3D to 2D Digital Patterning

For Transportation Interiors

Automotive Trim ✦ Aircraft Interiors ✦ Marine ✦ Bus ✦ Rail

This is a whitepaper on the design and development of transportation interior trim as the industry transitions from legacy 2D hand patterning, to 3D digital patterning.

This paper uses examples from ExactFlat for Solidworks 3D to 2D digital patterning software. For more information visit www.exactflat.com or www.digitalpatterning.net

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Premise

The design and development of interior trim is changing. There is a major shift taking place from traditional 2D manual methods, to 3D digital patterning processes. The change has been underway for about 10 years but what is different now is the rate of change is accelerating. It is changing from an opportunity to improve quality while saving time and money, to an essential process just to stay competitive.

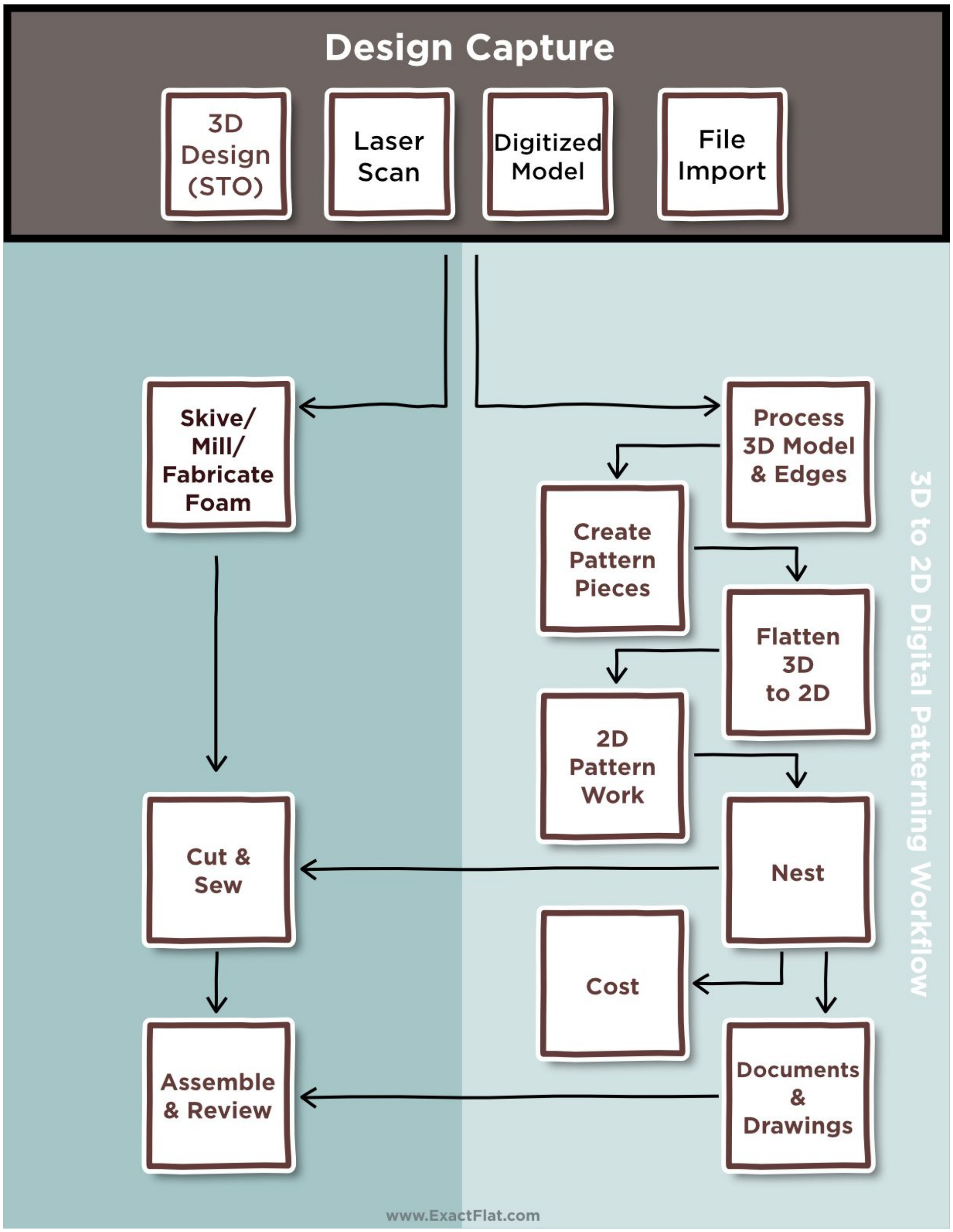
Another issue facing the industry is the reduction in the number of pattern makers.   Pattern makers are exiting the industry faster than they are being replaced. This is due to lack of investment in training and now the industry has a choice to make. Make significant long term investments in training or shift to digital and automate.

