FORMING THE FUTURE

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Member of the ANDRITZ GROUP

5TH OCTOBER 2016

Servo Press Technology

& Return on Investment

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SERVODIRECT TECNOLOGY

OVERVIEW

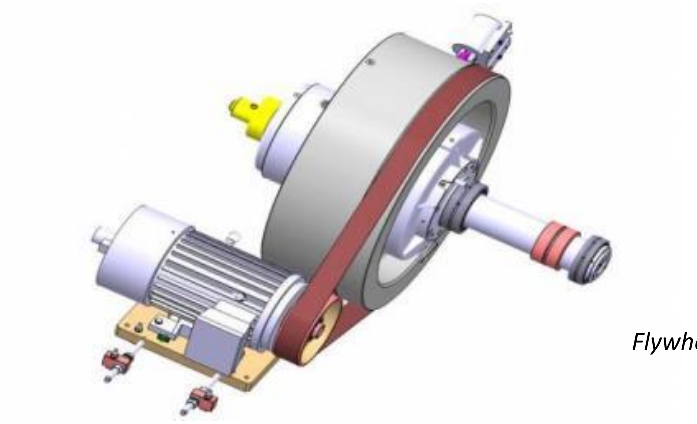
- DIFFERENCES BETWEEN CONVENTIONAL AND SERVO PRESS TECHNOLOGY
- FEATURES AND BENEFITS OF SERVO PRESSES
- COMPARISON OF STROKE PROFILE
- CASE STUDIES AND RESULTS

SERVO DIRECT TECHNOLOGY

DIFFERENCES COMPARED TO CONVENTIONAL

Mechanical Press

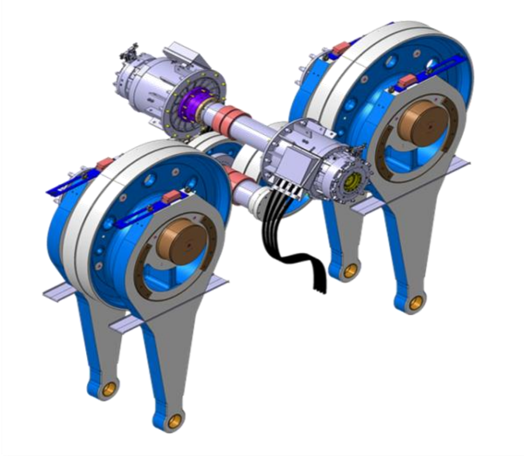
- No clutch / brake assembly
- No flywheel
- Less efficiency



Flywheel drive

Servo Press

- Highest motor efficiency
- Speed of press is Programmable
- Programmable stoke length



ServoDirect drive

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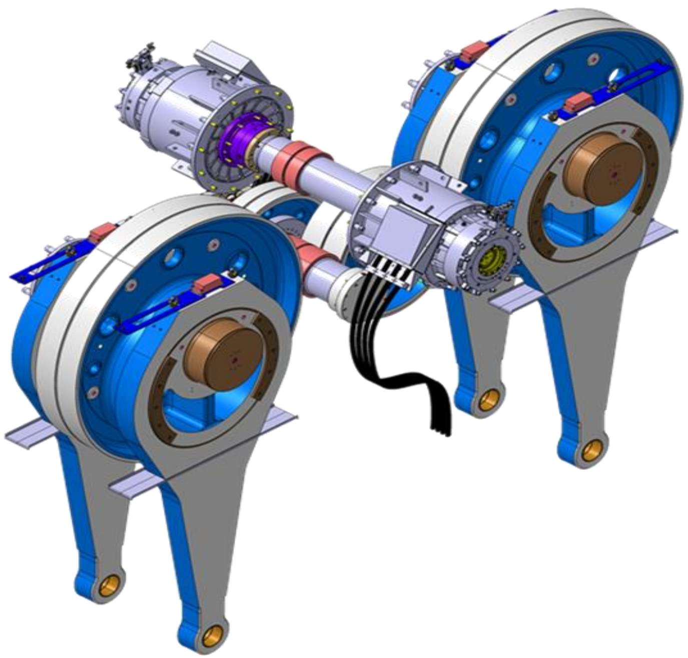
SERVO DIRECT TECHNOLOGY

DRIVE CONCEPT

- **Direct drive concept**
- Use of **highly dynamic torque motors**
- **Time-travel profiles** are **user-programmable**
- **Setup and tryout functions**
- **Stroke length** is **user-programmable** (pendulum motion)



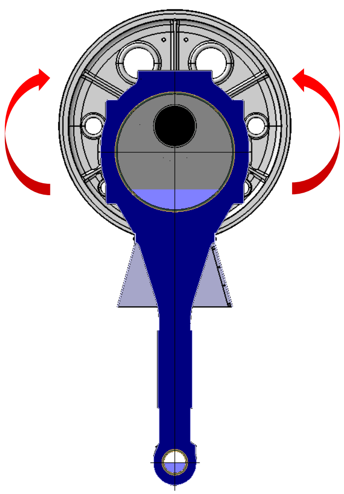
ServoDirect drive with 2 torque motors

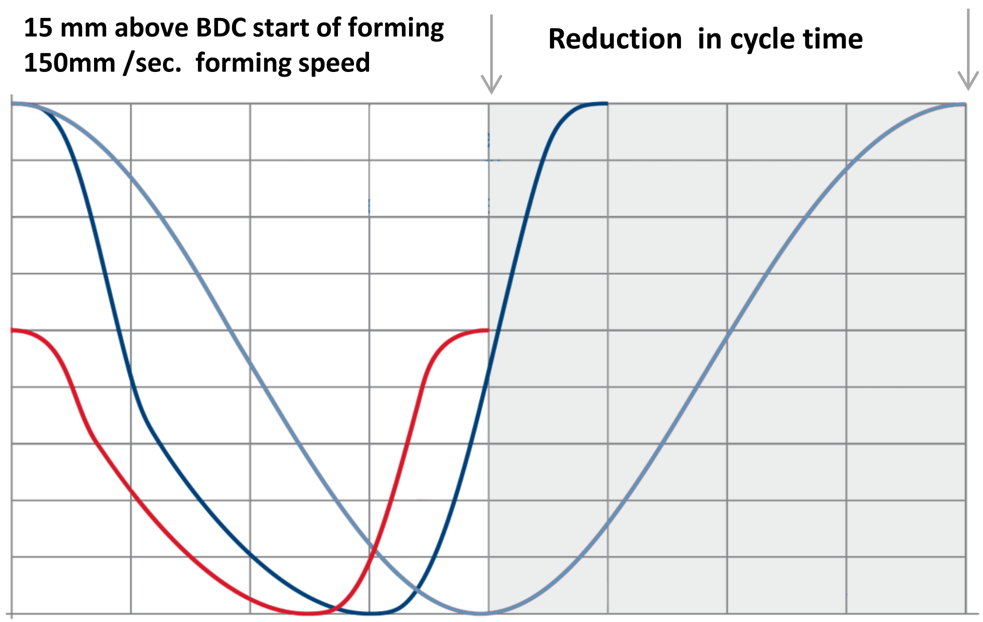
PREVIEW
ADVANTAGES OF SERVO PRESS TECHNOLOGY

