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METALFORMING SIMULATION

SCENE 1.
CG: FBI warning
white text centered on black to blue gradient

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SCENE 2.

tape 40, 01:00:00-01:00:12
SME logo, with music

SCENE 3.

MI logo opening

NARRATION (VO):

MANUFACTURING INSIGHTS, MANUFACTURING ENGINEERING MAGAZINE'S VIDEO SERIES FOR PROCESS IMPROVEMENT. THIS PROGRAM SHOWS YOU HOW METAL FORMING SIMULATION IS HELPING COMPANIES USE LESS MATERIAL AND CREATE BETTER STAMPING DIES.

SCENE 4. Riviera Tool

Sign outside building

TO SHOW YOU METAL FORMING SIMULATION IN USE, WE VISITED RIVIERA TOOL IN GRAND RAPIDS, MICHIGAN.

Fade to Black

SCENE 5.

Disc 2, 02:00:24:19

engineer at CAD workstation Disc

NARRATION (VO):

TOOL AND DIE ENGINEERS HAVE ALWAYS BEEN ABLE TO CREATE TOOLING TO PRODUCE FORMED PARTS TO VERY CLOSE TOLERANCES.

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SCENE 6.2, 02:16:20:26-02:16:34:16, press ram going up and down	TODAY, INCREASED COMPETITION HAS MADE IT NECESSARY TO LOOK CLOSER INTO NEW AND IMPROVED TECHNOLOGIES.
SCENE 7.	DIE DESIGN HAS ALWAYS BEEN LOOKED UPON AS AN ART. BUT THE NEED FOR INCREASED PRODUCTIONCOST CONTROL HAS DEMANDED THAT DIE DESIGN BE TAKEN OUT OF THE ART REALM AND TURNED INTO A SCIENCE IN WHICH TOOLING CAN BE DEPENDED UPON TO PRODUCE GOOD PARTS STARTING ALMOST WITH THE FIRST HIT.
SCENE 8.	THE USE OF COMPUTER AIDED DESIGN SYSTEMS HAS PROVIDED SIGNIFICANT TIME SAVINGS IN TOOLING DESIGN. BUT HOW WILL YOU KNOW THAT THE TOOL'S DESIGN WILL BE THE RIGHT DESIGN TO OBTAIN A GOOD PART STARTING FROM THE FIRST HIT ON?
SCENE 9.	THE NEED FOR THIS HIGH STANDARD SHOULD BE OBVIOUS.ACCURATE DIES ARE REQUIRED BECAUSE IMPROPERLY DESIGNED DIES MAY THAT CAUSE TEARS AND WRINKLES IN THE SHEET METAL BLANK. BRING PRODUCTION TO AN ABRUPT HALT WHILE THE DIE IS BEING MODIFIED. NOT ONLY DOES THIS STOP PRODUCTION ON THAT PARTICULAR LINE, IT ALSO AFFECTS OTHER LINES THAT DEPEND ON THOSE PARTS.
SCENE 10. Disc 2, 02:00:24:19-02:00:51:26, over-the-shoulder shot of engineer at CAD workstation	**NARRATION (VO):** INSTEAD OF RISKING ERRORS IN DIE DESIGN THAT WILL CAUSE DELAYS ON THE PRODUCTION LINE, THERE IS A TECHNOLOGY THAT CAN MINIMIZE THESE RISKS.

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SCENE 11. Disc 1, 01:51:03:16-01:51:22:05 shot of computer simulation of the part predicted to rip	**NARRATION (VO):** WHILE THE TECHNOLOGY OF METALFORMING SIMULATION IS NOT NEW, . BUT MAJOR STRIDES HAVE RECENTLY BEEN MADE TOWARD PROVIDING TOOLING WITH A MORE RELIABLE TOOLING.MEANS OF ENSURING THAT NEW TOOLING WILL NOT BE THE CAUSE OF EXPENSIVE PRODUCTION DELAYS.
SCENE 12. Disc 2, 02:28:19:09 external shot of Riviera	**NARRATION (VO):** THE ANSWER TO MEETING THE CHALLENGES OF MAKING TOOLING THAT WILL MEET TODAY’S PRODUCTION NEEDS, LIES IN UNDERSTANDING WHAT HAPPENS AS THE SHEETMETAL BLANK IS FORMED. TO FIND OUT HOW TODAY'S METALFORMING SIMULATION SOFTWARE IS BEING USED BY TOOLING ENGINEERS, SME VISITED RIVIERA TOOL CO. IN GRAND RAPIDS MICHIGAN.
SCENE 13.	RIVERIA TOOL USES METALFORMING SIMULATION ON EACH DIE SET CREATED FOR ITS CUSTOMERS IN INDUSTRIES, INCLUDING AUTOMOTIVE AND APPLIANCE. ALTHOUGH IT DOES NOT SPEED UP THE TOOL DESIGN PHASE, SIMULATION DOES PROVIDE ADVANTAGES.

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SCENE 14.

Disc 1, 01:23:20:14

Jon

JON BROUWER(ON-CAM):

I wouldn't say simulation helps us get the quote out any faster, but it's useful in helping us determine whether we need two forming stages or one. For some particular complex parts, you're going to need two or three forms, stations, whereas if you only quote one form station you're not going to get paid for the next two

SCENE 15.

Disc 1, 01:22:03:15

Jon

Also during the quote stages we'll simulate the part to get a rough idea of our blank size to give to the customer, so they can provide a more accurate piece price to their customer in turn.

SCENE 16.

Disc 01, 01:27:41:25

Jon

NARRATION (VO):

PREDICTING PRODUCTION PROBLEMS, SUCH AS SHEETMETAL TEARING AND WRINKLING IS ALSO A PLUS.

SCENE 17.

JON BROUWER(ON-CAM):

As far as rips, tears, wrinkles, thin-out issues, it's fantastic for that. Simulation software will predict all of those quite nicely. Some of the results are inconclusive out of the springback simulation result.