The forward march of time pressured industries looking to do three things is driving the changes:

- Meet evolving customer needs that support winning new business.
- Improve internal processes to secure more profit.
- Better integrate upstream inputs with downstreams outputs to maximize efficiency.

For those who are new to 3D to 2D digital patterning, this paper will serve as a good overview.

3D to 2D Digital Patterning Process Overview



The chart above uses the example steps for automotive seating trim, however, the 3D to 2D digital patterning workflow, applies to all transportation interior soft goods.

1. Design Capture:
3D Designs can be captured in a variety of ways. Current methods include

- Design in leading 3D CAD platforms
- Laser scanning physical prototypes
- Digitizing physical prototypes, or
- Importing 3D design files of different types

2. Process 3D Model & Edges.

- 3D designs are not always made for the explicit purpose of pattern making.
- They could be design concepts, virtual samples for review and approval, or used for testing and engineering other components.
- Therefore pattern makers must be able to process the models given. Pattern pieces must be continuous without unwanted holes. Edge geometry should be as desired. Adjacent pattern edges should be "air tight." This helps to guarantee an accurate fit.

3. Create Pattern Pieces
In this step, final pattern geometry is created by selecting surface bodies or faces and combining them to create pattern pieces with the correct shape.

4. Flatten 3D to 2D
This process takes the input of the 3D design and uses a series of sophisticated fabric and flattening simulation algorithms to generate flat patterns. This step replaces the legacy manual hand-patterning process.

5. 2D Pattern Work
Once flattened, manufacturing features such as seam allowances, grain lines, notches, appliques, hardware points, etc. can be added to the 2D flat patterns.

At this point pattern makers have choice, they either work in the same environment at the 3D flattening software, or they can export to another fabric specific 2D CAD package. The advantage to staying in the same 3D to 2D environment is significant. All associations between pattern pieces, the beginning and end of seams, notch points etc are automatically inherited from the 3D model and therefore, no time and effort is required to build them. This saves time on every single project and every pattern piece developed. If the work is exported to another 2D CAD tool, the associations are all lost and rework has to put them back in place. The advantage of using another 2D CAD tool is that existing staff may be already trained.

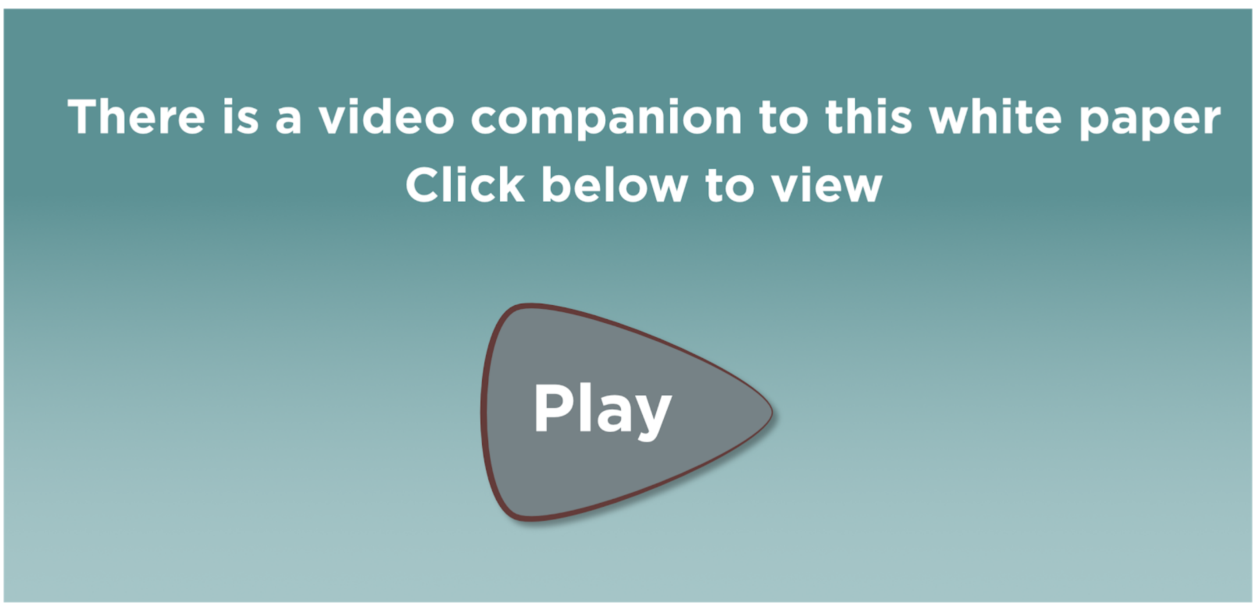
6, 7, 8. Nesting, Costing, and Documents