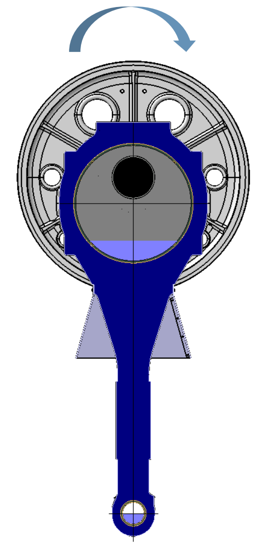
- **Servo Motion Increases SPM Output:** by adjusting stroke lenghts and slide motion curves
- **Maximum production flexibility:** by optimizing the process and forming motion curves .
- **Shorter setup times for toolings:** by using the features of the servo tryout function
- **Increase part quality and die lifetime:** through optimization of the forming process
- **Lower energy costs:** through an efficent energy management system
- **Lower costs per part ratio:** by increasing the spm part output

SERVO DIRECT TECHNOLOGY VS CONVENTIONAL PRESS FULL STOKE

PENDULAR MOTION FOR INCREASED PRODUCTION RATE







Servo
Pendular Motion
Reversing rotating motion of the drive

Servo Press pendulum motion
- **Cycle time = 1.7 s**
- **Stroke rate = 35 spm = 133 %**

Servo Press full stroke
- Cycle time = 2.3 s
- Stroke rate = 26 spm = 73%

Conventional Press full stroke
- Cycle time = 4 s
- Stroke rate = 15 spm = 100%

Full stroke
Complete rotating motion of the drive

PRACTICAL EXPERIENCE : 250 - 800 TON

INCREASED PRODUCTION RATES WITH EXISTING PROGRESSIVE DIES

Formed part	Operating mode	Press force [kN]	Drawing depth [mm]	Max. stroke rate Conventional [spm]	Max. stroke rate Servo [Spm]	Increase
Flange	Progressive	2,500	30	30	56	87 %
Gas generator holder	Progressive	2,500	60	25	40	60 %
Holder	Progressive	2,500	40	30	60	100 %
Cage	Progressive	4,000	50	30	50	67 %
Gripper rail drive unit	Progressive	8,000	65	20	40	100 %





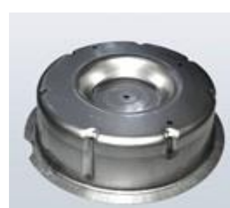


PRACTICAL EXPERIENCE : 1,100 – 2,500 TON

INCREASED PRODUCTION RATES WITH EXISTING TRANSFER & PROG DIES

Formed part	Operating mode	Press force [kN]	Drawing depth [mm]	Max. stroke rate Conventional [spm]	Max. stroke rate Servo [spm]	Increase
Cover	Progressive	11,000	40	15	34	126 %
Center console	Transfer	11,000	190	12	17	42 %
Insert cup	Transfer	11,000	130	8	15	88 %
Cross plate	Progressive	16,000	90	23	33	43 %
Tank filler neck	Transfer	16,000	145	14	18	29 %
Side panel	Transfer	16,000	80	19	29	53 %
Geared ring	Transfer	16,000	45	15	21	40 %
Seat part	Transfer	25,000	130	16	24	50 %





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ServoDirect Technology:
Transfer or Prog-die?

SERVODIRECT TECNOLOGY: TRANSFER OR PROG-DIE?

AGENDA

- ADVANTAGES OF BOTH TRANSPORT PRINCIPLES
- REQUIREMENTS ON PRESS-LINE LAYOUT
- DECISION MAKING PROCESS
- IMPORTANCE OF HIGHEST FLEXIBILITY
- CONCLUSION

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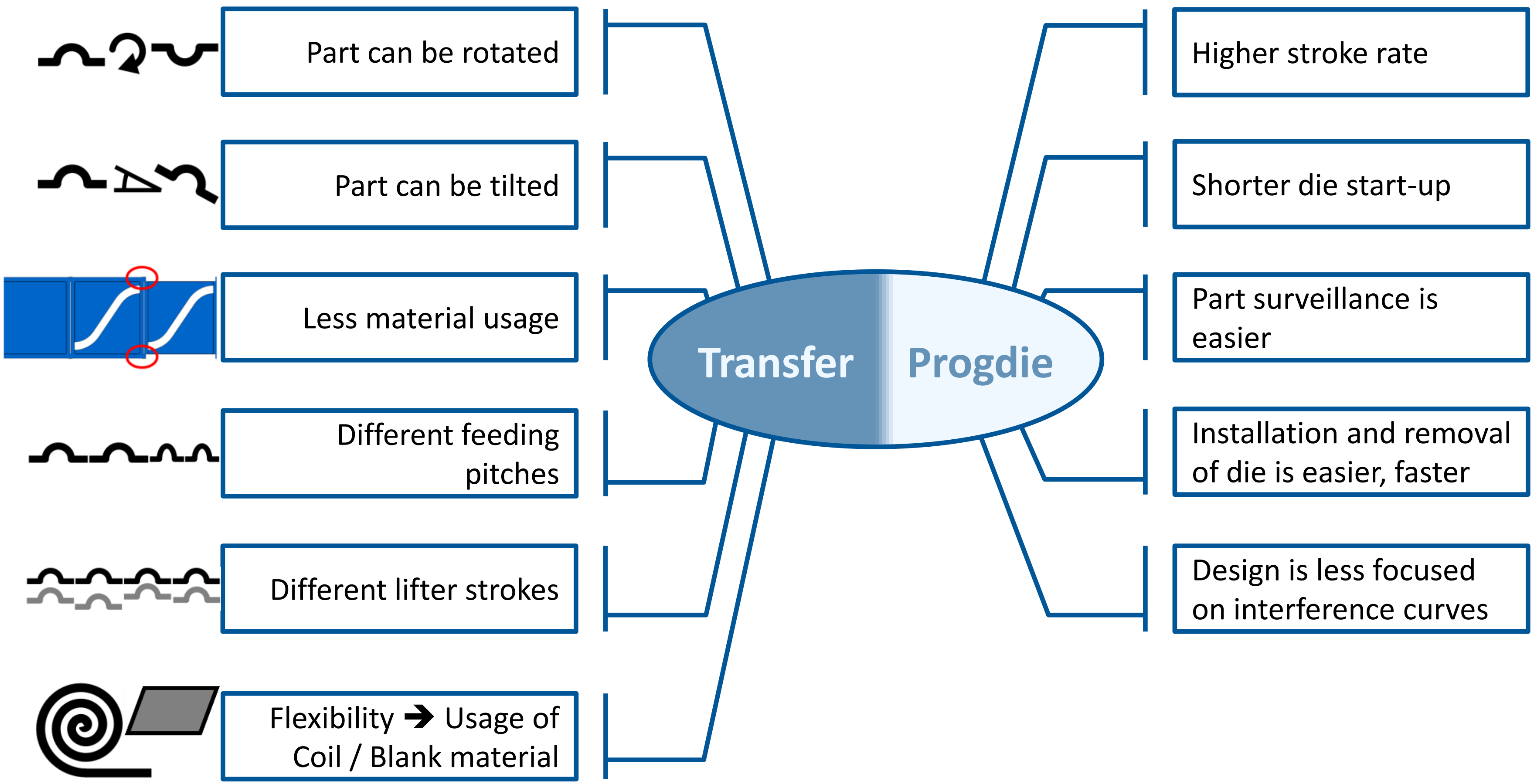
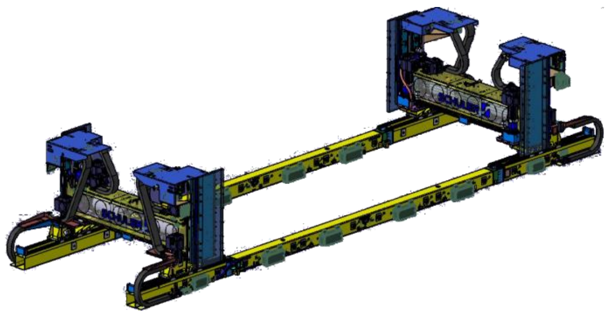
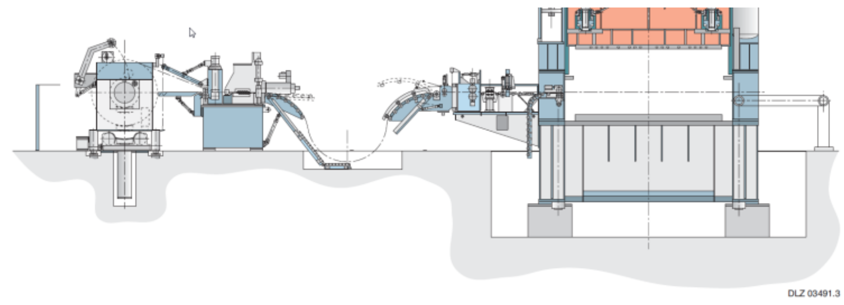
TRANSFER – PROGDIE COMPARISON OF THE ADVANTAGES



