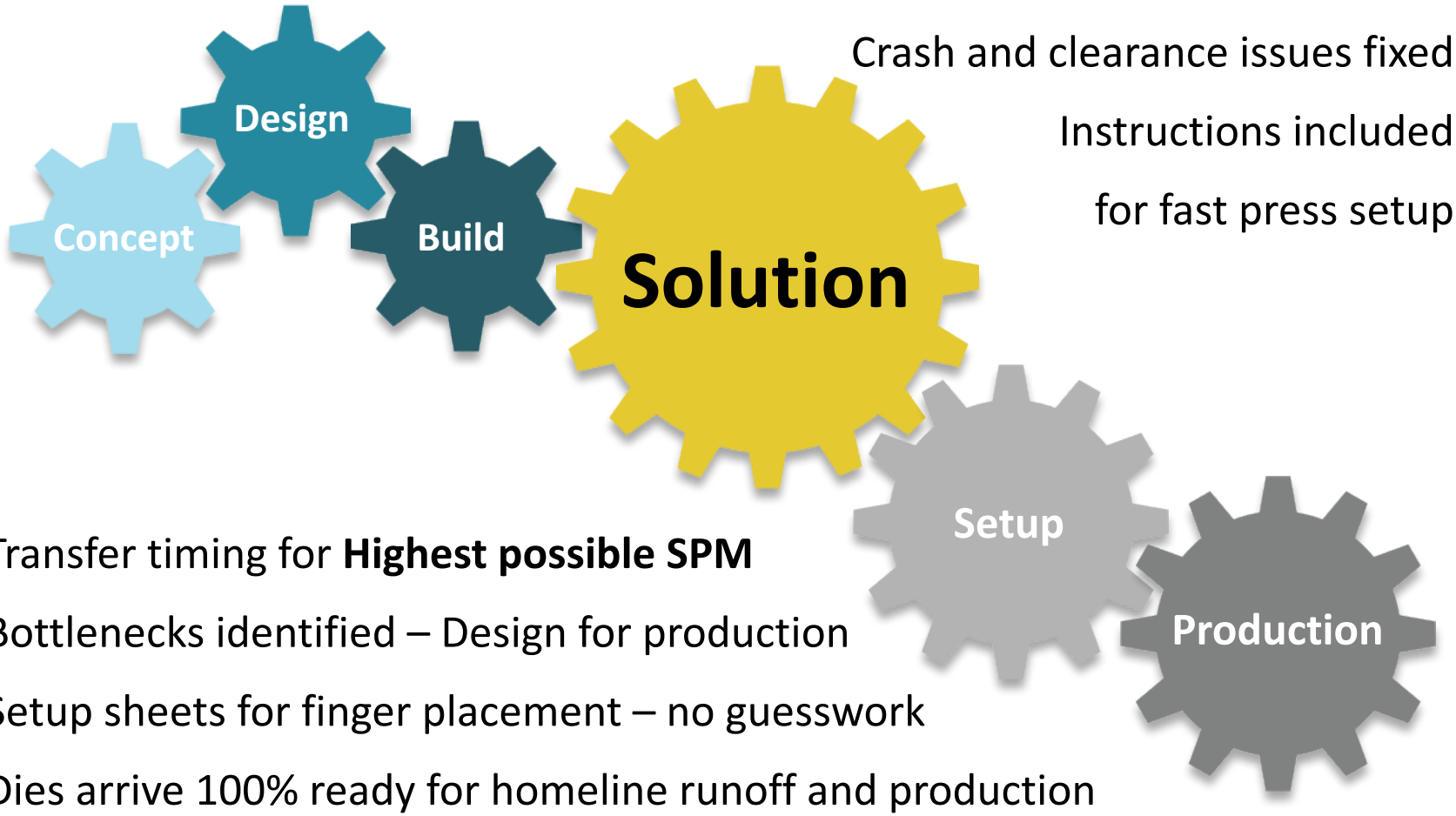
2. Information Disconnect - Solution

Solution: Kinematic Transfer Simulation using press & transfer specs

Crash and clearance issues fixed

Instructions included

for fast press setup



Transfer timing for **Highest possible SPM**

Bottlenecks identified – Design for production

Setup sheets for finger placement – no guesswork

Dies arrive 100% ready for homeline runoff and production

2. Information Disconnect - Solution

T-SIM (case study): From start of initial setup to running high SPM = 4 hours

2. Information Disconnect - Solution

T-SIM (case study): From start of initial setup to running high SPM = 4 hours

2. Information Disconnect - Solution

Benefits: All crash and clearance issues are fixed before die is built

Setup instructions included with the die for fast press setup

Transfer timing for **Highest possible SPM**

Bottlenecks identified – Design for production

Setup sheets for finger placement – no guesswork

Dies arrive 100% ready for production – NO HEADACHES!

3. Find and Remove Bottlenecks

Bottleneck (bot-l-nek) dictionary meaning:

- (noun) place in a process where progress is impeded
- (verb) to hamper, confine, or hinder production

SPM Bottlenecks that limit production:

- **Distance**

  Ask: What determines amount of clamp, lift, and pitch required?

- **Time**

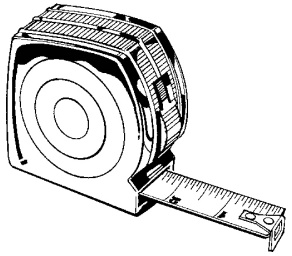
  Ask: What determines when clamp, lift, and pitch must happen?

- **Obstacles**

  … are the answers to the above questions!

3. Find and Remove Bottlenecks

SPM Bottleneck – Distance:



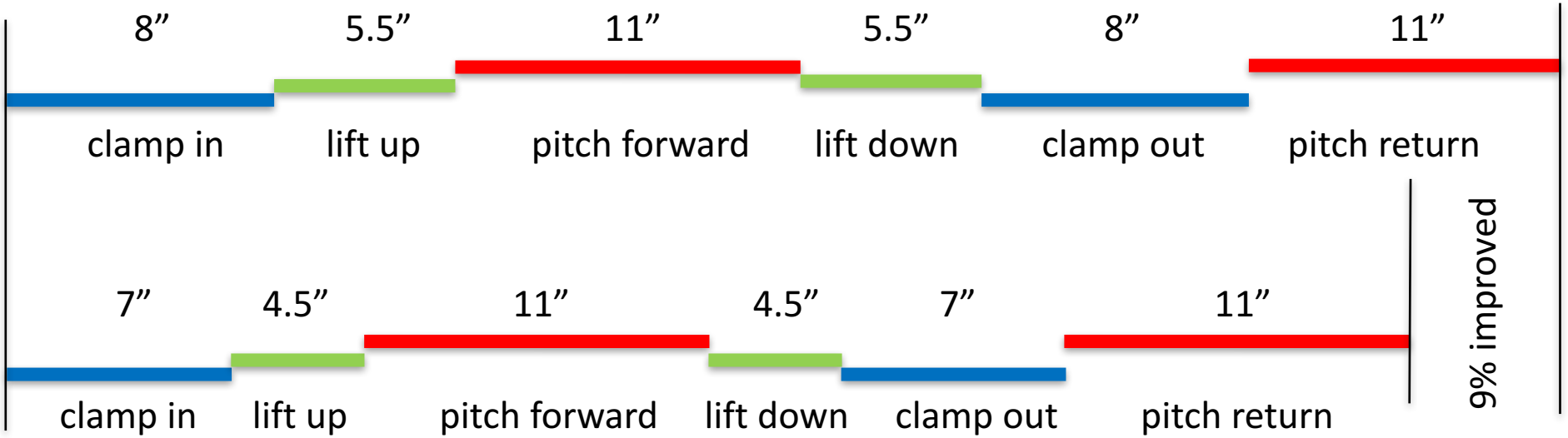
- Distance for transfer system to Clamp, Lift and Pitch
- Requires more time to travel a longer distance
- Excessive clamp distance requires longer (unstable) fingers
- May require switching to a larger press due to bar spread
- Park position difficult to reach without finger interference
- Lift is already slower than clamp because panels are present
- Pitch distance set early in design process – fixed once built

Remedy – Reduce Distance!

- Design for production, not just to make a good part

3. Find and Remove Bottlenecks

Linear graph showing distance reduced:



3. Find and Remove Bottlenecks

SPM Bottleneck – Time:

- Time required for transfer to Clamp, Lift and Pitch

Remedy – Run faster?

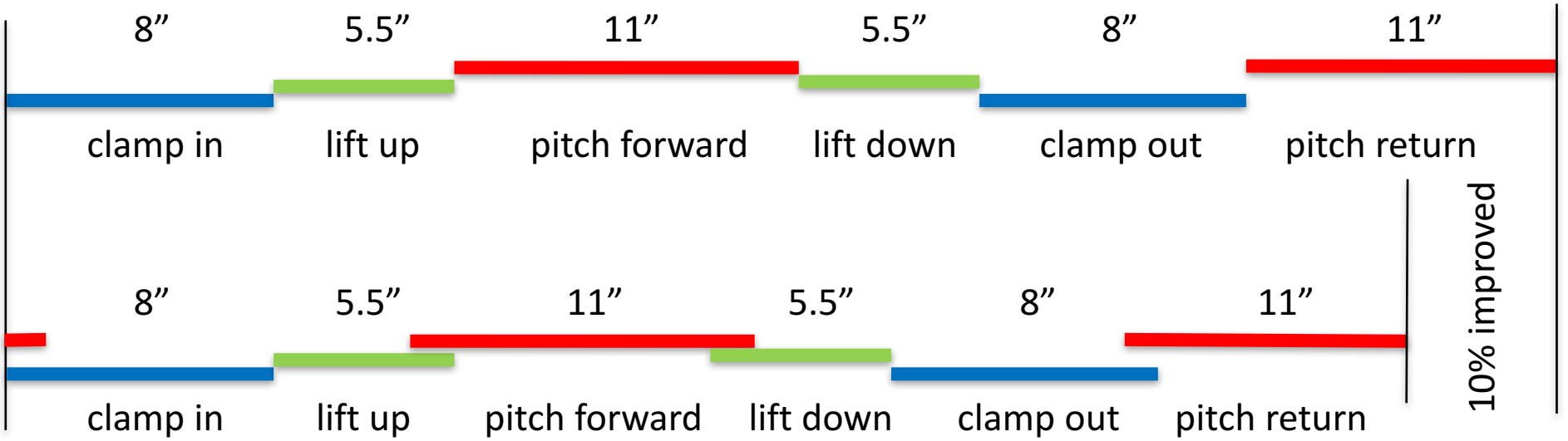
- Clamp in/out and pitch return have max accel and velocity limits
- Lift up/down and pitch forward have part/panel control limits

Remedy – Overlap!