As in 2D patterning, users may elect to export the finished 2D patterns into other nesting, costing, and documentation processes. However, by staying in the same 3D to 2D environment, all upstream work is inherited for subsequent processes. The reality is the current 2D CAD enabled workflow is disconnected. Therefore time is wasted on non valued actions: trafficking work from one system to the next, re-enter data, recreating outputs to make them compatible with downstream inputs. These actions and systems have been tolerated due to the lack of alternatives. The current 3D to 2D digital patterning workflow is an alternative. It is not new, since it has been around for more than a decade, however, it is has now entered into mainstream adoption.

Process Improvement

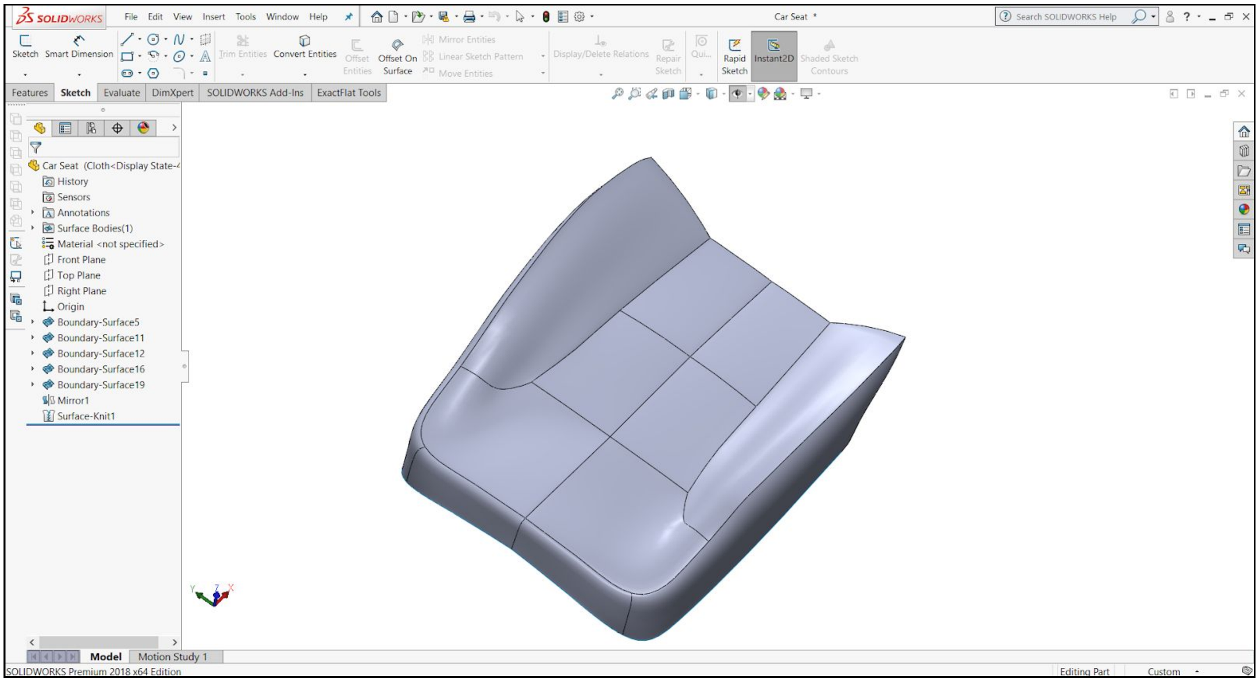
Automating the process is a key way to reduce time, eliminate errors and increase profitability. 3D digital design and patterning provide the only practical way to automate this process.