PRESS-LINE COMPONENTS

NECESSARY PRESS-LINE EQUIPEMENT





Transfer

Progdie

Blank Material

Coil Material

Shear cutting

Die integrated Cutting

DECISION MAKING PROCESS

THERE IS ONE AND ONLY ONE RESPONSIBILITY OF BUSINESS: TO USE ITS RESOURCES AND ENGAGE IN ACTIVITIES DESIGNED TO INCREASE ITS PROFITS SO LONG AS IT STAYS WITHIN THE RULES OF THE GAME.— MILTON FRIEDMAN, ECONOMIST; 1976 NOBEL PRIZE IN ECONOMIC SCIENCES

DIE COSTS

+

MATERIAL COSTS

+

STROKE RATE - NET

=

PROFIT

→

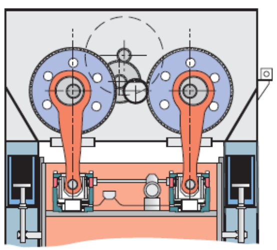
PROFITABILITY

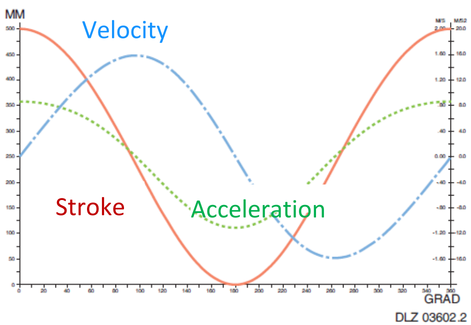
Is achieved and increased through an total view on the machine and die technology based on apropriate machine settings.

APPROPRIATE FORMING PROCESS USING CONVENTIONAL TECHNOLOGY

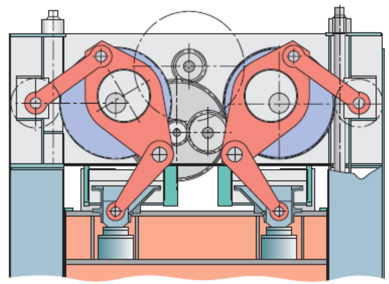
PROCESS OPTIMIZATION IN THE PRE-SERVO AGE

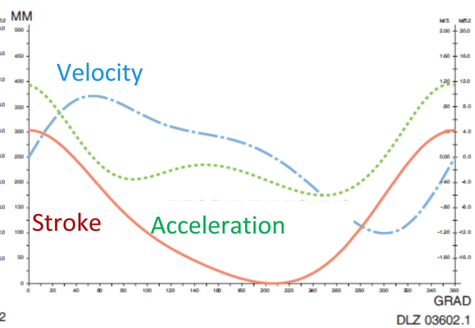
EXCENTRIC DRIVE



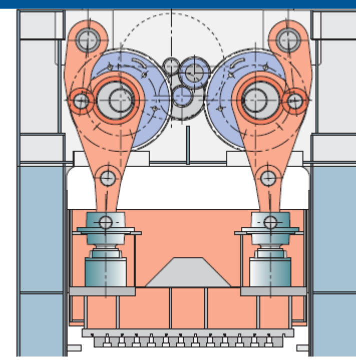


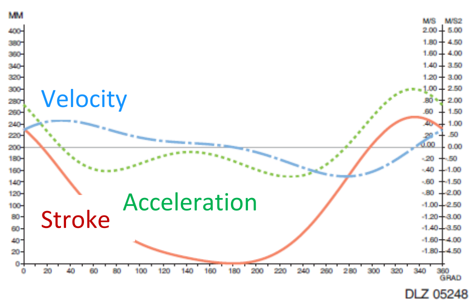
DRAW LINK DRIVE



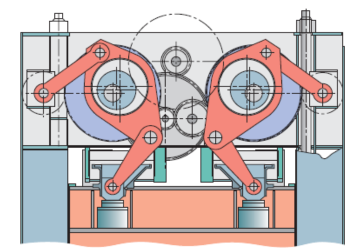


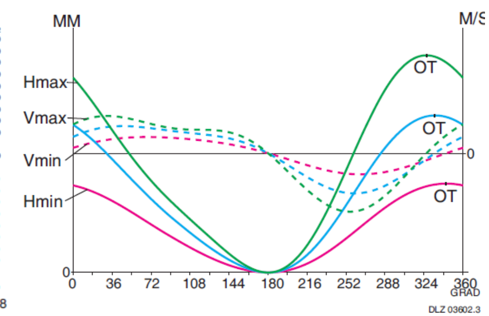
CUTTING LINK DRIVE





LINK DRIVE WITH SLIDE STROKE ADJUSTMENT





➔ NO FELXIBILITY AND RIGID PROCESS CHARACTERISTIC

Slide stroke characteristic determined and fixed through the mechanical drive design