- Doing two things at once means the time for one is free
- Significantly reduces overall transfer time
- Smoother panel movement (less “jerk”)
- Easier to change direction with a rounded corner vs. sharp corner

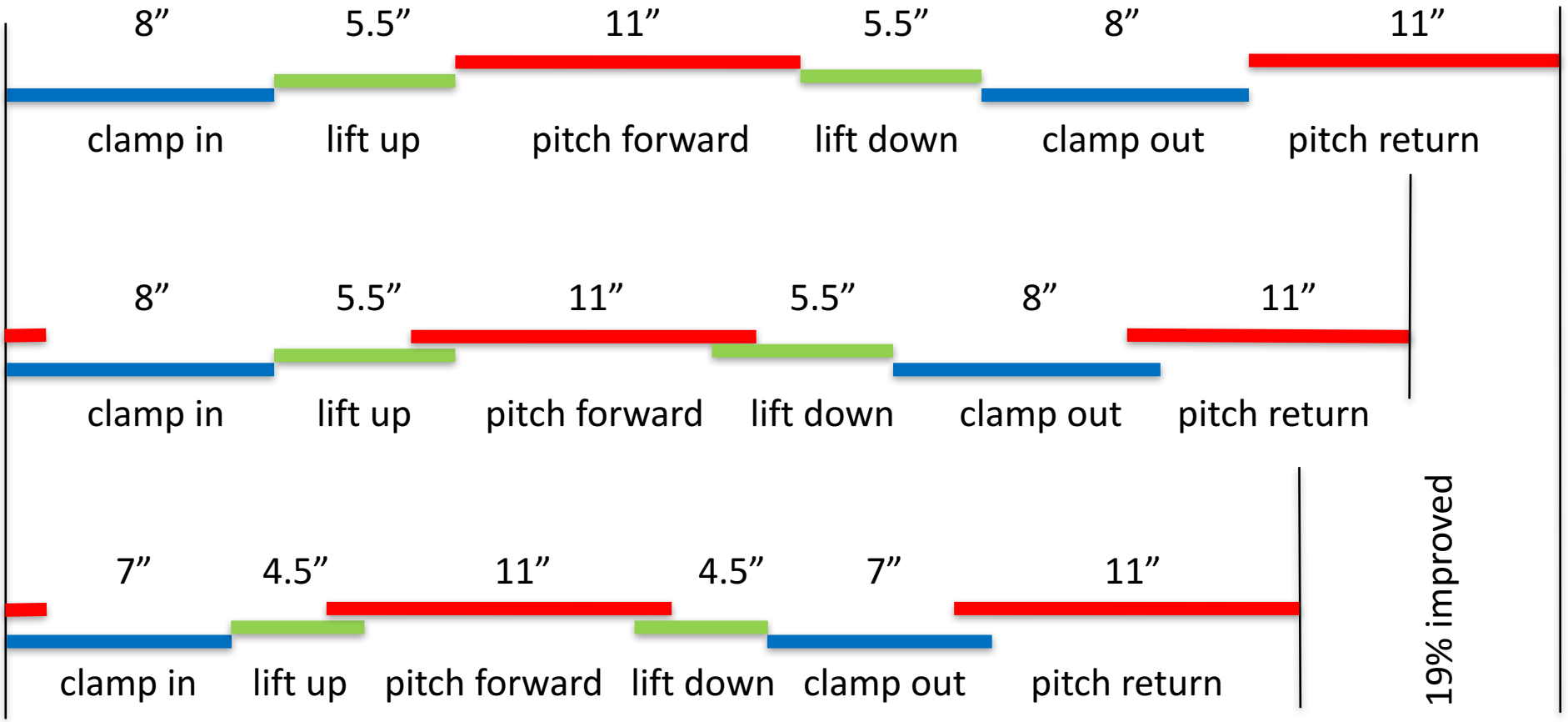
3. Find and Remove Bottlenecks

Linear graph showing overlap added:



3. Find and Remove Bottlenecks

Linear graph showing <u>overlap added</u> AND <u>distance reduced</u>:



3. Find and Remove Bottlenecks

SPM Bottleneck – Obstacles (determine distance and time):

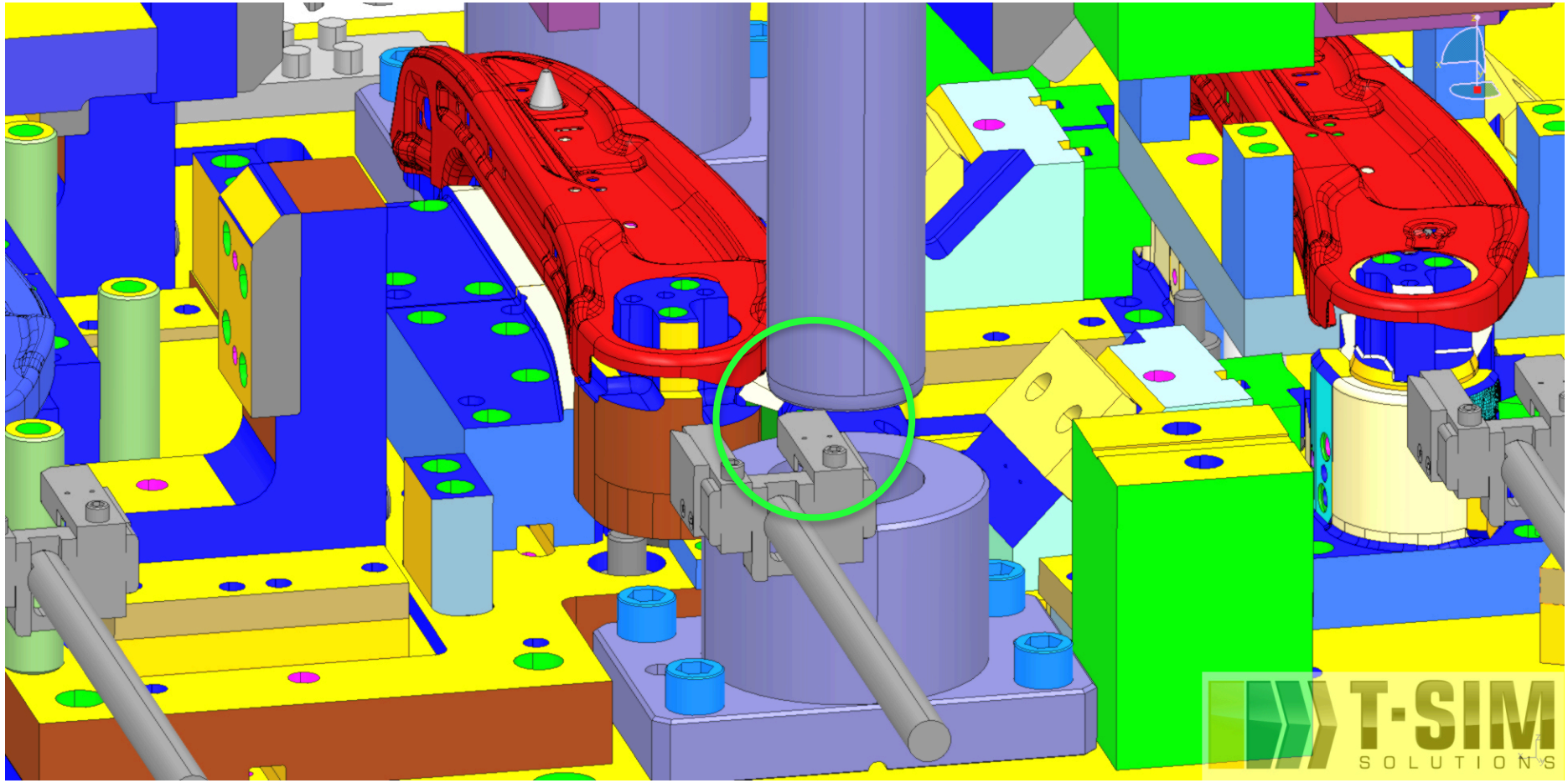
- Increase distances required for clamp, lift, and pitch
- Delay clamp in and out timing – significant impact on SPM
- Reduce allowable overlap between lift up and pitch forward
- Reduce allowable overlap between pitch forward and lift down
- Hamper pitch return when die is closed – increase clamp distance

Remedy – Remove Obstacles!