The remainder of this White Paper provides a quick overview of the 3D to 2D digital patterning method using ExactFlat for SOLIDWORKS on a leather car seat as an example.



https://youtu.be/lJV9IUJHRtk

Step 1: Capture The Design

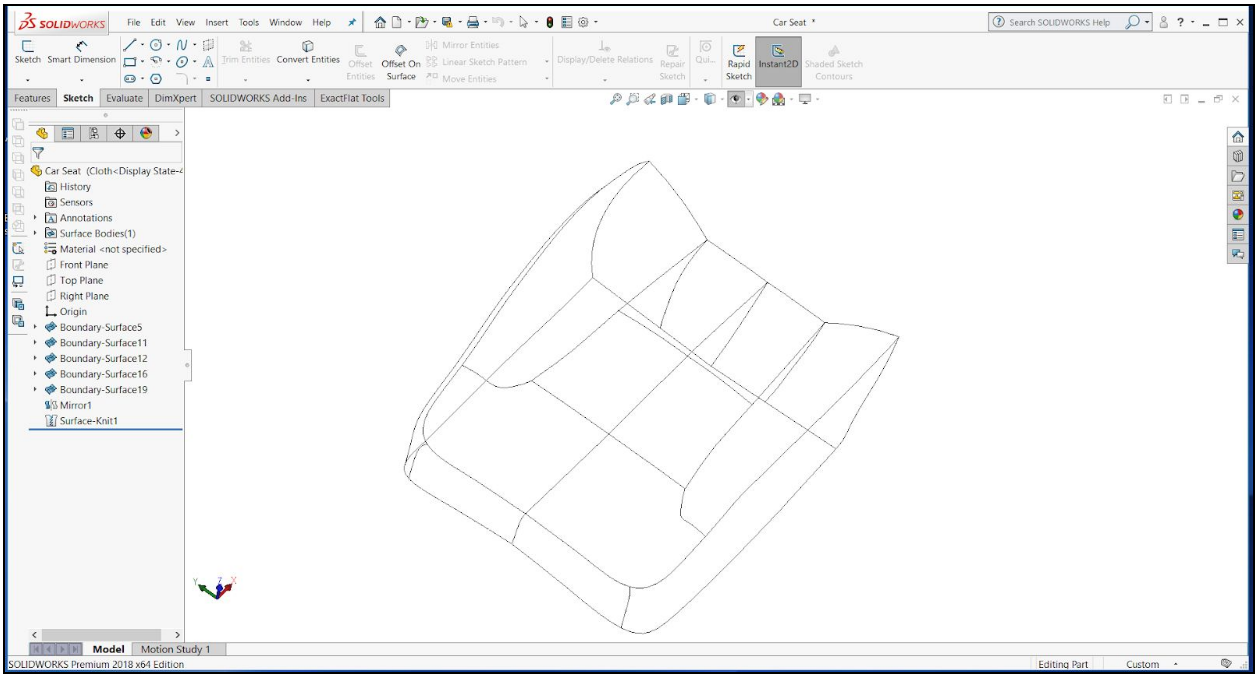


This stage typically starts when the trim team or aftermarket partner receives a Tech Pack or Standard Trim Order (STO) from the designers. ExactFlat for SOLIDWORKS can import a wide array of native and standard 3D file types. The 3D model should include all of the pertinent information needed to produce the product:

- overall size
- areas of curvature
- feature details
- locations of cut lines and/or hardware, etc...

In some cases, an STO will only contain production requirements, 2D CAD files and the production team might also be given access to existing physical prototypes or previously designed products. 3D laser scanning can be used in this situation to capture and refine the 3D design.