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SCENE 18. Disc 1, 01:45:08:01 computer screen shot	**NARRATION (VO):** METAL FORMING SIMULATION SOFTWARE ALSO HAS THE CAPABILITY OF PREDICTING PART THICKNESS VARIATIONS OVER THE ENTIRE FORMED PART. THE COLOR KEY IN THE UPPER LEFT PORTION OF THE SCREEN REPRESENTS METAL THICKNESS ACROSS THE PART.
SCENE 19.	COLOR ON THE SIMULATED PART CORRESPONDS TO THICKNESSES SHOWN ON THE COLOR KEY. RED AREAS ARE PREDICTED TO BE THE PART'S THINNEST PORTIONS.
SCENE 20.	EVEN THOUGH THE THINNEST AREAS ARE SHOWN IN THE RED AREAS, THEIR ACTUAL VALUES ARE NOT NECESSARILY A SIGN OF MATERIAL FAILURE. THEY BUT MAY , IN FACT, BE ACCEPTABLE DEPENDING ON THOSE AREA'S ACTUAL THICKNESS, AS WELL AS WHERE ON THE STAMPING IT OCCURS.
SCENE 21.	**NARRATION (VO):** THE KEY IS TO GET THE RESULTS OF THESE SIMULATIONS TO THE CUSTOMER SO THEY CAN TO MAKE CHANGES IN PART DESIGN BEFORE THE TOOLING IS ACTUALLY BUILT.

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SCENE 22.

Disc 1, 01:25:31:28

Jon

JON BROUWER(ON-CAM):

With a lot of the parts we've been working on currently, we've been going back and forth with the customer, who has actually been doing the product design on these parts. He will ask for the simulation results, and he will look at the areas that are thinned to over 20 percent, because that is their standard. They will not buy a part with thinning over 20 percent. He will go back and actually tweak his product design so that the part will not thin over 20 percent. That works quite nicely when a customer will do that.

NARRATION (VO):

WHILE MINOR CHANGES ARE ROUTINE AND EXPECTED, SIMULATION'S ADVANTAGE IS NEVER HAVING TO COMPLETELY REDO A DIE SET.

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SCENE 23.

Disc 1, 01:24:36:14

Jon

JON BROUWER(ON-CAM):

Basically, we don't ever have to go back and reprocess a job anymore. Before simulation was around, sometimes you'd put a job in the press, and you might have to go back and actually redesign the whole set of tooling based on the results of that one drawn panel out of the press. You might have to totally process the tool lineup. We don't have to do that anymore. We may have to make a few small tweaks in the press to the draw die, or a few small tweaks to the process, but we don't find ourselves having to recut or redesign an entire line set of tooling to manufacture a part.

SCENE 24.

NARRATION (VO):

BESIDES AVOIDING TOOLING REDESIGNS, THE SOFTWARE CAN ALSO HELP FABRICATORS REDUCE THEIR MATERIAL COSTS.

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SCENE 25.

Disc 1, 01:26:34:24

Jon

JON BROUWER(ON-CAM):

We use it quite extensively for blank developments. In fact, our original development, we use a one step simulation code to pick the final part shape and we call it smashing a blank, but basically it's taking the final part shape, unfolding it, accounting for stretch, and coming up with a rough idea of what the outline of that ((blank)) shape is going to be. That's the first iteration of the blank that we start with, is out of that one step code. Then we'll tweak the blank, iterate it on the blank, as we go through the simulation process.

SCENE 26.

Disc 1, 01:53:06:12

computer screen shot

NARRATION (VO):

IN ONE PROJECT AT RIVIERA TOOL, SIMULATION SOFTWARE PROVIDED SIGNIFICANT MATERIAL SAVINGS OVER THE CUSTOMER'S ORIGINAL DESIGN. THE SIMULATION ENABLED THIS BLANK'S WIDTH TO BE REDUCED BY 14 INCHES AND THE LENGTH, BY 12 INCHES. THESE SAVINGS WERE POSSIBLE BECAUSE THE SOFTWARE ALLOWED THE TOOLING ENGINEER TO EASILYCOULD EXPERIMENT WITH VARIOUS POST, DRAW BEAD, AND BINDER CONFIGURATIONS.

SCENE 27.

Disc 1, 01:45:46:04-01:45:52:07

computer screen shot

NARRATION (VO):

THE SIMULATION PROGRAM ALSO VISUALIZES STRAIN ACROSS THE PART.

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SCENE 28.

NARRATION (VO):

WITH ANY NEW TECHNOLOGY, THERE IS SOME SKEPTICISM, AND THE RESULTS OF METAL FORMING SIMULATIONS HAVE NOT ALWAYS BEEN TAKEN FOR GOSPEL.

SCENE 29.

Disc 1, 01:10:53:12

Jon

JON BROUWER(ON-CAM):

In the last five years it's become more acceptable. I'd say before that, there was still a level of skepticism. Tool and die makers and engineers didn't want to believe the results of simulations. But after years of doing it and seeing the results that come out of the simulation and seeing the results in the trial press, it's gained acceptance. Actually I'd say a lot of those tool and die makers that didn't want to believe the results before are now actually reliant on the results.

SCENE 30.

NARRATION (VO):

WHILE THE COST OF THE SOFTWARE IS NOT INSIGNIFICANT, USERS CAN LEARN IT IN A FEW WEEKS AND BECOME PROFICIENT IN ABOUT A YEAR.

SCENE 31.

Disc 1, 01:12:08:12

Jon

JON BROUWER(ON-CAM):

You may want to double check these figures- these were quoted to me several years ago, and the prices have probably changed since then. Additionally, the price for simulation codes vary based on who you are and what company you work for if that makes

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any sense…

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SCENE 32.