- Relocate hanging upper components that delay clamp in / out
- Alter items affecting lift up-to-pitch and pitch-to-lift down overlaps
- Make sure pitch return path is clear and minimize clamp distance

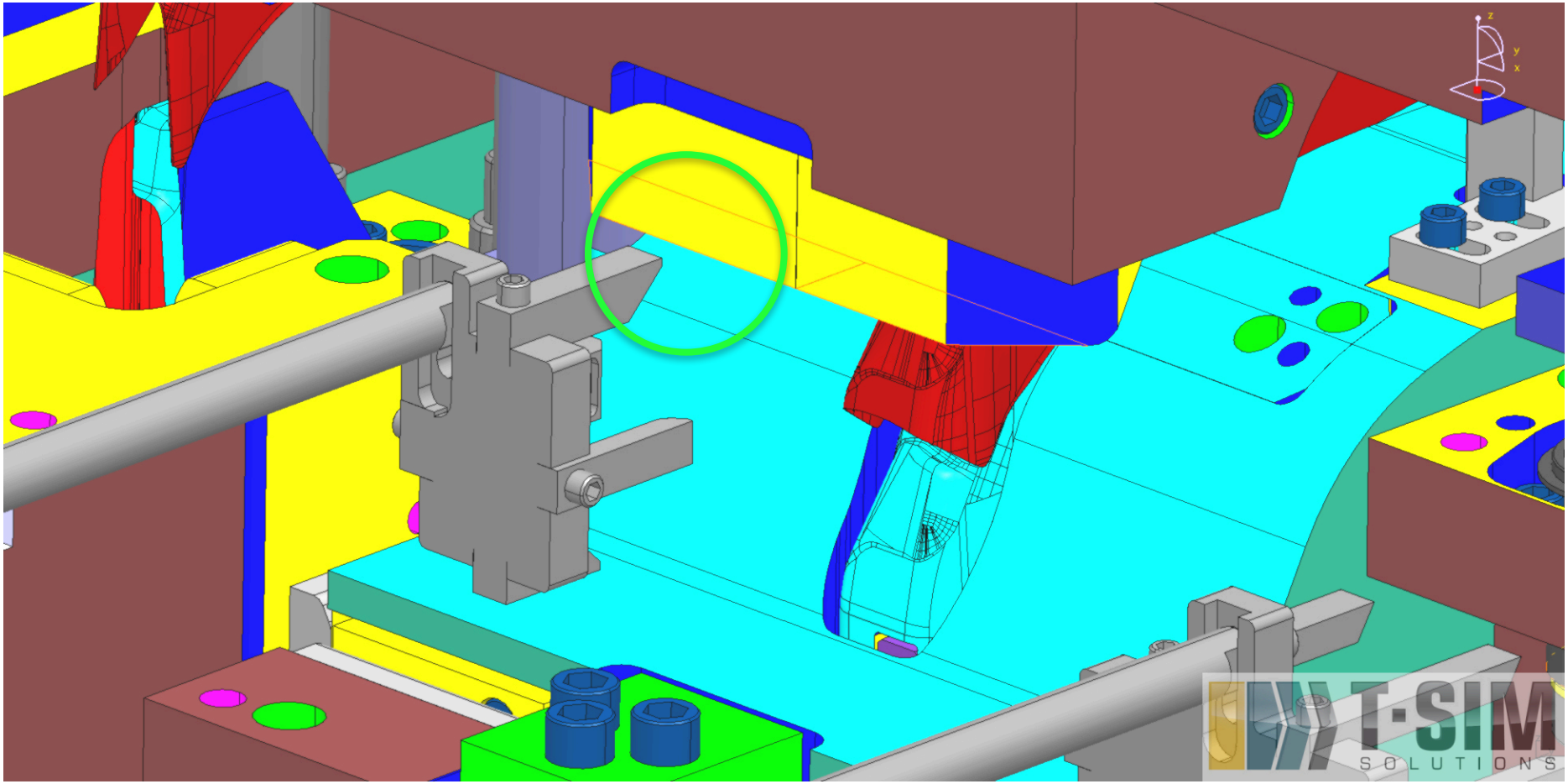
3. Find and Remove Bottlenecks

Bottleneck: Clamp-out finger vs. upper pin. Switch pin/bushing with stop blocks.



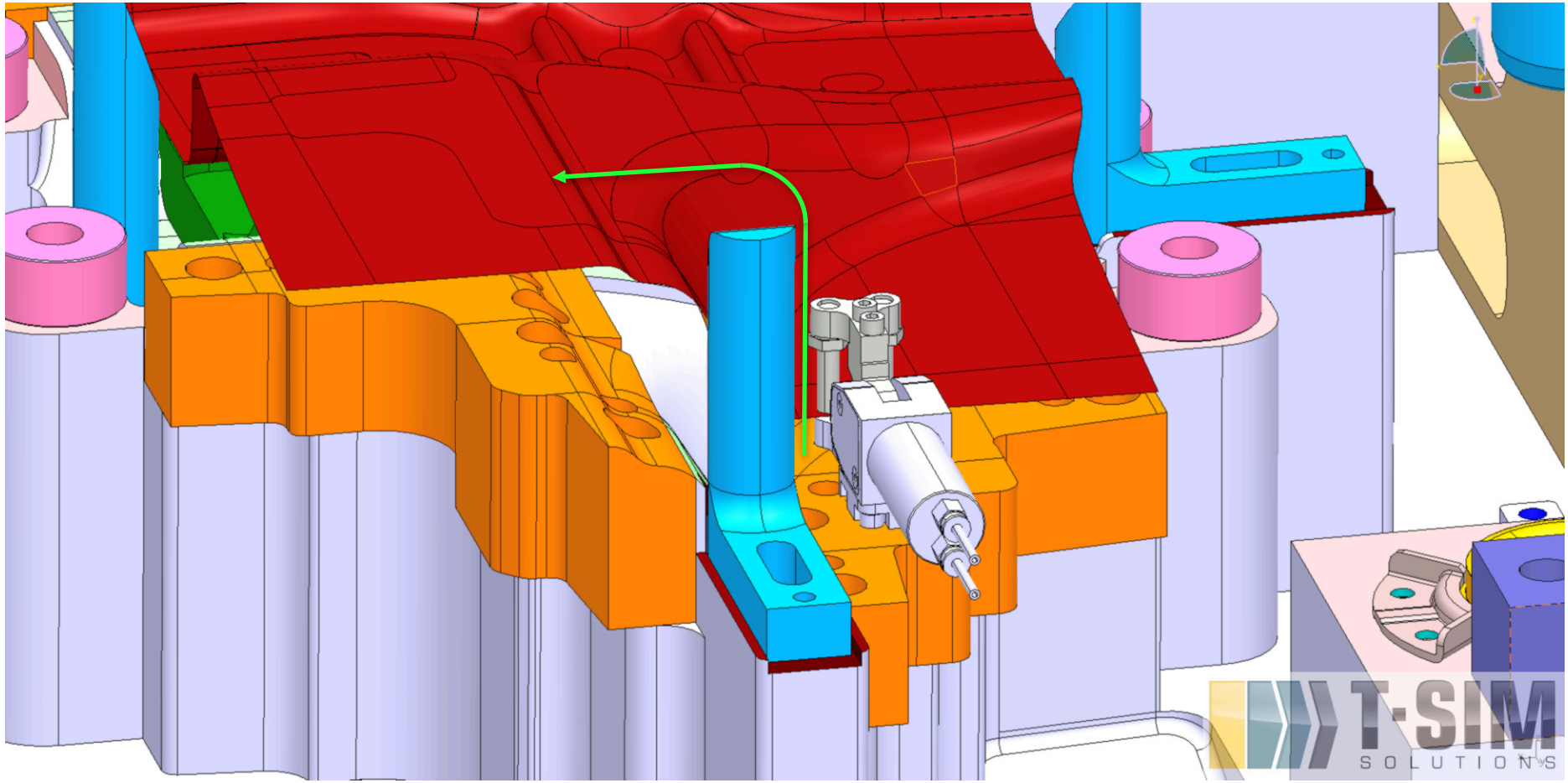
3. Find and Remove Bottlenecks

Bottleneck: Clamp-in finger vs. upper form insert. Add 45 degree chamfer.