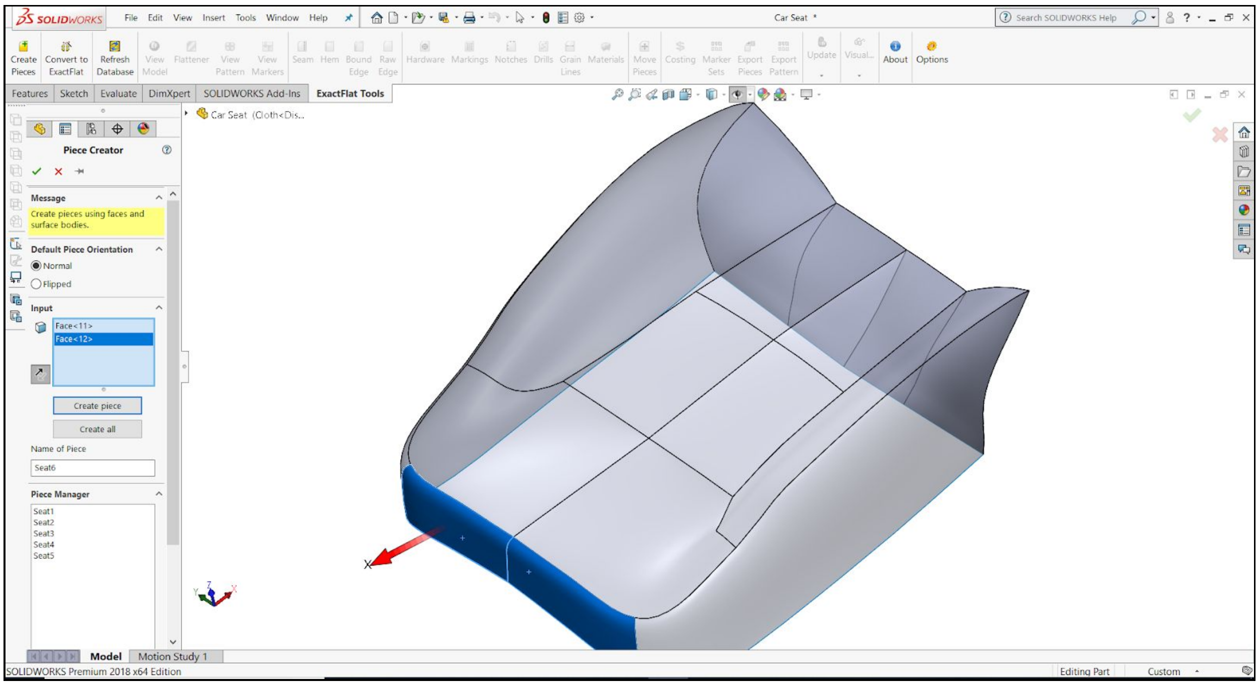
Step 2: Process The 3D Model & Edges



An STO file may or may not be provided with seam lines drawn directly onto the 3D Model using line entities or faces split where seams are intended. To handle both cases, 3D sketch lines are inserted into the 3D model, outlining where splits must occur. From that information the manufacturing team can edit the 3D solid into the separate 3D pieces.

Step 3. Create Pattern Pieces

In ExactFlat, pattern pieces are created by clicking on groups of faces or surface bodies which are then welded together to form a pattern piece.   Any naming convention can be employed. Pattern pieces can be created from single or multi-layered models.