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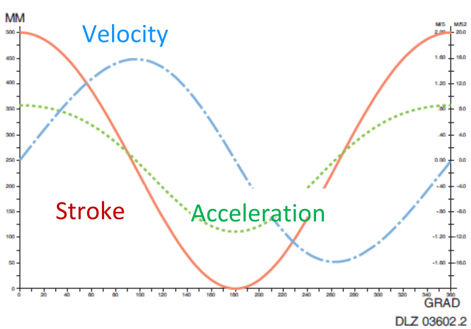
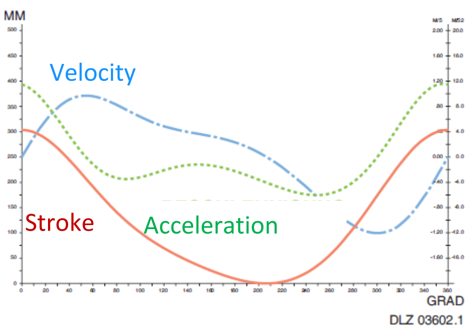
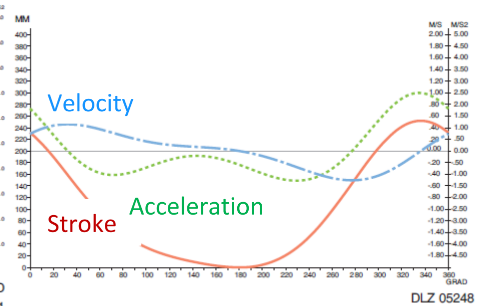
PROCESS-FOCUSED VIEW ON SDT SERVO PRESS TECHNOLOGY

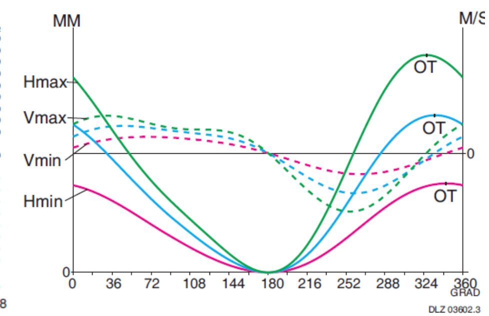
OPTIMIZED PROCESSES THROUGH SDT SERVO DRIVE

SDT SERVO DRIVE









➔ **HIGHEST FLEXIBILITY AT OPTIMAL PROCESSES**

Slide stroke characteristic and stroke height is freely programmable

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CONCLUSION : FOR BEST RETURN ON INVESTMENT

- Optimal match of the process, material and part shapes.
- Production at the highest possible rate
- Transfer or Progdie decison is made based upon the most profitable process

SERVO TECHNOLOGY

Decision for a flexible press line

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SERVO TECHNOLOGY

Die Design for Servo Presses

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DIE DESIGN FOR SERVO PRESSES

AGENDA

- REASON FOR NEW NEEDS ON DIE DESIGN
- EFFECTS WITH PENDULAR STROKE
- EFFECTS THROUGH HIGHER VELOCITY
- IT-TOOLS FOR DIE-DESIGNERS
- TRANSPORTATION SIMULATION WITH DIGISIM
- CONCLUSION