NARRATION (VO):

THE LOWER-COST PACKAGES USE A ONE-STEP CODE TO DEFINE BLANK SHAPE AND BASIC FORMABILITY AND DIE PROCESSING ISSUES. INCREMENTAL CODES ARE USED FOR MORE ACCURATE FORMABILITY PREDICTIONS AND WILL COST MORE.

SCENE 33.

Disc 1, 01:12:23:16

Jon

JON BROUWER(ON-CAM):

A lot of simulation software companies will offer a one step code, which is basically an inverse code. It goes from the finished part to a flat blank, and will give you the blank development shape. Then you can build up from there to a fully incremental code, which is what we use here. The fully incremental code takes a lot longer to run than the one step code, but the results as far as formability goes are much more accurate. The cost is greater as well.

SCENE 34.

NARRATION (VO):

TIME SAVINGS ARE NOT EVIDENT IN THE DESIGN PAHASE, BUT WILL SHOW UP LATER.

SCENE 35.

Disc 1, 01:13:15:11

Jon

JON BROUWER(ON-CAM):

The time savings question is a difficult one to answer. It’s very difficult to quantify. If you’re

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simulating all the parts and you have no parts that you do not simulate, to make the comparison between the two is quite tough.

Disc 1, 01:13:51:14

Jon

JON BROUWER(ON-CAM):

My gut feeling, it's probably a month on complex parts, if not longer. I'm talking about trial time, savings in die trial.

SCENE 36.

NARRATION (VO):

BECAUSE OF ITS FLEXABILITY THE SOFTWARE CAN SIMULATE ANY PROCESS THAT HAPPENS IN A PRESS.

SCENE 37.

Disc 1, 01:14:26:26

Jon

JON BROUWER(ON-CAM):

Basically whatever you can do in the press you can do in the simulation software. Drawing, flanging, restriking, cam flanging. I just got done doing a cam flange that had seven collapsible cams on a wheelhouse, and they all collapsed in and flanged the flange underneath. Basically whatever you can do in the press you can do in the simulation software, it just might take you a little bit longer.

SCENE 38.

NARRATION (VO):

EVEN MULTI-STAGE PROGRESSIVE DIES CAN BE SIMULATED.

SCENE 39.

JON BROUWER(ON-CAM):

~~You can do it with progressive dies.~~ We do that

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Disc 1, 01:15:03:02

Jon

quite often actually. We use it for developing webs, stretch webs ((check this: …developing blanks, and we'll actually move the part from one station to the next. We…)) simulate all of our parts all the way through the process, from beginning to end, so from the first form all the way to the final form restrike.

SCENE 40.

NARRATION (VO):

THE SOFTWARE CAN SIMULATE EITHER HYDRAULIC OR MECHANICAL PRESSES.

SCENE 41. Disc 1, 01:16:52:07

Jon

JON BROUWER(ON-CAM):

The simulation really does not care whether the press is mechanical or hydraulic. The way you define a press in the simulation software is you actually just apply a velocity-time curve to the steels that are attached to the upper ram of the press. If you had a hydraulic press that maybe you were slowing down, you would just have to make a velocity time curve that would reflect that slowdown later on in the press stroke.

SCENE 42.

NARRATION (VO):

BECAUSE THE SOFTWARE ACCEPTS ALL TYPES OF MATERIALS DATA, IT CAN BE USED WITH MANY DIFFERENTVARIOUS MATERIALS, INCLUDING TUNGSTEN AND TITANIUM.

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SCENE 43.

Disc 1, 01:17:27:21

Jon

JON BROUWER(ON-CAM):

You can form exotic materials in the simulation software. It's just going to depend on getting the accurate specs either from a tensile test or the material supplier. You input those values into the simulation software. Even hot forming. If you have a tensile test from a hot formed piece of material, you can input that.

SCENE 44.

Disc 2, 02:18:50:21-02:18:55:23

NARRATION (VO):

WITH IMPROVEMENT IN THE ACCURACY OF SIMULATION SOFTWARE, SHOULD COMPANIES SELL THEIR TRYOUT PRESSES?

SCENE 45.

Disc 1, 01:19:07:27

JON BROUWER(ON-CAM):

I don't think trial presses will ever be eliminated We still need them for spotting. We still need them for home line runoffs of parts for customers. The customers will want to come in and get early parts every once in a while. We'll never eliminate the need for a trial press. However, I can see it would result in potentially a reduction in the number of trial presses. The die is taking less time in the press, so you might not need eight presses anymore, you might be able to get away with four.

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SCENE 46. Disc 1, 01:38:07:11 computer screen	**NARRATION (VO):** INPUT TO THE METAL FORMING SIMULATION PROGRAM COMES FROM THE COMPANY'S DIE DESIGN CAD FILE. THE FINISHED PART DETERMINES THE SHAPE OF THE TOOLING, USED TO PRODUCE IT. IN THIS CASE, A VEHICLE FLOOR PAN.
SCENE 47. Disc 1, 01:30:53:09 computer screen	**NARRATION (VO):** THE PREPROCESSING SIMULATION SHOWS THE DIE TOOLS, INCLUDING THE UPPER DIE CAVITY IN ORANGE, THE POST IN LIGHT GREEN, AND THE BINDER IN BLUE CONTAINING A FEMALE BEAD TROUGH FOR THE DRAW BEADS. THE DRAW BEADS ARE THE FIRST PART OF THE DIE TO TOUCH THE MATERIAL AND CONTROL THE FLOW OF MATERIAL.
SCENE 48. Disc 1, 01:38:14:22 Disc 1, 01:38:28:12 computer screen	**NARRATION (VO):** THE CAVITY SURFACE WILL BE MACHINED INTO THE UPPER DIE. AN IGES FILE IS THEN EXPORTED TO THE SIMULATION preprocessing PROGRAM WHICH, IN TURN, GENERATES THE MESH APPLICABLE TO THE FORMED PART.