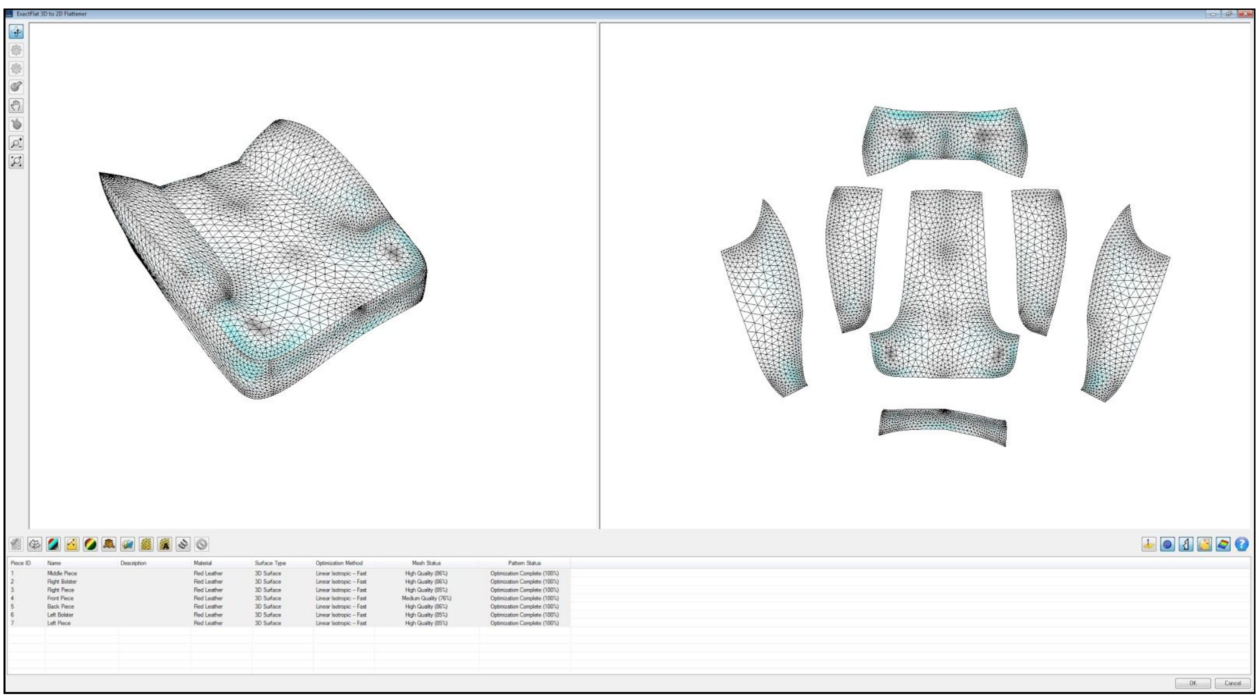
Step 4. Flatten 3D to 2D

Create a Mesh

Once the model has been edited into 3D pattern pieces it is converted into a 3D Mesh. ExactFlat works using FEA technology to simulate fabric behavior and ensure the best possible flat patterns. The 3D triangle mesh is the basis for that simulation. The ExactFlat meshing tools create element shapes that are ideal for the optimization steps for flattening. Users also use the meshing tools to knit gaps in geometry, join surfaces and create a simplified mesh for flattening.

Once the pattern pieces are defined, the user assigns a material type to the 3D pattern geometry. The materials are selected from the ExactFlat Material Library or entered directly. Material properties are applied simultaneously to all pieces or individually. The combination of FEA technology and accurate materials data are the key to simulating precise fabric behavior and to ensuring well fitting patterns.

Flatten the 3D model and Optimize the 2D pattern



The next step is to enter the pattern environment in order to flatten the design. After selecting the patterning menu, ExactFlat generates a flat pattern layout for each material in the design. Strain and sag displays are mapped on both the 3D model and 2D pattern pieces. This information is then used to help determine if edits, such has relief cuts are needed to ensure pattern fit. Various tools are available to edit and optimize patterns and address production problems before any material is cut.

The Advantage of Maintaining Edge Associations

The Advantage of 3D to 2D digital patterning with ExactFlat is all piece and edge associations are maintained from 3D to 2D. Piece and edge associations are an important part of the workflow enhancements provided in ExactFlat. 3D model pieces are assigned a label that matches labels attached to the corresponding 2D pattern pieces.   Edge association, grain lines, markings and internal features from the 3D model are automatically transferred to the 2D patterns.

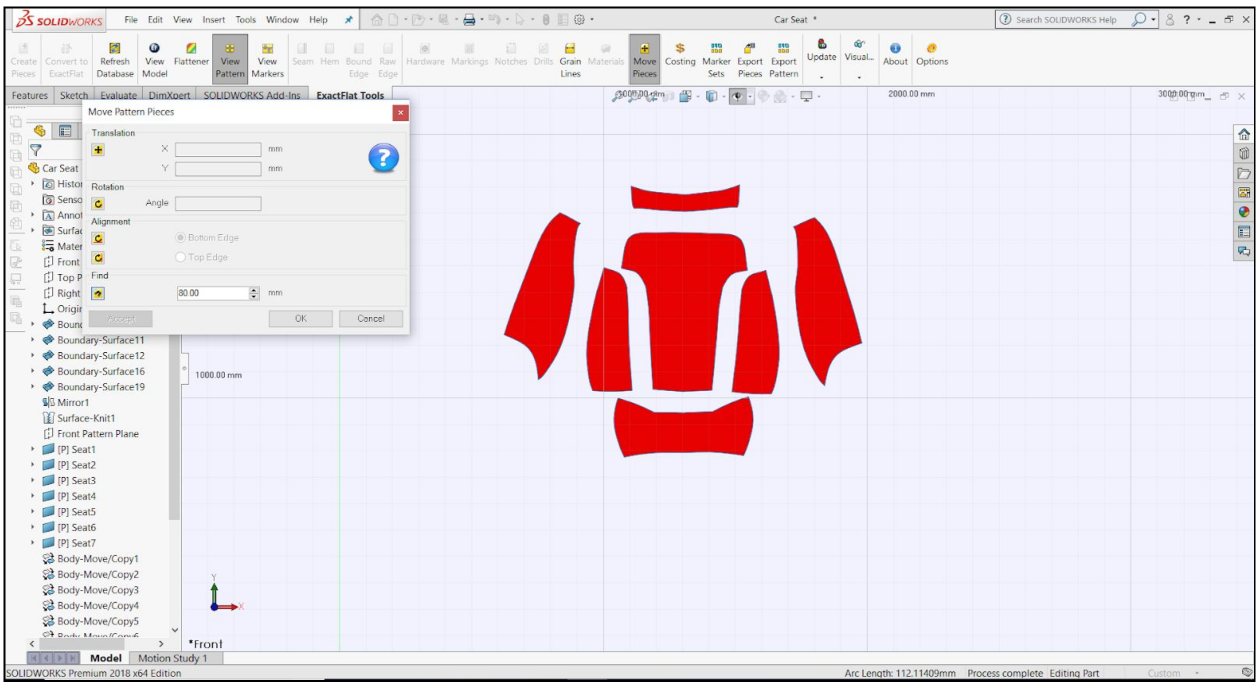
The link between the flat pattern and the 3D model is maintained throughout the pattern development process. This streamlines pattern detailing and ensures that changes made in one area are automatically applied everywhere.