REASON FOR NEW NEEDS ON DIE DESIGN

Flexibility = Variability

Pendular Mode

- HIGHER OUTPUT
- PROFITABLE PROCESS FOR TRANSFER OR PROGDIE ON THE SAME MACHINE

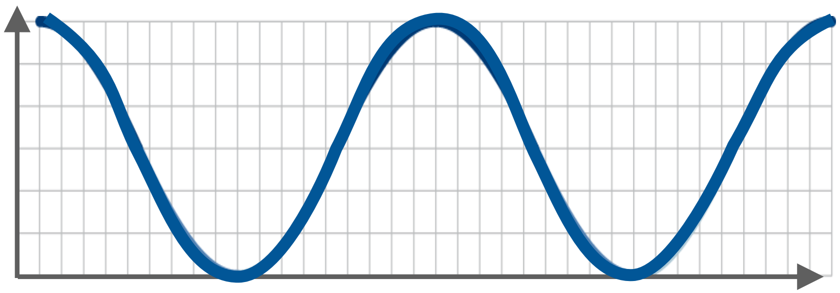
Slide Velocity

- PROGRAMMABLE SLIDE VELOCITY FOR THE FORMING AREA TO IMPROVE PART QUALITY AND REDUCE DIE WEAR AND HEATING

REASON OF HIGHER OUTPUTS WITH SERVO TECHNOLOGY SDT

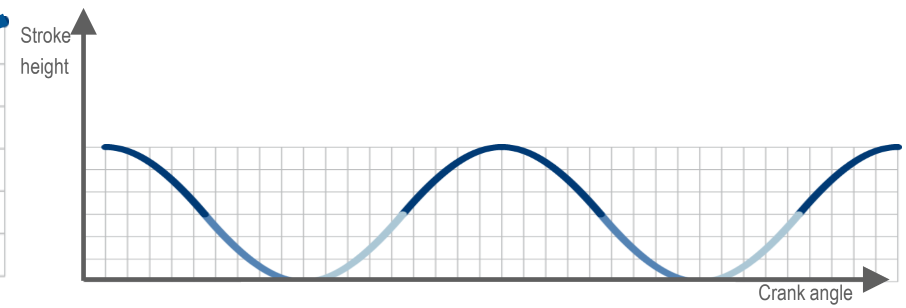
Conventional Technology

Stroke rate can be changed

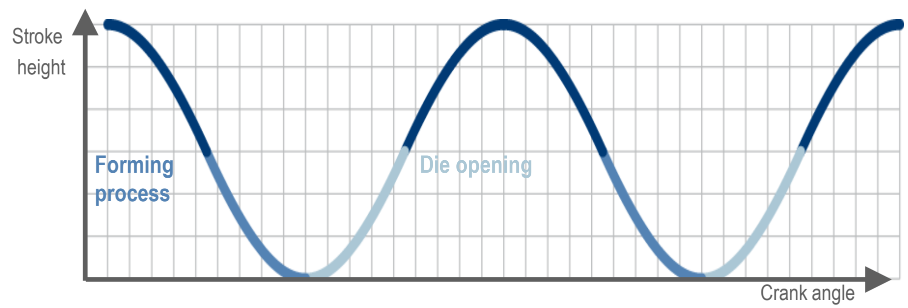


Servo Technology

Adaptable silde stroke height = pendular mode



Adaptable silde velocity

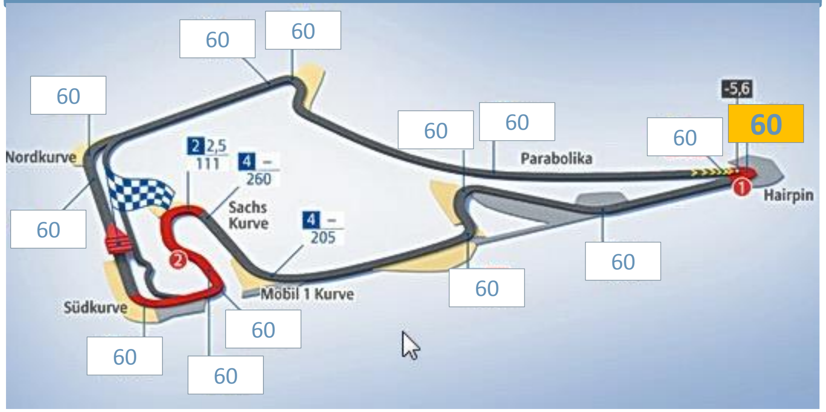


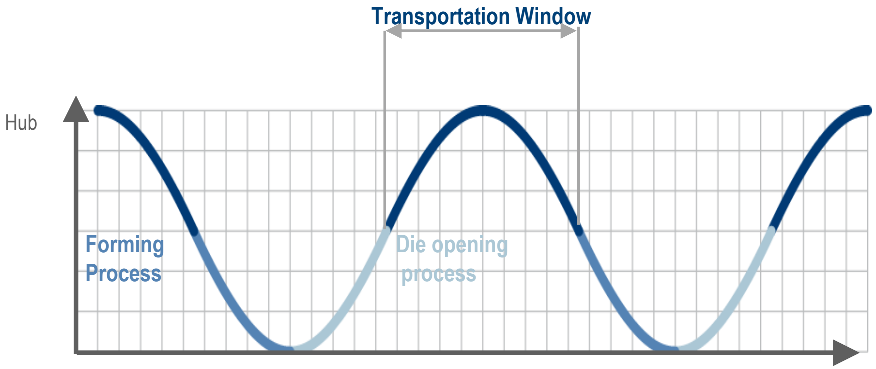
OUTPUT INCREASE AT SERVO PRESSES

1. PARTIAL CUSTOMIZED SLIDE VELOCITY

➔ PROCESS-BOTTLE NECK DOES NOT DEFINE THE THE MAXIMUM SPEED FOR THE WHOLE PROCESS

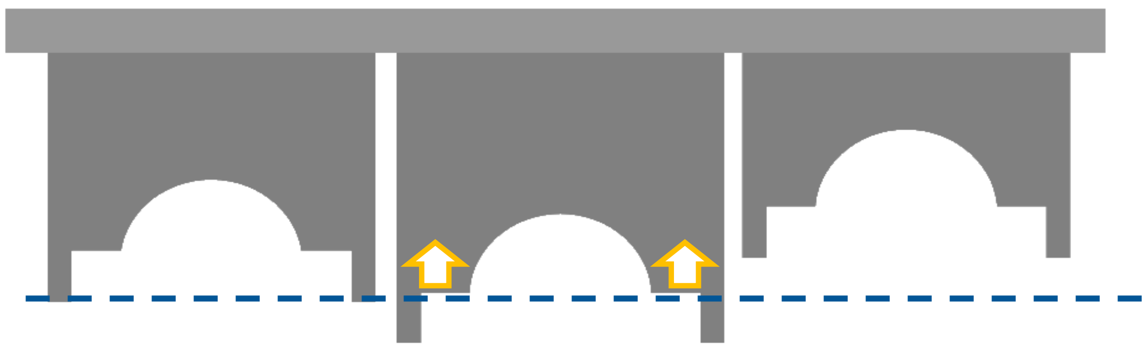
RACE TRACK - CONVENTIONAL



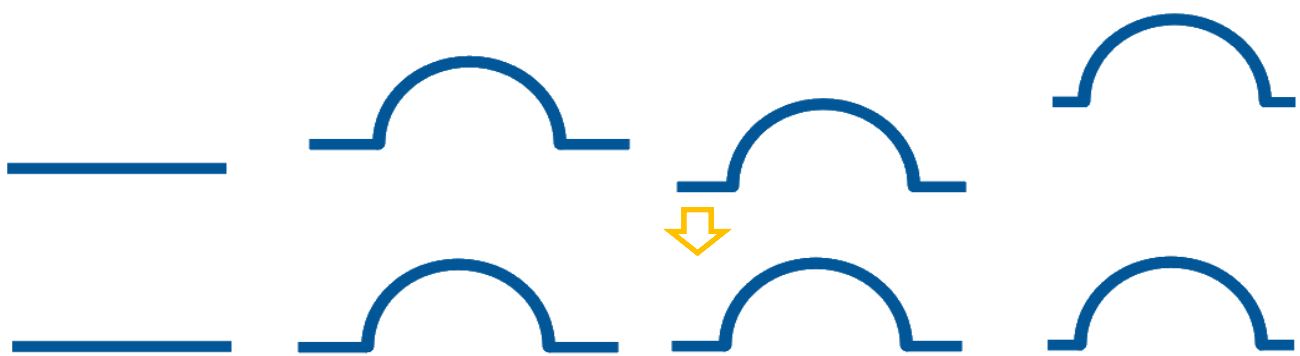


SERVO-DESIGNED DIES

- 1. PRINCIPLE – GUIDANCE PILLAR LENGTH ON THE SAME LEVEL ➔ AS SHORT AS POSSIBLE



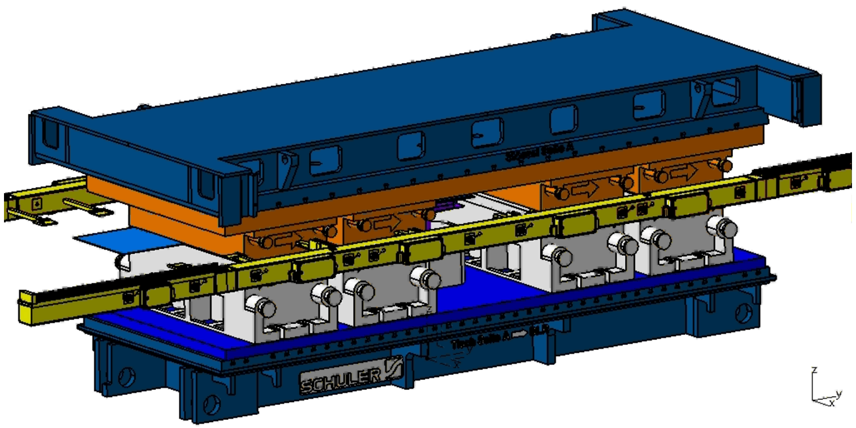
- 2. PRINCIPLE – GRABBING HEIGHT OF THE PART ON THE SAME LEVEL



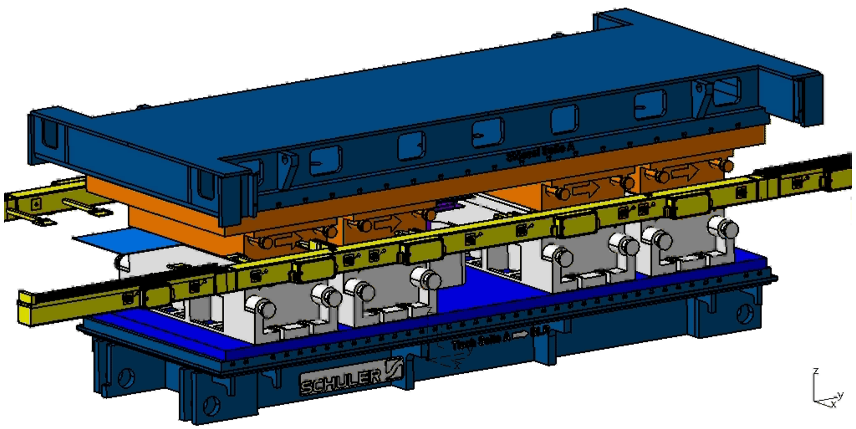
EFFECT OF THE PENDULAR MODE ON CLEARANCE

Pendular stroke = 300mm slide stroke

- Higher output
- Less clearance ➔
- Dies design enabling lower stroke heights



Fulls stroke = 700mm slide stroke



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CONCLUSION – DIE DESIGN.

SERVO DIE DESIGN CONSIDERS:

- Reduction of guidance length
- Reduction of mass
- Damped moveable elements
- Usage of standard parts bearing higher velocities
- Interference curves for the specific forming part