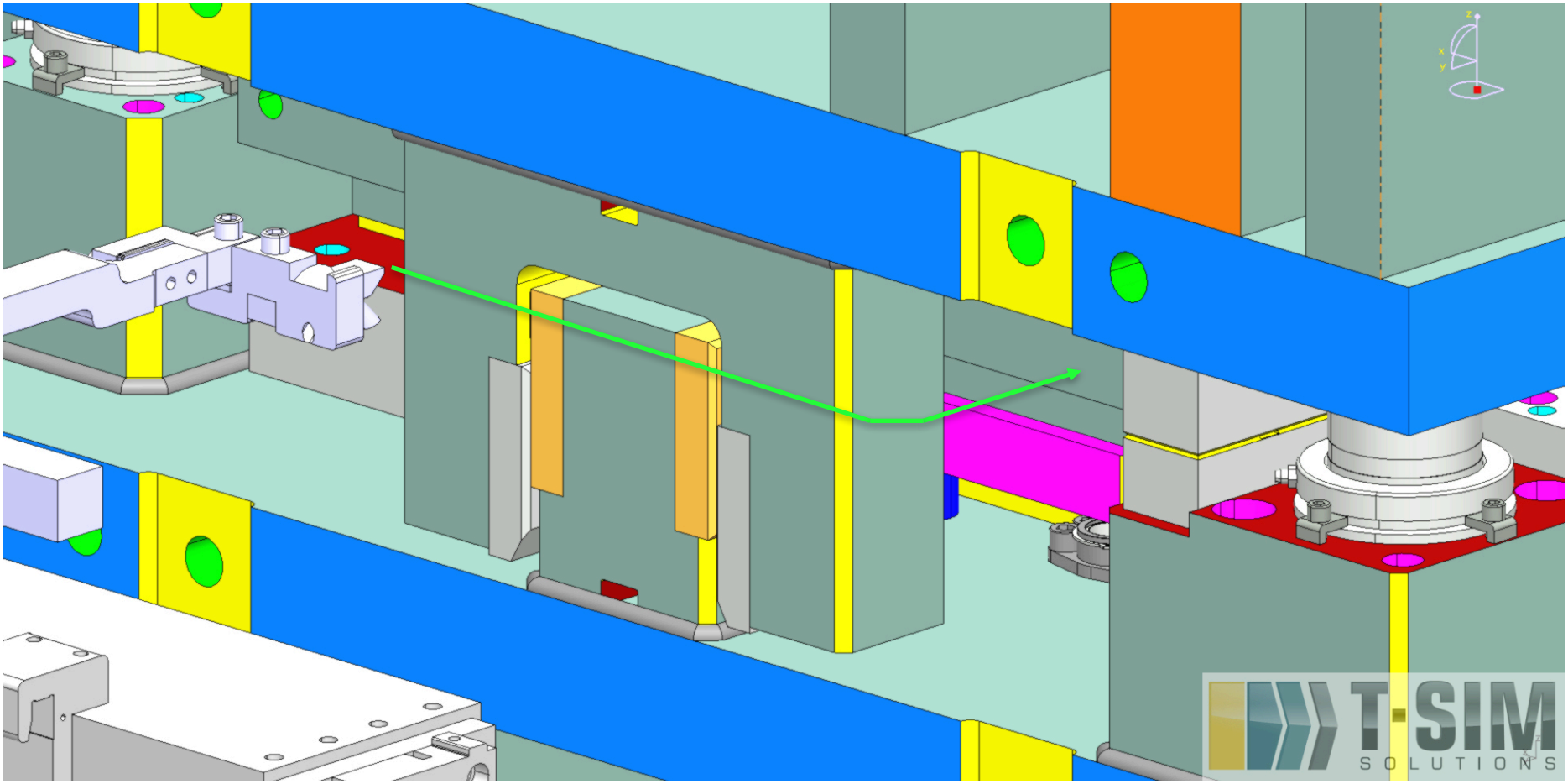
3. Find and Remove Bottlenecks

Bottleneck: Gripper vs. gage on lift-to-pitch overlap. Shorten or move gage.



3. Find and Remove Bottlenecks

Bottleneck: Finger vs. heel during pitch return. Move heel assembly in.



3. Find and Remove Bottlenecks

What is the best method to find Bottlenecks?

A. Human eye at the press during homeline runoff

(die is already built and shipped, improvements are limited)

B. Human eye using software that moves CAD to fixed positions

(risk of human error, time consuming, and subjective)

C. Transfer simulation software that automatically finds restrictive bottlenecks and auto-optimizes time for clamp, lift & pitch

Answer = C. (Should be done when design is 95% complete)

3. Find and Remove Bottlenecks

Bottleneck Recap:

- Keep clamp, lift, and pitch distances to a minimum
- Identify and fix what limits when clamp in motion can occur
- Identify and fix what limits when clamp out must occur
- Pitch forward should start before lift up is complete (overlap)
- Lift down should start before pitch forward is complete (overlap)
- Keep pitch return path clear so clamp distance is reduced

4. Design and Build for Production

Advantages of designing for production:

- Production cost over the life of the die is significantly reduced
- Higher revenue for the Stamper (and also for the build shop)
- Production requirements are not only met, but are exceeded
- Design & Build shop recognized as “the source” for high SPM

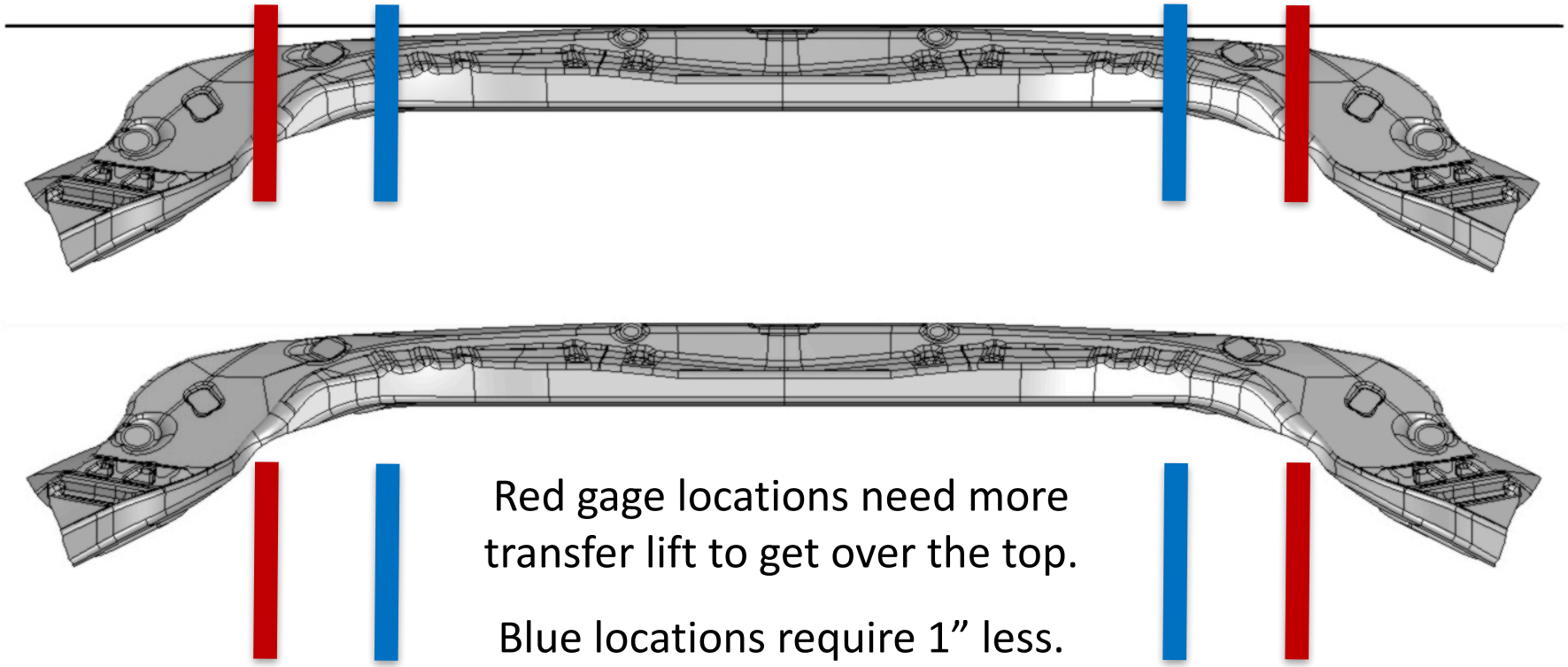
4. Design and Build for Production

Design "tips" that benefit production:

- Don't create bottlenecks in the design (distance, time, obstacles)
- Use die lift to move panels up rather than transfer lift
- Keep part gage heights low - allows pitch forward to start sooner
- Position guide bushings as high as possible - pins hang down less
- Overlap between clamp and lift means fingers enter lower - clear
- Shorter fingers - more rigid, less flexure, less "diving board" action
- Keep addendums between parts strong to reduce sag
- Finish strong! Adequate fingers once parts are separated and exit
- Keep components inboard as much as possible (heels, pins, etc)
- Keep clamp in and clamp out pathways free of die components

4. Design and Build for Production

Design "tips" that benefit production: example – gage positioning

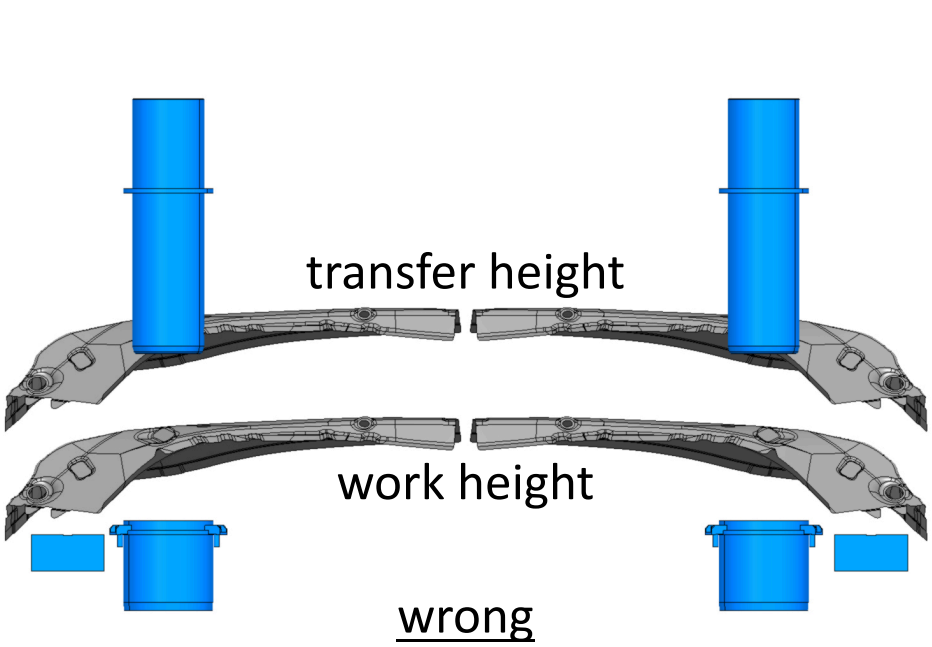


Red gage locations need more transfer lift to get over the top.