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SCENE 49. Disc 1, 01:54:40:10 computer screen	**NARRATION (VO):** BY CLICKING AND DRAGGING TO SELECT A SMALLER SECTION OF THE TOOLING AND BLANK, THE DESIGNER CAN ZOOM IN AND GET AN EVEN CLOSER LOOK AT THE FORMING PROCESS.
SCENE 50. Disc 1, 01:55:53:29 computer screen Disc 1, 01:56:43:12-01:56:06:14 computer screen	**NARRATION (VO):** A CLOSER LOOK AT WHAT IS OCCURRING IN THE PRESS MAY REVEAL WHAT IS CAUSING WRINKLING OR TEARING.
SCENE 51.	THE RED AREA PREDICTS WHERE THE FLOOR PAN STAMPING MAY TEAR, UNLESS SOME MINOR CHANGES ARE MADE IN ITS DESIGN.
SCENE 52. Disc 1, 01:39:11:27- computer screen	**NARRATION (VO):** HERE, THE SIMULATION SHOWS HOW THE PART WILL BE FORMED IN THE PRESS. THE LIGHT GREEN AREA UNDER THE PART REPRESENTS THE POST OF THE LOWER DIE. THE BLUE REPRESENTS THE AND BINDER. GRAY, SHOWS REPRESENTS THE WRAPPED BLANK.
SCENE 53. Disc 1, 01:41:05:28 computer screen	**NARRATION (VO):** THE DARK GREEN PARTS PROJECTING FROM THE TOP OF THE SIMULATED LOWER DIE SURFACE ARE GAUGES TO HELP THE PRESS OPERATOR PROPERLY POSITION THE BLANK. WHEN THE BLANK IS FIRST PLACED ON THE DIE, IT LIES FLAT, BUT GRAVITY CAUSES IT TO DROOP.

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SCENE 54.

Disc 1, 01:41:39:05

NARRATION (VO):

THE SIMULATION WILL SHOW HOW MUCH DROOP CAN BE EXPECTED.

SCENE 55.

Disc 1, 01:41:54:07

NARRATION (VO):

IT THEN IT GOES INTO A WRAP STAGE WHERE THE CAVITY ENGAGES THE BINDER IN THE UP POSITION. IT SETS the WRAP SHAPE and the drawbeads if applicable.

SCENE 56.

Disc 1, 01:43:39:05

NARRATION (VO):

IN THE WRAP STAGE, THE USER CAN SEE WHERE THE DIE CAVITY AND THE BINDER COME TOGETHER TO SET THE BINDER WRAP.

SCENE 57.

Disc 1, 01:43:56:05

NARRATION (VO):

THE TOOL DESIGNER CAN ALSO SEE THE CAVITY SURFACE OF THE UPPER DIE AND HOW IT INTERACTS WITH THE BLANK AND THE DIE'S LOWER SURFACE.

SCENE 58.

Disc 1, 01:44:10:02

NARRATION (VO):

THE PROGRAM CAN ALSO SHOW HOW THE BLANK WILL DEFORM BY REMOVING THE VISUALIZATION OF THE UPPER DIE CAVITY SURFACE, WHILE STILL SHOWING THE EXPECTED BLANK DEFORMATION.

SCENE 59.

Disc 1, 01:44:21:27

NARRATION (VO):

BUT IF THE TOOL DESIGNER WANTS TO SEE THE REPRESENTATION OF THE UPPER DIE CAVITY, IT CAN BE QUICKLY RETURNED TO THE ON-SCREEN VISUALIZATION.

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SCENE 60.

Disc 1, 01:55:26:05

NARRATION (VO):

TO DIG DEEPER INTO PROBLEM AREAS, THE DESIGNER CAN CUT A CROSS-SECTION THROUGH ANY PORTION OF THE PART. HERE, THE UPPER AND LOWER LINES REPRESENT THE UPPER AND LOWER DIE SURFACES AT THE SELECTED SECTION. THE LINE IN BETWEEN REPRESENTS THE SHEET-METAL BLANK. THIS CAPABILITY ALLOWS THE TOOL DESIGNER TO SEE HOW THE FORMING PROCESS TAKES PLACE.

SCENE 61.

Disc 1, 02:00:29:20

NARRATION (VO):

AFTER THE SIMULATED PART IS TRIMMED, SECONDARY PROCESSES, SUCH AS FLANGING, HOLE PUNCHING, EXTRUDING, AND EMBOSSING CAN BE SIMULATED.

SCENE 62.

Disc 2, 02:22:18:27

NARRATION (VO):

THE REAL PROOF OF THE SIMULATION TAKES PLACE IN A TRYOUT PRESS. AT RIVIERA TOOL, MECHANICAL PRESSES ARE USED TO TEST DIE SETS IN ACTUAL STAMPING OPERATIONS. OTHER THAN MANUALLY HANDLING SHEET-METAL BLANKS, THE STAMPING OPERATION IS THE SAME AS ON A PRODUCTION LINE.

SCENE 63.

Disc 2, 02:05:16:22

NARRATION (VO):

WHAT STARTED OUT AS AN ON-SCREEN COMPUTER SIMULATION, HAS BEEN TURNED INTO A SET OF UPPER AND LOWER DIES THAT WILL BE USED ON A PRODUCTION LINE TO PRODUCE STAMPED PARTS FOR TRUCK CABS.

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SCENE 64.

Disc 2, 02:08:29:05

NARRATION (VO):

THE FINAL RESULT OF THE DIE DESIGN AND METAL FORMING SIMULATION IS FORMED SHEET METAL. THE BINDER addenda MATERIAL WILL BE TRIMMED AWAY, LEAVING THE TWO RAISED SECTIONS IN THE CENTER, THAT WILL BE SEPARATED AND BECOME, IN THIS CASE TWO INDIVIDUAL TRUCK CAB VISORS.

SCENE 65.