SCHULER PROCESS SUPPORT…

…Increase performance and higher outputs

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SERVO PRESS TECHNOLOGY
& RETURN ON INVESTMENT

Part Analysis and Part Cost

AGENDA

PROCESS MANAGEMENT – HOW WE CAN SUPPORT

IDEAL PART AND PRODUCTION PROCESS

PART CALCULATION

ECONOMIC EFFICIENCY AND PROFITABILITY

THE SCHULER SUPPORT PACKAGE

Consulting

Part Calculations

IT-Solutions

Production Die testing

Tool Tryout and Start Up – Back-Up Production

Production Support

Process Optimization

Training and Workshops

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EFFICIENT PROCESS CHAIN

- Ideal Part and production -process
- Optimum Die design and simulation
- Optimization of set up times
- Optimization of strokes / min
- Energy saving
- Increase of employees qualification
- Increase of availibility

AGENDA

PROCESS MANAGEMENT – HOW WE CAN SUPPORT

IDEAL PART AND PRODUCTION PROCESS

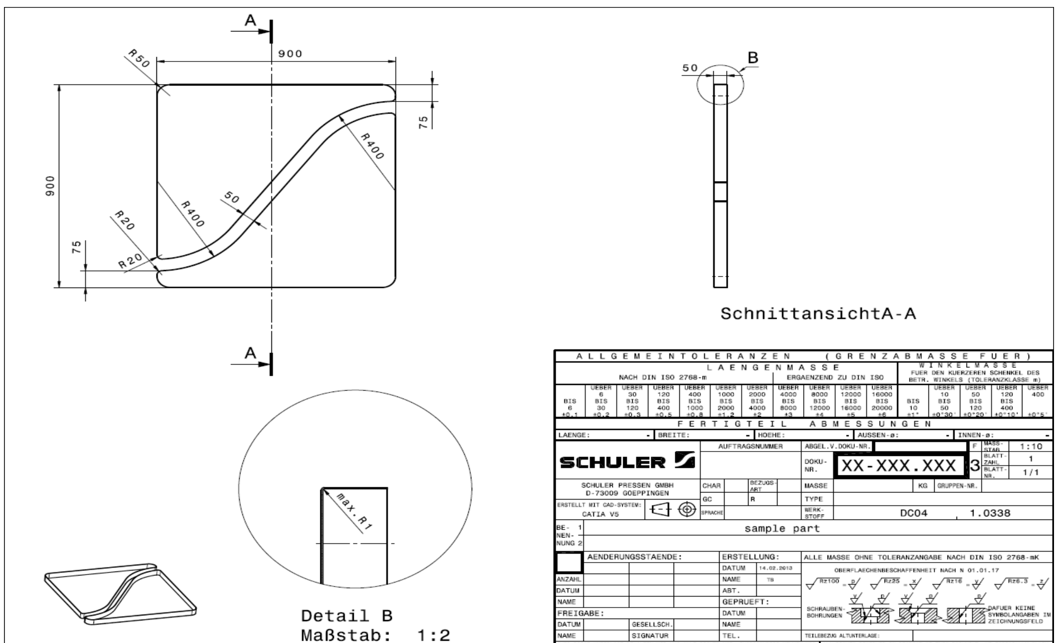
OPTIMUM DIE DESIGN AND SIMULATION

OUTPUT OPTIMIZATION

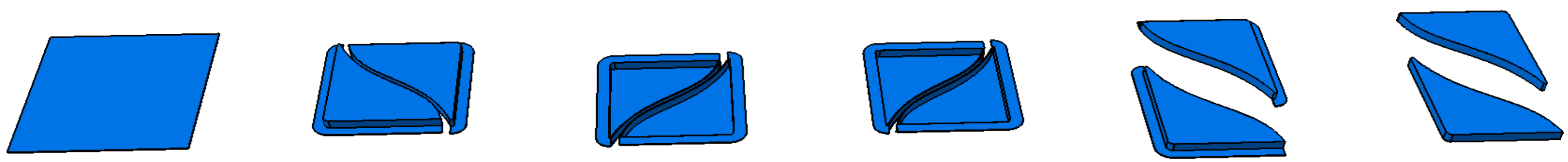
ECONOMIC EFFICIENCY AND PROFITABILITY

BASIC DATA OF SAMPLE PART

Material	DC04
Size	900 x 900 x 50
Thickness	1. 5
Production quantity per year in piece	500,000
Material costs per metric ton in	$ 750



STEP 1: FEASIBILITY STUDIES, METHOD PLANNING



PROCESS EVALUATION AND DECISION-MAKING PROCESS

- Is the part producible?
- Which processes are necessary?
- How many operations and die stages are required?
- Is the integration of a subsequent process possible?
- How important are material costs and savings?
- Targeted production costs per part?
  - Hand operated or automated production?
  - Transfer or ProgDie process?