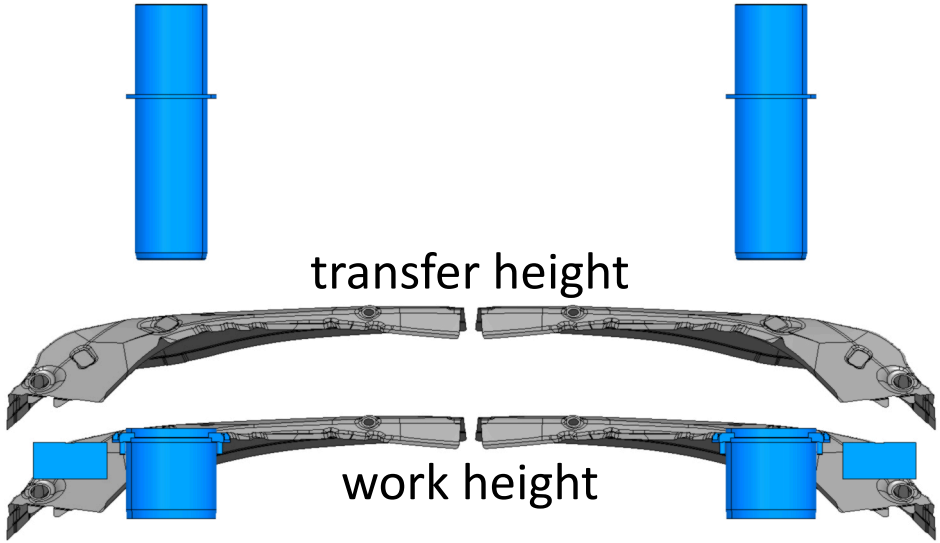
Blue locations require 1" less.

4. Design and Build for Production

Design "tips" that benefit production: example – bushing heights



wrong

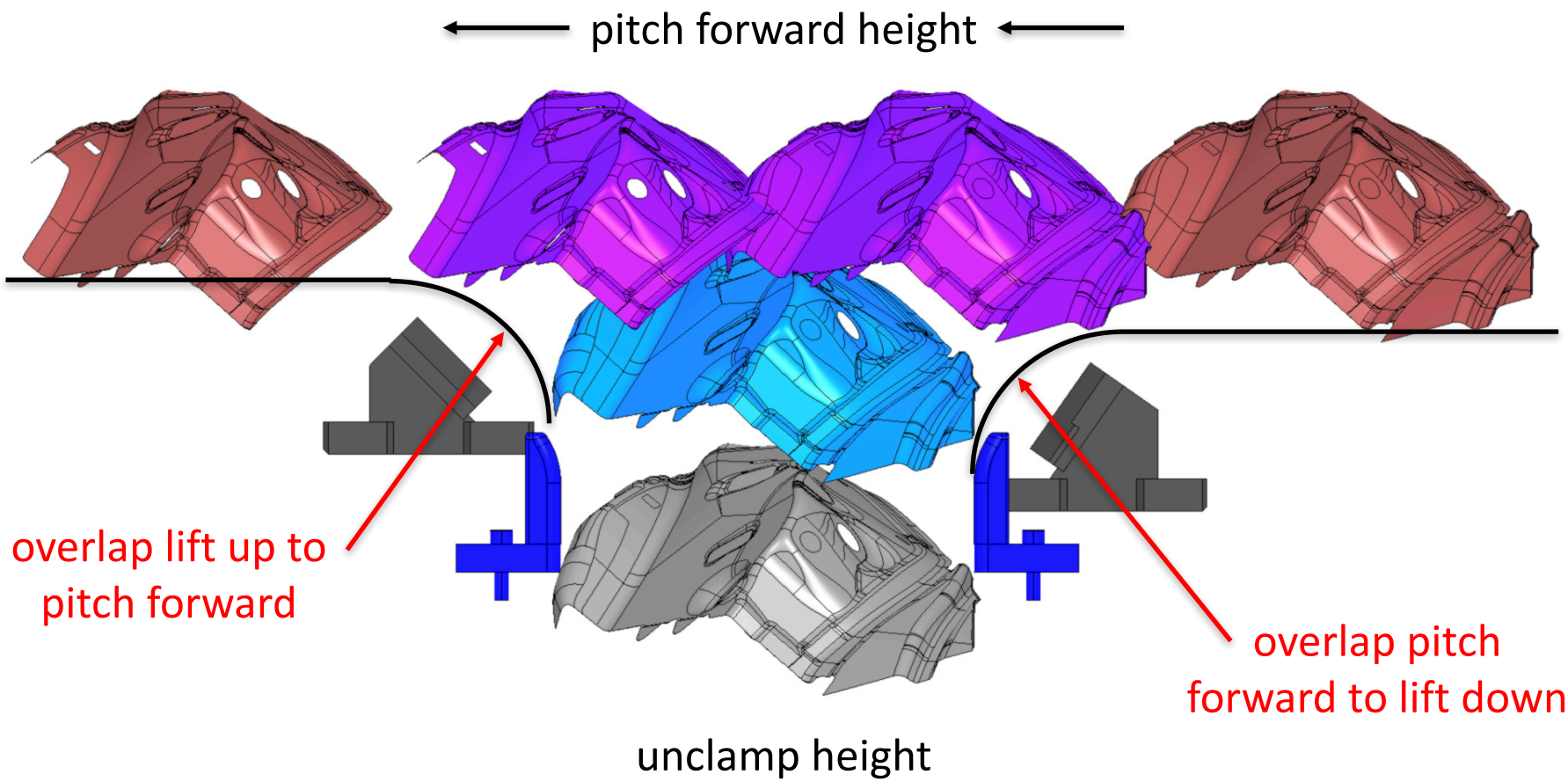


right

Keep bushings and stop blocks just under transfer pass-line height.
Upper pins are out of the way sooner, so transfer motion can begin.