Disc 2, 02:11:38:06

NARRATION (VO):

THE STAINLESS STEEL BLANK IS PLACED ON THE LOWER DIE. THE ENDS OF THE BLANK ARE SEEN TO DROOP, AS THEWAS SIMULATIONED PREDICTEDBY THE SOFTWARE.

SCENE 66.

Disc 2, 02:07:10:04

NARRATION (VO):

A CLOSER LOOK AT THE STAMPING REVEALS WHY TRYOUT PRESSES ARE STILL AN IMPORTANT PART OF THE PROCESS. IN THIS CASE, IT IS APPARENT THAT WRINKLING HAS OCCURRED IN THE PART. HOWEVER, IT IS A MUCH BETTER CHOICE TO FIND PROBLEMS AT THIS STAGE RATHER THAN ON THE PRODUCTION LINE WHERE THE NEED TO REDESIGN THE PART OR THE TOOLING, OR BOTH, WILL RESULT IN LOST PRODUCTION TIME AND INCREASED MANUFACTURING COSTS.

SCENE 67.

IN THIS CASE, HOWEVER, THE OCCURRENCE OF WRINKLING DOES NOT NECESSARILY DISQUALIFY THE DESIGN OF THE DIE, AS LONG AS WRINKLING, OR EVEN TEARING, DOES NOT OCCUR ON THE PART ITSELF. WRINKLING CAN OCCUR ON PORTIONS OF THE STAMPING THAT ARE TO BE TRIMMED

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AWAY, AND MAY BE ACCEPTABLE PROVIDED THEY DO NOT AFFECT HOW THE METAL FLOWS IN THE DIE.

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SCENE 68.

Disc 2, 02:02:52:16

NARRATION (VO):

ALTHOUGH FEEDING THE MATERIAL TO THE PRESS IS NOT PART OF THE METAL FORMING COMPUTER SIMULATION, THE SHEET METAL BLANK MUST BE PROPERLY PREPARED FOR THE FORMING PROCESS. HERE THE BLANK IS BEING LUBRICATED. BLANK LUBRICITY IS IMPORTANT TO THE FORMING PROCESS BECAUSE IT AFFECTS HOW THE BLANK SLIDES OVER THE DIES AS THE PRESS CLOSES.

SCENE 69.

Disc 2, 02:18:17:12-02:18:39:18

NARRATION (VO):

SOME HANDS-ON WORK WILL PROBABLY BE REQUIRED TO GET THE DIE INTO ITS FINAL SHAPE. THE AMOUNT OF TWEAKING THE FINAL TOOL IS NEVER KNOWN AT THE START OF THE JOB.

SCENE 70.

Disc 1, 01:18:09:29

JON BROUWER(ON-CAM):

It depends a lot on the part. Mainly what those guys are doing out in the trial press, they are initially spotting the tool, spotting the binder wraps, trueing up radii that may still have cutter marks in them. The work they have to do is very minimal. They might have to open up a die entry radius in a localized area to get the material to flow a little better. Occasionally we'll tweak a draw bead or two, cut down the height of a draw bead. But generally the blank that comes out of the simulation is what you'll see in the trial press.

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SCENE 71.

Disc 2, 02:16:53:13-02:16:57:20

blued panels in die

OR

Disc 2, 02:17:20:10-02:18:11:17

THEN

Disc 2, 02:18:17:12-02:18:39:18

NARRATION (VO):

SPOTTING CAN BE COMPARED TO WHEN YOUR DENTIST ASKS YOU TO BITE DOWN AND GRIND ON BLUE PAPER.

SCENE 72.

Disc 1, 01:19:51:19

Jon

JON BROUWER(ON-CAM):

You put a blued panel into the die. You roll the press over, and you'll try to get good bearing on good sides of the blank between the distance between the cavity and binder is basically what we do.

SCENE 73.

NARRATION (VO):

ALTHOUGH GOOD RESULTS ARE THE NORM, THE SIMULATION IS NOT ALWAYS PERFECT.

SCENE 74.

Disc 1, 01:20:53:10

Jon

JON BROUWER(ON-CAM):

Seventy five percent of the time we have a good part out of the press. The major problem we're experiencing at this point is springback, which is still quite theoretical as far as simulation goes. Every once in a while we'll get a part that comes out with the correct overbend, because we do model in the overbend based on the springback simulation results.

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SCENE 75.

NARRATION (VO):

UNDERSTANDING SPRINGBACK AND OTHER ASPECTS OF A MATERIAL'S PROPERTIES WILL HELP THE SIMULATION MODELER.

SCENE 76.

Disc 1, 01:04:08:01

JON BROUWER(ON-CAM):

Personally I do a lot of my own draw developments, my own iterations on simulation, so a knowledge of metal forming processes is important.

SCENE 77.

Disc 1, 01:38:02,07-01:38:05:18

computer screen showing FEA grids

NARRATION (VO):

UNDERSTANDING FINITE ELEMENT ANALYSIS AND FINITE ELEMENT MODELING MAY NOT ALWAYS BE NECESSARY.

SCENE 78.

Disc 1, 01:08:59:23

Jon

JON BROUWER(ON-CAM):

What I use finite element modeling and that kind of software is to clean my meshes. I'll mesh it in the presimulation processor, and then I'll take that mesh into a mesh cleanup software and actually tweak the mesh, fix the mesh. If there's any bad spots in the mesh I'll clean it there, and then bring it back into the preprocessor. So I think it's important that they have an idea what a good mesh looks like and how to get to a good mesh. But as far as the little nuances of finite element modeling, they don't really need to know that.

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SCENE 79.

Disc 1, 01:36:43:15

computer screen with grids

NARRATION (VO):

IN THIS EXAMPLE, THE BLANK WILL START WITH ELEMENTS OF THE SIZE SHOWN BECAUSE FEWER ELEMENTS NEED TO BE SHOWN DURING THE GRAVITY STAGE THAT CAUSES THE BLANK TO DROOP. THE HOLDING STAGE FOLLOWS AND SETS THE DRAW BEADS SHOWN INTO THE BINDER WRAP, AS WELL AS THE OUTSIDE WRAP SHAPE.