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STEP 2: CALCULATION OF THE REQUIRED PRESS FORCE

Forming force

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12.02.2013

customer		XYZ
part		sample part
process		transfer
part / stroke		1
size	L x B x H [mm]	900 x 900 x 50
material		DC04
tensile strength	Rm [N/mm²]	350
code material	St - Eingabe "ST" hochfestes Mat.- Eingabe "X" AL - Eingabe "AL" sonst.Nichteisenm. Eingabe "NE"	ST
thickness	s [mm]	1,5
safty factor calculation		1,2

		OP10	OP20	OP30	OP40	OP50	
drawing force	Fz_{ges}[kN]	1680					
cutting force	Fs_{ges} [kN]				1092	1470	
bending force	Fb_{ges} [kN]						
coining force	F_{cges} [kN]		1356				
∑forming force	**Fu [kN]**	**1680**	**1356**	**0**	**1092**	**1470**	
spring force / blank holder force * safty factor	F_F[kN]	605	163	0	131	176	**∑spring+blankholder force**
forming force * safty factor	Fges [kN]	**2016**	**1822**	**0**	**1468**	**1976**	**1075**
start forming	[mm]	**10**	**2**	**0**	**5**	**5**	**15**
stop forming	[mm]	**0**	**0**	**0**	**3,5**	**3,5**	**0**

15 bdc	spring force F_F	1075 kN
10 bdc	F_F + OP10	3091 kN
5 bdc	F_F + OP10 + OP40 + OP50	8357 kN
3,5 bdc	F_F + OP10 + OP40 + OP50	8357 kN
2 bdc	F_F + OP10 + OP20	4913 kN
bdc	F_F + OP10 + OP20	4913 kN

Max. press force

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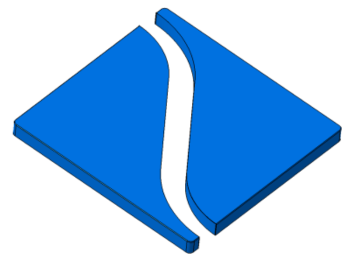
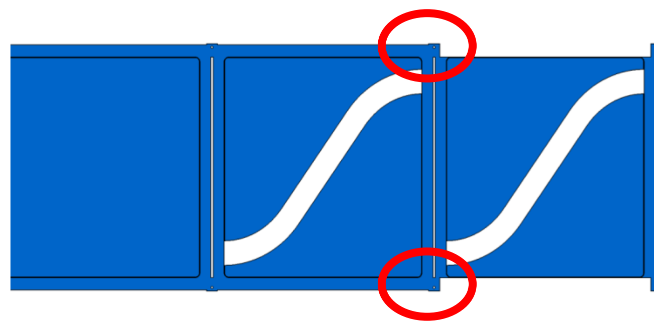
STEP 3: DIFFERENT PRODUCTION PROCESSES

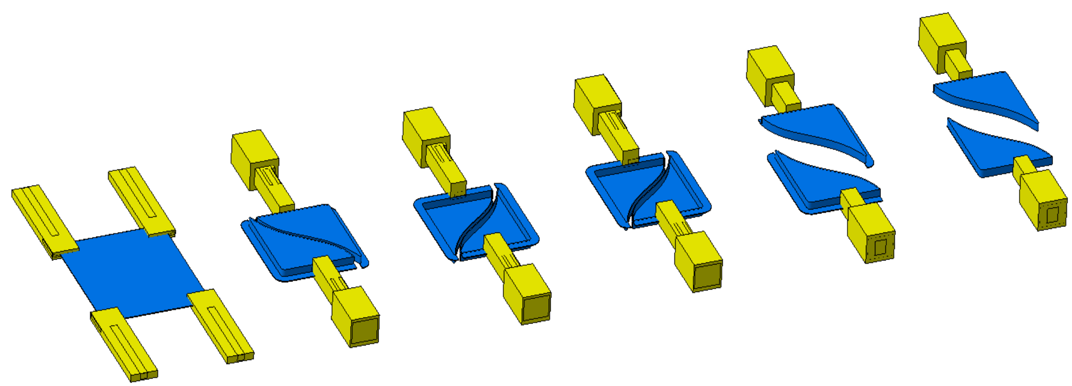
① Hand operated



② ProgDie process



③ Transfer process



STEP 3: DIFFERENT PRODUCTION PROCESSES (CONVENTIONAL PRESS)

	❶ Hand operated	❷ ProgDie	❸ Transfer
Estimated Output in spm (Basis: Conventional presses)	**4**	**25**	**20**
Number of presses	5 (each operation)	1	1
Production quantity per year	500.000 piece		
Availability in %	70	80	80
Shifts per day	2	2	2
Production days	**149**	**26**	**32,5**
One time investment costs	+	-	--
Material savings	++	-	++
Personnel costs	--	+	+
Maintenance costs	-	+	+
Die change time	-	++	+
Result	**-**	**++**	**+**

STEP 4: CALCULATION – MATERIAL COSTS PER PART (CONVENTIONAL PRESS)

	❶ Hand operated	❷ ProgDie	❸ Transfer
Material costs per ton	**$750**		
Feed length	1100 (Blanking operation)	1100	1100
Part weight – Gross	1,25	1,38	1,25
Part weight – Net	1,163	1,163	1,163
Cuttings & Scrap material	7%	**19%**	**7%**
Quantity Parts per / t.	800 piece	724 piece	800 piece
Material costs per Part	**$ 0,93**	**$ 1,04**	**$ 0,93**
Anual savings on production of 500.000 units	**$ 55,000**		**$ 55,000**

➡ Savings per year for 6 Parts with 500.000 pieces per year each = ~ $ 330.000

STEP 5: CALCULATION - PRODUCTION COSTS PER PART – CONVENTIONAL PRESS

	❶ Hand operated	❷ ProgDie	❸ Transfer
Estimated Stroke rate	**4**	**25**	**20**
Production quantity	500.000 piece		
Working days per year	149	26	32,5
Shifts per year	298	52	65
Availability in %	70	80	80
Production costs per Part Invest-& Fix-& Variable-Costs	**$ 0,32**	**$ 0,14**	**$ 0,17**
Material costs per Part	$ 0,93	$ 1,04	$ 0,93
Costs per Part	**$ 1,25**	**$ 1,18**	**$ 1,10**
Savings per– ❸ to ❷		→	$ 40.000

Annual Savings from Prog Die to Transfer for 6 Parts with 500.000 pieces = **~ $ 240.000**

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HOW TO INCREASE RETURN WITH SERVO

BY IMPROVING :

- SELECTION OF BEST PROCESSES
- OPTIMIZED DIE AND TOOL DESIGN
- INCREASER OUTPUT SPEED
- REDUCE MAINTENANCE COSTS
- LOWER ENERGY CONSUMPTION

- OPTIMIZED AND SHORTEN DIE CHANGE TIMES
- LESS COSTS FOR PERSONNEL
- INCREASE IN OEE (OVERALL EQUIPMENT EFFECTIVENESS)

RETURN ON INVESTMENT CONSIDERATIONS

MAIN STEPS

1. INVEST COSTS

a) Press
b) Coil line
c) Transfer
d) Additional Equipement

2. VARIABLE COSTS

a) Labor Costs
b) Maintenance Costs
c) Energy Consumption

3. FIX COSTS

a) Costs for Used Area
b) Crane Costs
c) Forklift & Logistics
d) Number of write-off years – interest rate
e) Machine-indepentent burden costs