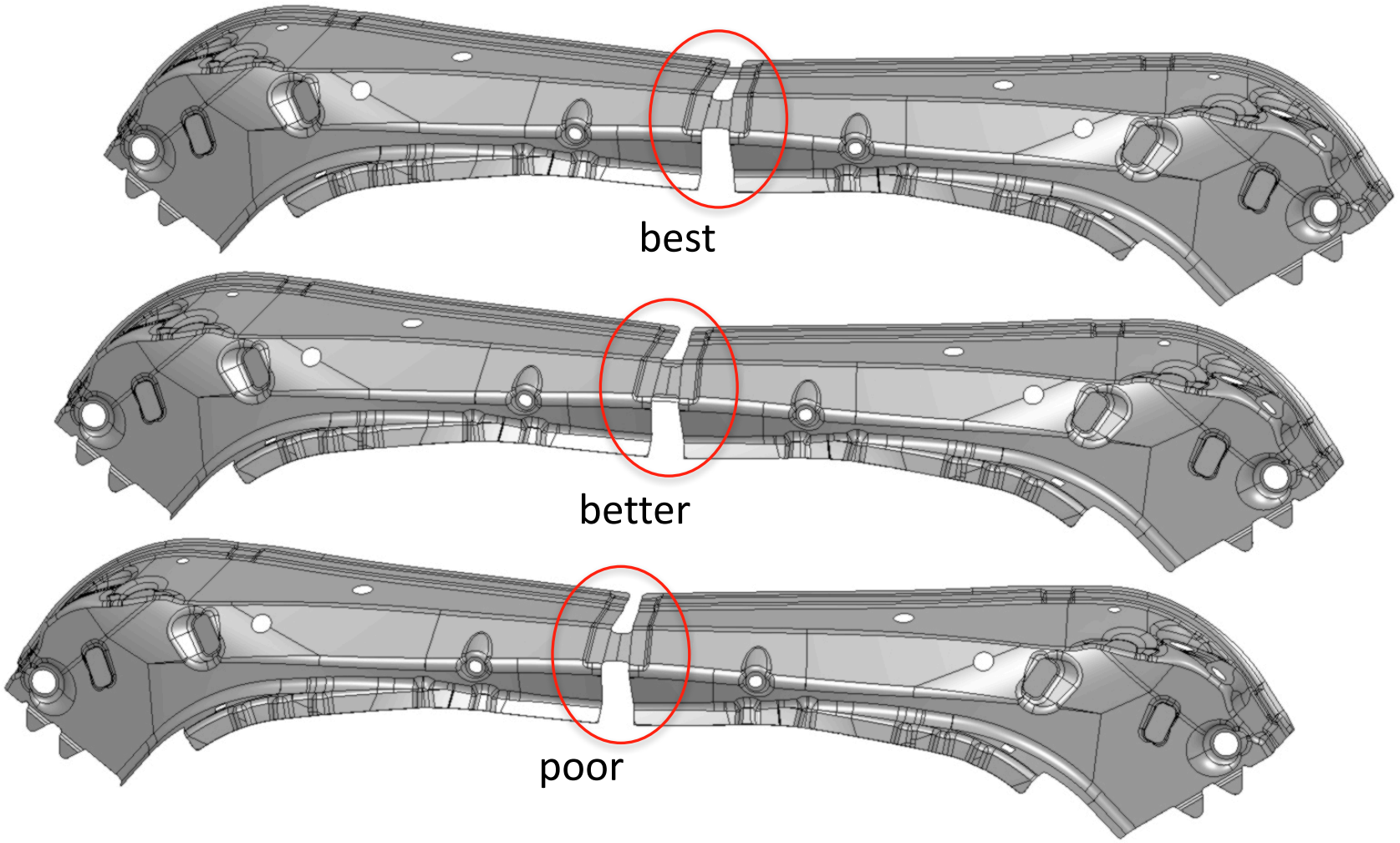
4. Design and Build for Production

Design "tips" that benefit production: example – overlap lift / pitch



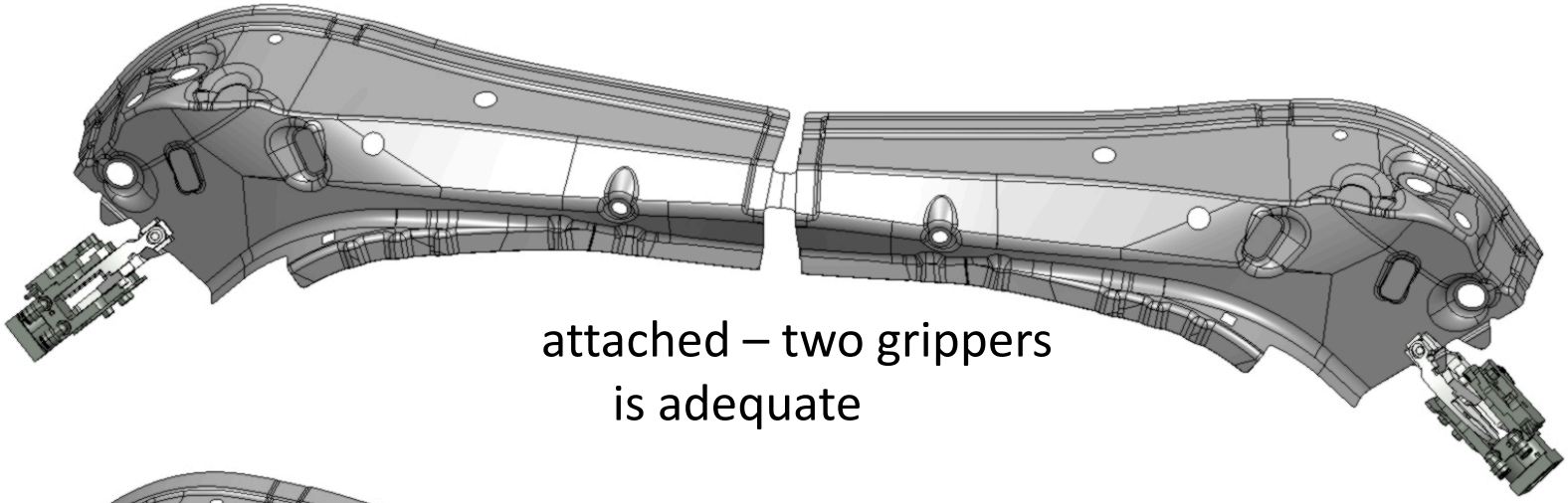
4. Design and Build for Production

Design "tips" that benefit production: example – strong addendums

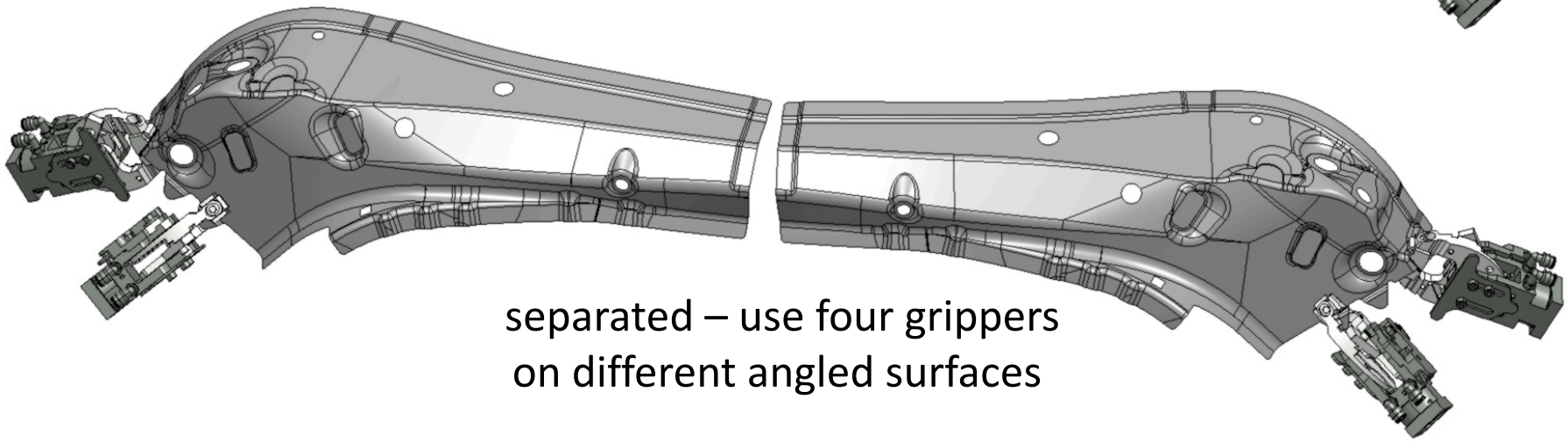


4. Design and Build for Production

Design "tips" that benefit production: example – finish strong!



attached – two grippers
is adequate



separated – use four grippers
on different angled surfaces

5. Press Ram in sync with Transfer System

A. Mechanical ram with a servo transfer:

SPM is limited by: **Ram Cycle Time** or

Transfer Cycle Time, whichever is slower

Ram Cycle Time = You can speed up or slow down the entire cycle, but not portions of it. The whole cycle runs faster or slower. Maximum ram cycle speed is governed by: panel forming, die contact, controller, or Transfer Cycle Time (Whichever is the slowest – usually it's Transfer Cycle Time)

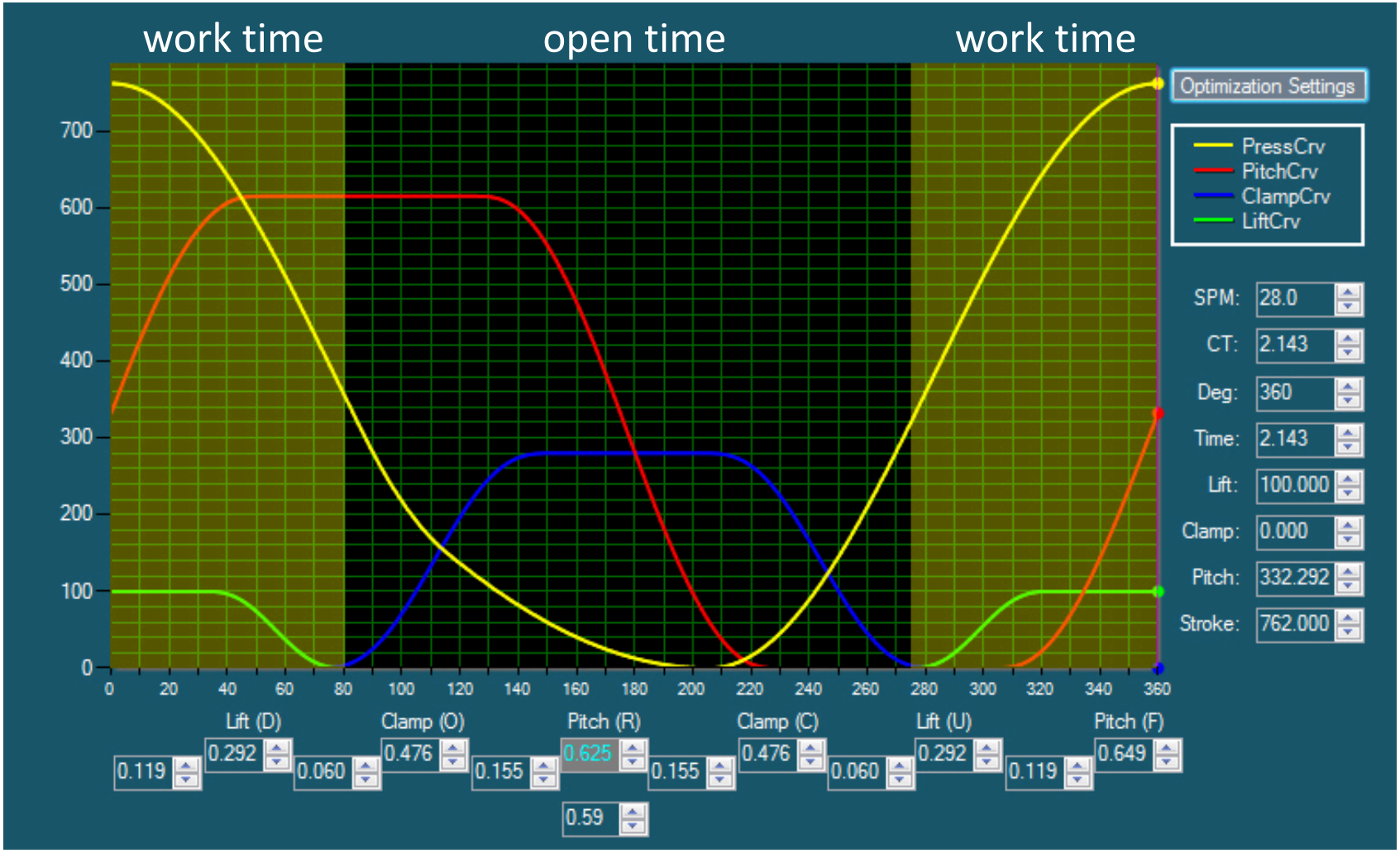
Transfer Cycle Time = Transfer working time + Transfer open time

Transfer working time = lift up + pitch forward + lift down (panel control)
Transfer open time = clamp out + pitch return + clamp in (empty fingers)

Transfer working time speed is limited by panel control
Transfer open time speed can run as fast as possible*

5. Press Ram in sync with Transfer System

Transfer Cycle Time = Transfer working time + Transfer open time



5. Press Ram in sync with Transfer System

B. Servo ram with a servo transfer:

SPM is now a combination of **Ram Cycle Time** and **Transfer Cycle Time**

Ram Cycle Time = You can speed up or slow down portions of the cycle

Transfer Cycle Time = Transfer working time + Transfer open time (same)