SCENE 80.

Disc 1, 01:37:16:12

computer screen with grids

NARRATION (VO):

IN AREAS WHERE THE BLANK IS TO BE BENT MORE SHARPLY, THE PROGRAM REDUCES THE SIZE OF THE MESH ELEMENTS TO MORE ACCURATELY REPRESENT CONDITIONS ALONG SIDE, AND ON, EVERY RADIUS. This is called mesh refinement, and most modern day simulation softwares have this functionality built into the code.

SCENE 81.

Disc 1, 01:38:04:22

computer screen with grids

NARRATION (VO):

THIS VIEW SHOWS HOW THE MESHES ARE CREATED TO SIMULATE THE CAVITY IN THE UPPER DIE.

SCENE 82.

NARRATION (VO):

EVEN THOUGH THIS LOOKS COMPLICATED, A NEW USER IS ABLE TO CREATE AN ACCURATE MESH.

SCENE 83.

Disc 1, 01:09:57:16

Jon

JON BROUWER(ON-CAM):

Most of the simulation softwares today have pretty good mesh cleanup options in them.

SCENE 84.

NARRATION (VO):

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BEYOND THE FORMING PROCESS AND THE SOFTWARE, WHAT ELSE IS NEEDED TO PREDICT WHAT WILL HAPPEN IN THE PRESS?

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SCENE 85.

Disc 1, 01:05:29:21

Jon

JON BROUWER(ON-CAM):

A knowledge of materials is quite important in my opinion. To define the material in the simulation preprocessors, you need to know the N value, the R value, the K value, the yield and the tensile strength. So I would say it's fairly important that you are able to make a good decision about how to determine those values and where those values are coming and especially the accuracy of those values.

SCENE 86.

NARRATION (VO):

GETTING THESE MATERIAL VALUES FROM THE SUPPLIER IS OK, BUT ACTUAL TEST DATA MAY PROVE BETTER.

SCENE 87.

Disc 1, 01:06:05:27

JON BROUWER(ON-CAM):

I would definitely suggest they do the in-house testing if available. If you have a tensile test machine, I would suggest you use it. Lately a lot of the material suppliers have been supplying quite accurate values for their materials. In years past, it used to be they would specify the yield and the tensile and the percent elongation, and you'd never be able to get the N value and the R value, which are critical for the formability of a part. Lately they've been giving out the N value and the R value, usually minimum and maximum values. They've been getting better.

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SCENE 88. TIME CODE?

N value is a strain hardening exponent. Basically what the n value describes is the stretchability of the material. The higher the n value, the better the stretchability of the material and the tool is going to be. Generally n values are going to range from 0.1 to 0.3, 0.3 being better than 0.1. Your HSLA steels are going to be around 0.1 and your cold rolled, deep draw quality are going to be around 0.28 to 0.3.

SCENE 89. TIME CODE?

R value is the plastic strain value. That is generally a value around 1, I've seen R values as high as 2. But the R value describes the material flow in the tool. The higher the R value, the better the material flow is going to be in the tool.

SCENE 90.
Disc 1, 01:32:31:24
GRAPHIC:

- MODULUS OF ELASTICITY
- DENSITY
- POISSON'S RATIO
- YIELD STRENGTH AT 0
- 45 AND 90 DEGREES TO THE COIL
- R-VALUE AT 0
- 45
- 90 DEGREES TO ROLLING DIRECTION
- N-VALUE
- K-VALUE

NARRATION (VO):

THE FOLLOWING MATERIAL PROPERTIES ARE ENTERED IN THE SIMULATION:. THEIS MATERIAL IS STAINLESS STEEL. IT'S SPECIFICATIONS INCLUDING: MODULUS OF ELASTICITY; DENSITY; POISSON'S RATIO; YIELD STRENGTH AT 0, 45 AND 90 DEGREES TO THE COIL; R-VALUE AT 0, 45, AND 90 DEGREES TO ROLLING DIRECTION; N-VALUE; AND K-VALUE. (the k-value can be determined from the Power Law, or Holloman's Equation).

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SCENE 91.

Disc 1, 01:33:49:11

NARRATION (VO):

THE USER CAN ALSO DEFINE THE TRUE STRESS-TRUE STRAIN CURVE BY ENTERING DATA POINTS FROM AN ACTUAL TENSILE TEST. THE ADVANTAGE OF USING ACTUAL TENSILE TEST DATA IS THAT THE MATERIAL'S REAL PERFORMANCE throughout the plastic region, RATHER THAN ITS THEORETICAL PERFORMANCE, WILL BE AVAILABLE TO THE SIMULATION. USING TENSILE TEST RESULTS IS PARTICULARLY ADVANTAGEOUS WHEN THE MATERIAL TO BE FORMED IS ALUMINUM OR STAINLESS STEEL.

SCENE 92.

Disc 1, 01:35:24:16

NARRATION (VO):

ONE WAY TO SIMULATE THESE JOBS IS TO USE THE MINIMUM SPECS. USING THE MINIMUM VALUES OF N, R, AND TENSILE STRENGTH REPRESENT A WORST-CASE SCENARIO.

SCENE 93.

BECAUSE THIS SIMULATES THE LOWEST ONE PERCENT OF THE BLANK MATERIAL, THE SIMULATION WILL ALSO YIELD THE WORST-CASE RESULTS, MEANING THAT NINETY-NINE PERCENT OF THE MATERIAL THE MANUFACTURER IS GOING TO USE TO PRODUCE THE PART WILL BE BETTER THAN THE MATERIAL SPECS USED IN THE SIMULATION.

SCENE 94.