4. PRODUCTIVITY INPUTS

a) Number of productive days
b) Number of productive hours each day
c) Plant availability
d) Overall Equipment Efficency (OEE)
e) Stroke rate – production SPM (result of part calculation)

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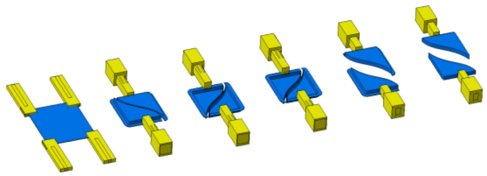
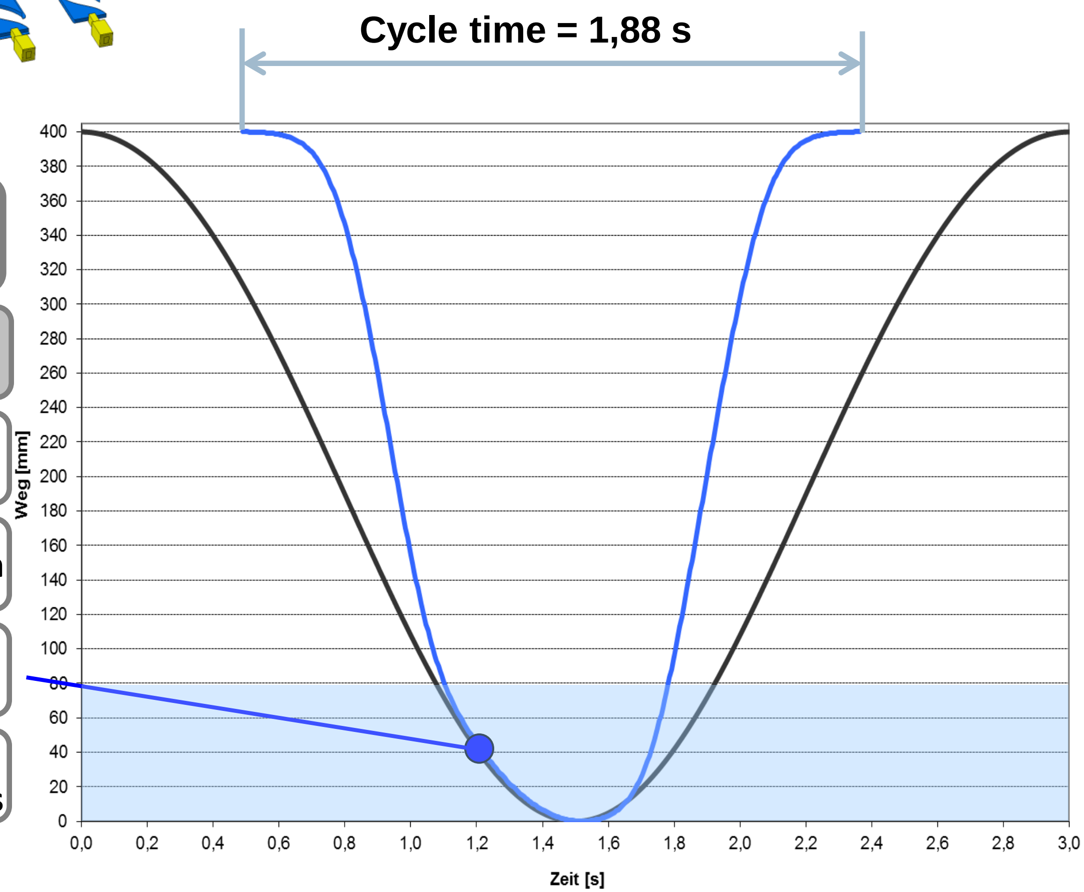
STEP 6: OUTPUT OPTIMIZATION – **SERVO PRESS AND TRANSFER MOVEMENT**





Conventaional press
Initial situation

Stroke rate = 20 1/min

Cycle time = 3,0 s

Stroke height = 400 mm

Start forming = 40 mm

Forming speed = 200 mm/ s

Servo press
TSC2-1250

Stroke rate = 32 1/min

Cycle time = 1,88 s

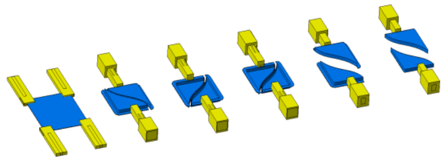
Stroke height = 400 mm

Start forming = 40 mm

Forming speed = 200 mm/ s

60% increase in production rate

STEP 7: CALCULATION - PRODUCTION COSTS PER PART



	❷ Conventional Transfer	❸ Servo Transfer	Revenue out of additional production
Actual parts study result in SPM	20	**32**	
Annual Production 3Sft., 7Hr, 6Dy	2,419,200	3,870,720	
Real production time	80%	85%	
Annual production capacity	1,935,360	3,290,112	
Production quantity	500,000	500,000	
Working days	20	**12**	
Production costs per part Invest- & Fix- & Variable-Costs	$ 0.17	**$ 0.11**	
Savings with Servo Press based up 12 days production		$ 30,000	
Savings for 6 parts based up 72 days production		$ 180,000	
Additional Parts Produced with Servo during the rest of year			1,354,752
Percentage more with Servo			70%
Net revenue per part			$ 0.12
Extra revenue for parts produced			$ 162,570
Additional Annual Return On Investment with servo press			**$ 342,570**

Having flexible Schuler Servo Press which enables you to select the most cost efficient process Progdie or Transfer **- Addition Return on Investment $342,570 x 5 yr = $1,712,850**

POTENTIAL: RATIONALISATION OPPORTUNITIES

BUSINESS CASE: ONE SCHULER SERVO PRESS REPLACES TWO EXISTING CONVENTIONAL MECHANICAL PRESSES

CONSIDERABLY HIGHER PRODUCTION FLEXIBILITY

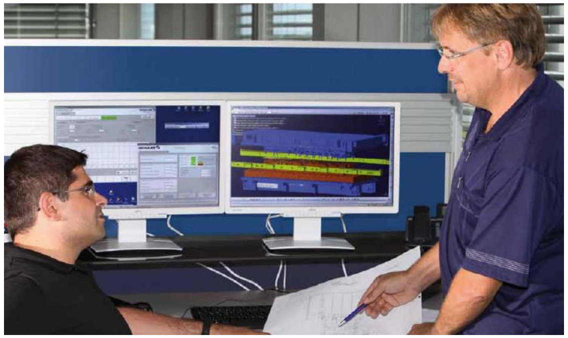
➡LESS PRODUCTION PERSONNEL

➡REDUCED SPACE REQUIREMENTS

➡LESS UNPLANNED STANDSTILLS COMBINED WITH CONSIDERABLY REDUCED REPAIR AND MAINTENANCE COST

➡CONSIDERABLY INCREASED COMPETITIVENESS FOR THE ACQUISITION OF NEW ORDERS

SCHULER AS PARTNER .... FOR SUCCESS IS IN THE FUTURE.



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THANK YOU, FOR YOUR KIND ATTENTION!