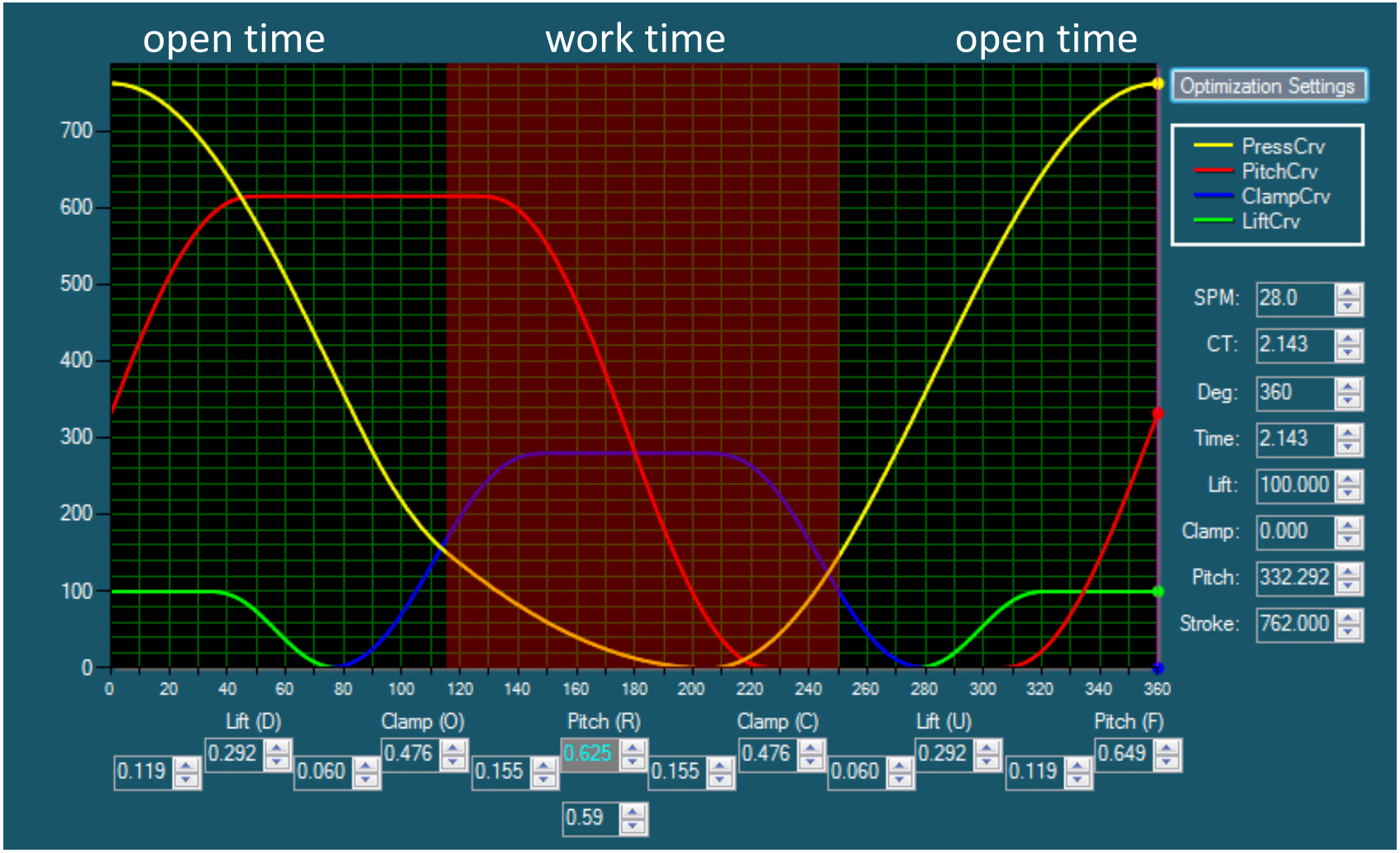
Ram Cycle Time = Ram working time + Ram open time

Ram working time = die contact through forming & back to die contact

Ram open time = can run as fast as possible (full stroke or pendulum)

5. Press Ram in sync with Transfer System

Ram Cycle Time = Ram working time + Ram open time



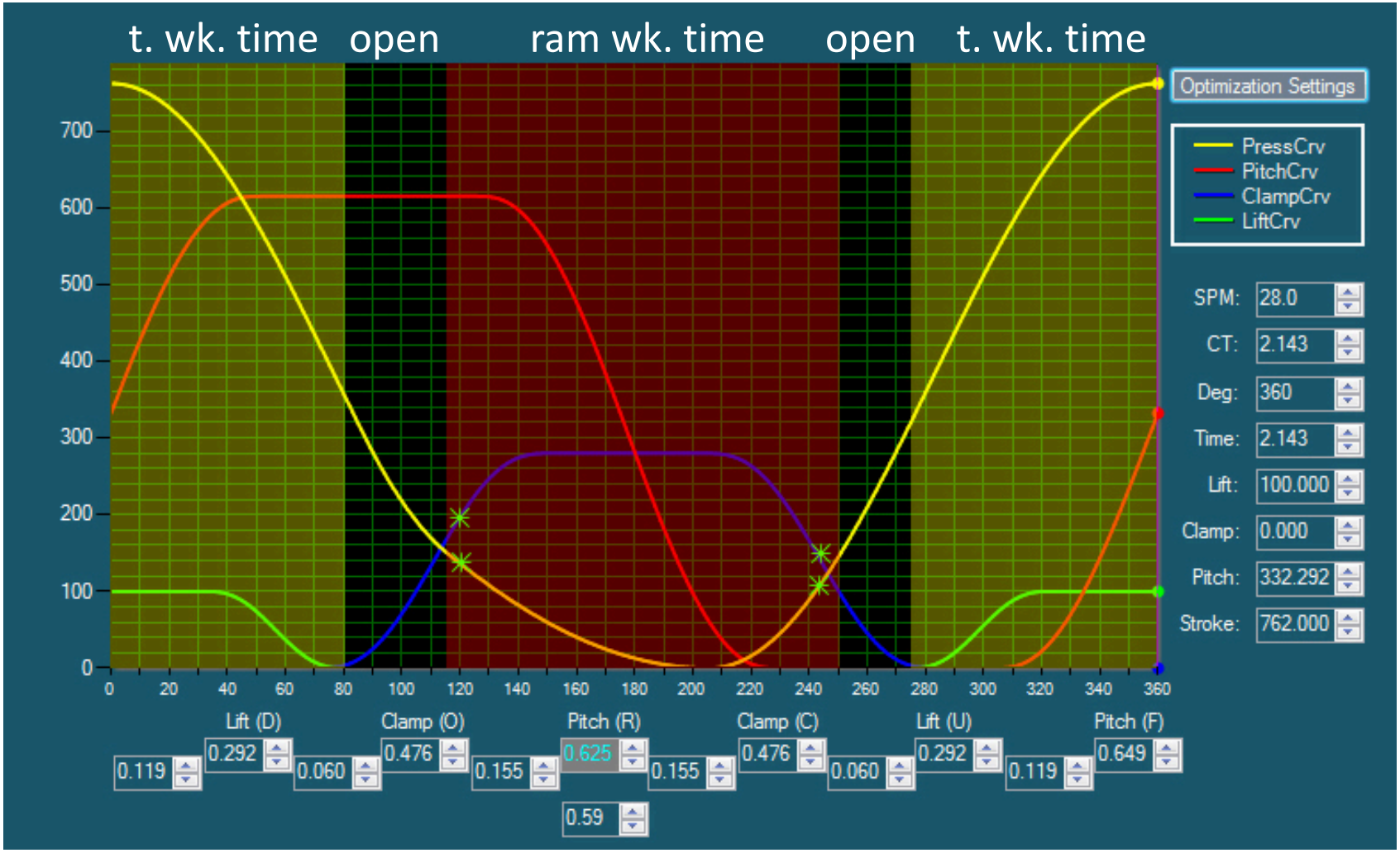
5. Press Ram in sync with Transfer System

Servo ram with a servo transfer: FACTS (95% of the time)

- Transfer working time (panel in fingers) occurs during Ram open time. The ram is slowed down or in pendulum mode (stop with dwell).
- Ram working time (die contact and forming speeds) occurs during Transfer open time (empty fingers). The transfer is slowed down.
- From clamp out start to die contact (start of Ram working as die closes) both the Ram and Transfer can run at their highest speeds.
- From last die contact (end of Ram working as die opens) to clamp in stop both the Ram and Transfer can run at their highest speeds.
- Clamp in bottleneck (A) occurs during ram working time (die contact).
- Clamp out bottleneck (B) occurs during ram working time (die contact).