Disc 1, 01:35:44:18

computer screen of material area

NARRATION (VO):

IN THIS SIMULATION, THE TRUE STRAIN-TRUE STRESS DATA CURVE WAS BASED ON DATA FROM AN ACTUAL TENSILE TEST. DATA POINTS ARE ENTERED INTO THIS POP-UP SCREEN. THE RESULTING CURVE SHOWS THE MATERIAL'S ACTUAL PERFORMANCE.

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SCENE 95. USING THE RESULTS OF TENSILE TESTS WILL RESULT IN A MORE ACCURATE SIMULATION BECAUSE ACTUAL MATERIAL STRESS-STRAIN CHARACTERISTICS, RATHER THAN THEORETICAL STRESS VALUES, ARE USED.

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SCENE 96. Disc 1, 01:46:04:16 computer screen with FLD curve	**NARRATION (VO):** ANOTHER IMPORTANT METAL FORMING ANALYSIS TECHNIQUE USED BY THE SIMULATION PROGRAM IS GENERATING A FORMING LIMIT DIAGRAM. THE FORMING LIMIT DIAGRAM IS A PLOT OF major STRAIN VERSUS MINOR STRAIN. FORMING LIMIT DIAGRAMS PREVIOUSLY REQUIRED USING A TECHNIQUE KNOWN AS CIRCLE GRIDDING TO GENERATE DATA POINTS TO BE ENTERED ON THE FORMING LIMIT DIAGRAM.
SCENE 97.	A SLOW, TEDIOUS PROCESS, USE OF CIRCLE GRIDS IS NOW LONGER REQUIRED. UNTIL THE BUYOFF MOSTONLY USED BECAUSE CUSTOMERS DO STILL REQUIRE CIRCLED GRIDDED PARTS FOR BUYOFF.
SCENE 98.	THE END RESULT OF THIS PROCESS IS STILL IMPORTANT TO PREDICTING THE BEHAVIOR OF SHEET METAL IN A PRESS. THE RESULTING FORMING LIMIT DIAGRAM PROVIDES A PREDICTION OF WHETHER THE SHEET METAL WILL WRINKLE OR RIP DURING FORMING.
SCENE 99.	THE FORMING LIMIT DIAGRAM DISPLAYED HERE SHOWS MAJOR STRAIN ON THE VERTICAL AXIS, MINOR STRAIN ON THE HORIZONTAL AXIS, THE MATERIAL FAILURE REGION ABOVE THE TOP RED CURVE, AND THE MARGINAL AREA BETWEEN THE TWO RED CURVES. POINTS SHOWN BELOW THE LOWER RED CURVE REPRESENT ACCEPTABLE STRAIN RESULTS.

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SCENE 100.	THE STRAIN ON EACH MESH ELEMENT IS MAPPED AS AN INDIVIDUAL POINT ON THE DIAGRAM. COLOR CODING BY STRAIN RANGE INCREMENTS HELPS VISUALIZE WHERE EACH PORTION OF THE FORMED PART FALLS ON THE FORMING LIMIT DIAGRAM.
SCENE 101. Disc 1, 01:46:08:19 computer screen	**NARRATION (VO):** THE LIGHT GREEN AREAS ARE THOSE THAT ARE WELL WITHIN THE SAFE AREA OF THE FORMING LIMIT DIAGRAM AND EXPERIENCE ADEQUATE STRETCH. THE DARK GREEN AREAS ARE AREAS OF INSUFFICIENT STRETCH. WITH THIS PART, STRETCHING IS NECESSARY TO WORK-HARDEN THE MATERIAL so that the part will better hold its shape after springback and the surface quality will be clean and free from imperfections.
SCENE 102.	THE DARK BLUE AREAS may NOT BE ACCEPTABLE IF THEY OCCURRED ON THE FINISHED PART, BUT IN THIS EXAMPLE, THE BLUE AREAS WILL BE TRIMMED. The blue areas show a tendency towards compressive strain which may lead to wrinkling or oil-canning in the final part.
SCENE 103. Disc 1, 01:47:29:19 computer screen	**NARRATION (VO):** FOR A COSE-UP LOOK, EACH ELEMENT OF THE MESH HAS A CORRESPONDING COLOR-CODED POINT ON THE FORMING LIMIT DIAGRAM.

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SCENE 104. Disc 1, 01:47:48:03 computer screen	**NARRATION (VO):** THE USER CAN ALSO SELECT A POINT OR GROUP OF POINTS ON THE FORMING LIMIT DIAGRAM AND RELATE EACH TO ITS LOCATION ON THE PART'S MESH DIAGRAM.
SCENE 105. Disc 1, 01:48:11:14 computer screen	**NARRATION (VO):** HERE THE SELECTED RED POINTS ON THE FORMING LIMIT DIAGRAM CORRESPOND TO THE RED ELEMENTS OF THE MESH DIAGRAM.
SCENE 106. Disc 1, 01:48:35:06 computer screen	**NARRATION (VO):** FORMING LIMIT DIAGRAMS HAVE LIMITATIONS WHEN USED WITH ALUMINUM AND STAINLESS STEEL, BUT ARE EXTREMELY USEFUL WHEN WORKING WITH PARTS TO BE FORMED FROM MILD AND ADVANCED HIGH STRENGTH STEELS. THE FAILURE CURVES FOR ALUMINUM, STAINLESS STEEL, AND OTHER MORE EXOTIC MATERIAL WILL NOT HAVE THE SAME GENERAL SHAPE THAT REGULAR STEELS SHARE. AND THEREFORE, UNLESS ANOTHER FAILURE CURVE CAN BE INPUT INTO THE FORMING LIMITLD, THE FAILURE CURVE FOR GENERAL STEELS WILL NOT APPLY TO THESE MORE EXOTIC MATERIALS. FOR ALUMINUM ESPECIALLY, THESE FAILURE CURVES NEED TO BE GENERATED EXPERIMENTALLY WHICH CAN BE EXTREMELY TIME-CONSUMING AND TEDIOUS.