5. Press Ram in sync with Transfer System

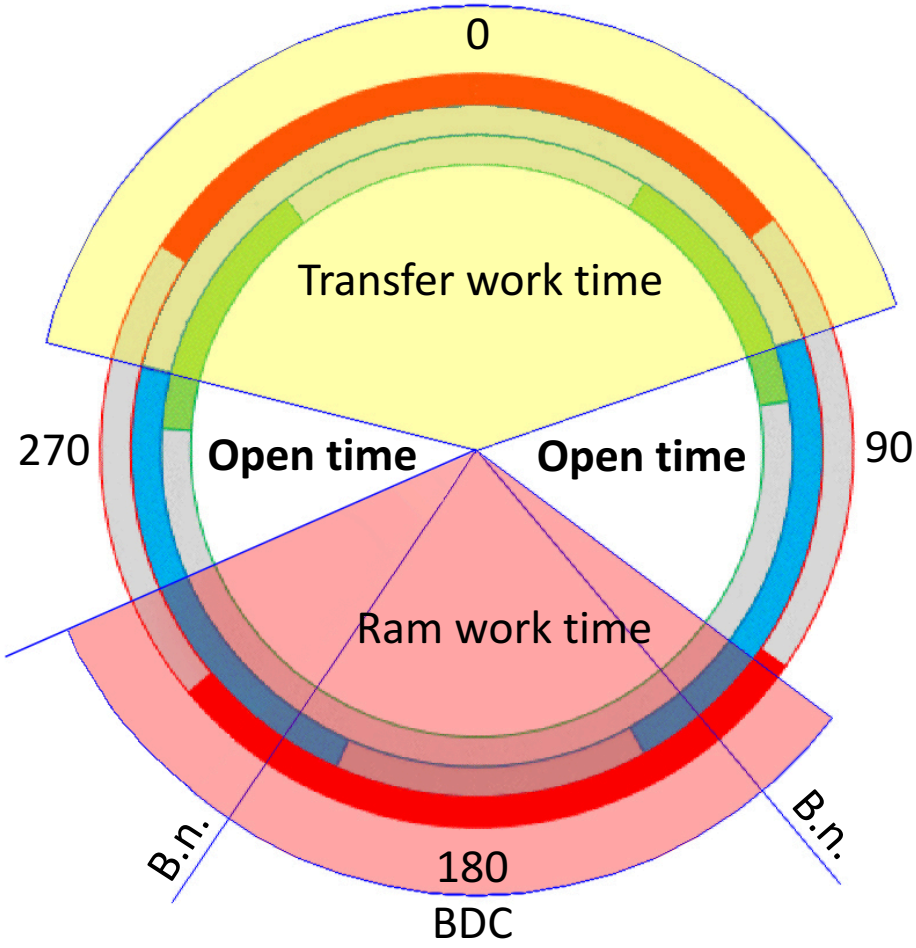
Optimized Cycle Time = Transfer work time + Ram work time + open time



5. Press Ram in sync with Transfer System

Optimized Cycle Time = Transfer work time + Ram work time + open time

Clamp Angles	
CIS	204
CIC	284
COS	71
COC	151
Lift Angles	
LUS	274
LUC	323
LDS	32
LDC	81
Pitch Angles	
PFS	303
PFC	52
PRS	125
PRC	230



5. Press Ram in sync with Transfer System

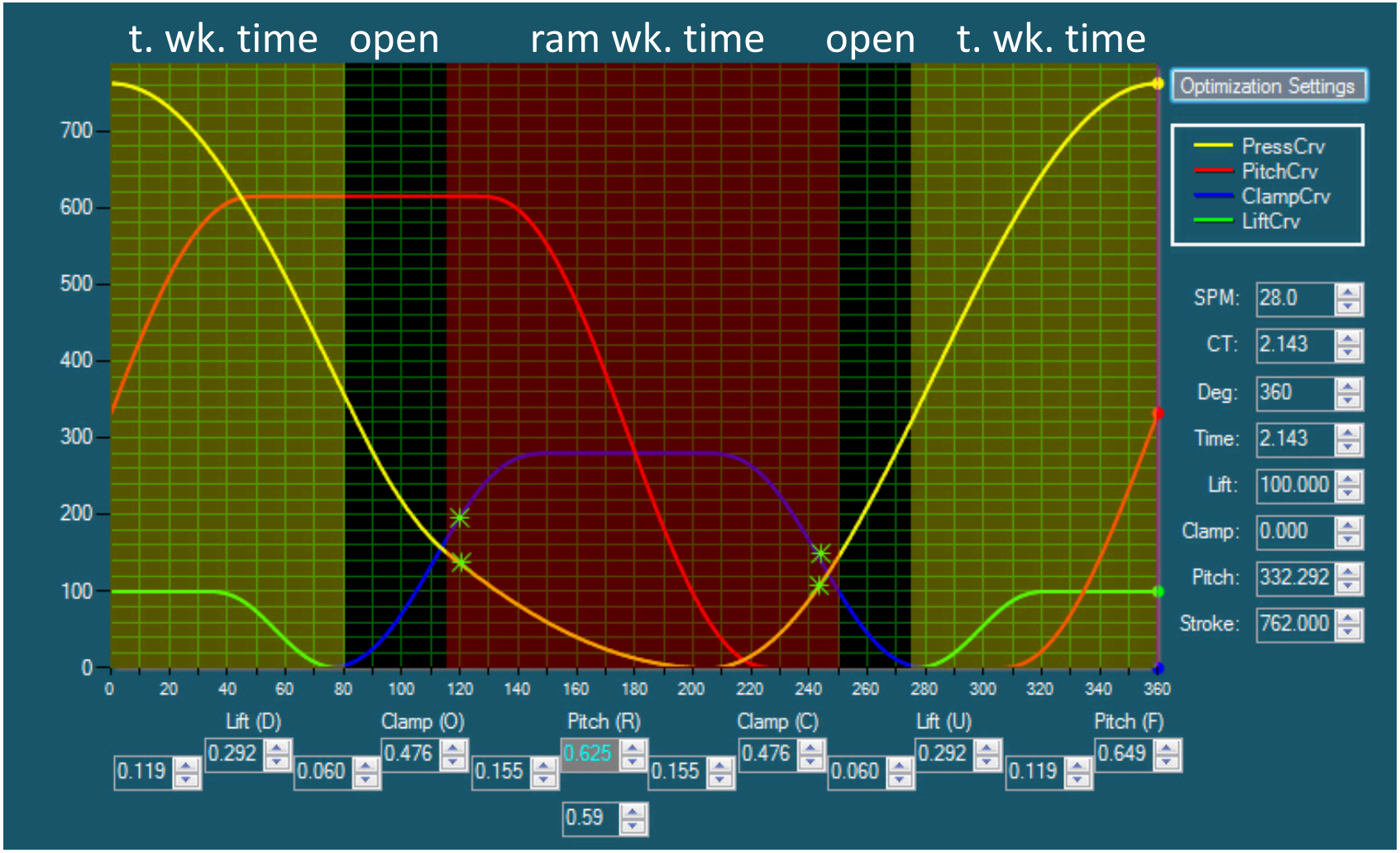
Servo ram with a servo transfer – Recap:

- Transfer open time occurs during Ram working time. Transfer is slowed.
- Ram open time occurs during Transfer working time. Ram is slowed.
- Clamp in bottleneck (A) affects when clamp in stop occurs.
- Clamp out bottleneck (B) affects when clamp out start occurs.
- Improvements to bottlenecks (A) and (B) improve SPM. Why?

1. From clamp out start to die contact (start of Ram working as die closes) both the Ram and Transfer can run at their highest speeds.
2. From last die contact (end of Ram working as die opens) to clamp in stop both the Ram and Transfer can run at their highest speeds.
3. There is more time left for Transfer working time (moving panels).

5. Press Ram in sync with Transfer System

Optimized Cycle Time = Transfer work time + Ram work time + open time



5. Press Ram in sync with Transfer System

Servo ram with a servo transfer – Recap:

1. Don’t run your Servo Press like a mechanical press! Sync ram timing with the transfer system timing and the die for highest possible SPM.

2. Utilize Transfer Simulation & Optimization to identify bottlenecks, program Ram speed during Ram working time and Ram open time, and program Transfer speed during Transfer working & open time.

3. Improving bottlenecks (Distance, Time, Obstacles) has significant impact on total press cycle time and SPM. Higher SPM = higher $.

6. Simulation and Optimization - Recommendations

Simulation (what to look for from a software or service provider):

- Kinematic analysis with all components put into full motion including the entire die assembly, ram, and transfer system
- Virtual process is data-driven using ram & transfer system specifications
- Key bottlenecks affecting SPM are automatically identified and improved
- All crashes and clearances are found by the software (not a visual check)
- Corrective Action Report provided showing the die changes required
- Instructions provided for initial press setup (drawings, 3D data, movies)
- Closed loop system – confirm virtual results match real world results

6. Simulation and Optimization - Recommendations

Optimization (what to look for from a software or service provider):

- Digital process used to balance time & distance for transfer, die, and ram
- Software automatically calculates & combines ALL functions for max SPM
- Process must utilize ram and transfer specs for velocity and acceleration
- Servo Ram process must be time and distance based (not crank degrees)
- Must be adaptable to part control conditions during production – ability to re-allocate and distribute time for transfer functions (clamp, lift, pitch)
- Closed loop system – confirm virtual results match real world results
- Guesswork is eliminated, decisions are data-driven, sustainable production

6. Simulation and Optimization - Recommendations

Animation (what to look for from a software or service provider):

- Definition - still frames combined and “flipped through” to add motion
- Powerful communication tool used to show die and transfer functions
- Animations can be based on real, factual, data-driven simulations
- Animations can also be false, misleading, inaccurate, and unrealistic
- Animations should be the result of a Transfer Simulation, and not used visually in place of Transfer Simulation. Visual checks have human errors
- Make sure valid Transfer Simulation and Optimization accompany any Animations provided. Animations should be used for reference only

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Conclusion:

- Reduce distance bottlenecks for clamp, lift, and pitch
- Reduce time bottlenecks by using overlap (two things at once, one is free)
- Remove obstacle bottlenecks that affect when clamp, lift, pitch can occur
- Design for higher production rates, not just to make an acceptable part
- Sync your servo press and servo transfer using Transfer Simulation
- Animation should be a result of a valid Kinematic Transfer Simulation
- Optimization must automatically combine ram and transfer motions and balance the time required for each to yield the highest SPM
- Fix the Information Disconnect between build & production (instructions)
- Q and A