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SCENE 107. Disc 1, 01:50:58:05-01:51:19:14 screen of floor pan	**NARRATION (VO):** THIS PART SIMULATION PREDICTED A TEAR, SHOWN BY THE RED POINTS ABOVE THE RED FAILURE CURVE AND THE RED ELEMENTS ON THE STAMPED PART CORRESPONDING TO THOSE POINTS. FAILURE OCCURRED BECAUSE THE RADIUS OF THE BEND WAS TOO TIGHT.
SCENE 108.	BY ALTERING THE PARTS CURVATURE -- MAKING THE BEND RADIUS LARGER -- THE STRAIN ON THAT AREA IS REDUCED and is less localized spreading out the strains more evenly, AND THE PART MAY NO LONGER BE AT RISK OF TEARING.
SCENE 109. Disc 1, 01:51:30:02 computer screen	**NARRATION (VO):** IN THE REAL WORLD, HOWEVER, ALL PROBLEMS CANNOT BE ELIMINATED WITH THE CLICK OF A KEYBOARD. WRINKLING MAY OCCUR CLOSE TO WHERE THE TEAR HAD BEEN ELIMINATED.
SCENE 110. Disc 1, 01:52:08:02 computer screen	**NARRATION (VO):** ANOTHER ADVANTAGE TO METAL FORMING SIMULATION SOFTWARE IS THAT THE USER CAN SHIFT QUESTIONABLE POINTS UP AND DOWN BY MAKING CHANGES IN THE PRODUCT.
SCENE 111.	A POINT THAT LIES ABOVE THE FAILURE LINE MAY BE MOVED DOWN INTO THE SAFE AREA BY, SAY, INCREASING THE BEND RADIUS NEAR THE PROBLEM AREA. THE PREDICTED FAILURE MAY BE ELIMINATED.

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SCENE 112.

Disc 1, 01:28:33:02

Jon

STEVE: YOU CHANGED JON'S COMMENTS INTO NARRATION. NEED DIFFERENT VIDEO HERE.

NARRATION (VO):

TO RUN A SIMULATION, A USER IS GOING TO REQUIRE A TOP-OF-THE-LINE COMPUTER, LOTS OF DISK SPACE, AND A NETWORK TO FACILITATE ENGINEERS' ACCESS TO STORED FILES THAT CAN CONTAIN ONE OR TWO GIGAS OF BYTESDATA.

SEVERAL COMPANIES ARE PROVIDING SOFTWARE SOLUTIONS FOR METAL FORMING SIMULATION, INCLUDING THE ESI GROUP, AUTOFORM, DYNAFORM, AND Altair Engineering.

SCENE 113.

NARRATION (VO):

NEW USERS AND THEIR CUSTOMERS MAY FIND THAT SIMULATION ADDS TIME IN THE EARLY PORTION OF THE DESIGN PHASE.

SCENE 114.

Disc 1, 01:29:02:15

Jon

JON BROUWER(ON-CAM):

It takes some significant time up front, but we'd rather do the engineering up front than out on the shop floor. There's quite a significant savings by using the simulation up front, even though it does take longer to design the tooling.

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SCENE 115.	**NARRATION (VO):**
Disc 2, 02:01:33:05-02:01:35:12 Disc 2, 02:14:08:20-02:14:12:27	THE CURRENT STATE OF THE ART OF METAL FORMING SIMULATION IS THAT IT IS NOT YET A PROCESS WHICH CAN TAKE THE TOOLING ENGINEER FROM A COMPUTER SIMULATION DIRECTLY TO A FINISHED DIE THAT WILL DO THE JOB RIGHT FROM ITS FIRST HIT.
Disc 2, 02:12:48:02-02:12:56:28	EVEN AFTER THE DIE IS FABRICATED, CONSIDERABLE WORK MAY STILL BE REQUIRED TO MAKE THE ADJUSTMENTS THAT WILL MAKE THE DIE PRODUCTIVE THE FIRST TIME IT IS USED.
Disc 2, 02:13:20:00-02:13:24:03 Disc 2, 02:13:36:20-02:13:46:05	BECAUSE NO MATTER HOW SOPHISTICATED TODAY'S METAL FORMING SIMULATION PROGRAMS ARE, IT STILL TAKES THE FINE TOUCH OF A SKILLED CRAFTSMAN TO MAKE SURE IT IS RIGHT.
SCENE 116.	**NARRATION (VO):**
SME home page (see attached screen prints)	TO RESEARCH VARIOUS METAL FORMING SIMULATION SOFTWARE, VISIT WWW.SME.ORG. USE THE "KEYWORD SEARCH," CLICK "PRODUCT CATEGORY," AND TYPE "SIMULATION." CLICK "SEARCH." UNDER "PRODUCT CATEGORY," CLICK "SOFTWARE, SIMULATION, STAMPING."
SCENE 117.	**NARRATION (VO): (wrap up)** YOU HAVE SEEN HOW USEFUL TO TOOLING DESIGNERS METALFORMING SIMULATION SOFTWARE CAN BE IN SERVING THEIR CUSTOMERS. SIMULATION ACCURACY HAS ACHIEVED

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HIGH CONFIDENCE LEVELS AMONG USERS AND THEIR CUSTOMERS.

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SCENE 118.

NEW USERS CAN BE REAPING ITS BENEFITS WITHIN A FEW WEEKS. BETTER MATERIAL UTILIZATION REDUCES MANUFACTURERS' MATERIAL COSTS. AND MANUFACTURERS APPRECIATE THE ABILITY TO PUT A NEW DIE IN SERVICE WITHOUT START-UP PROBLEMS.

SCENE 119.

CG: credit roll

white text on black, fade up mid-screen

Produced By:

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SCENE 120.

tape 40, 01:00:00-01:00:12

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