Step 5. 2D Pattern Work

Arranging Pieces

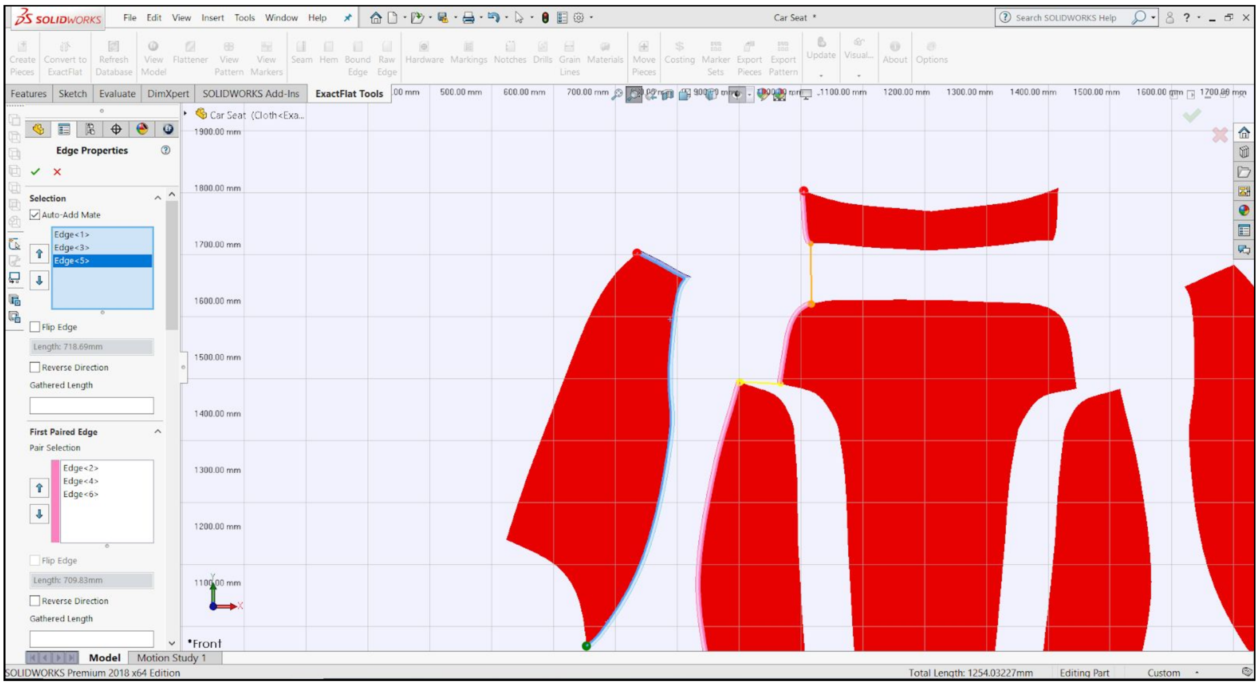
Because piece associations from 3D are maintained into 2D pattern work, flattened pieces can be arranged in a visual layout which is helpful for quickly understanding which piece is connected to which piece. The “find” tool works by simply clicking on an edge of a pattern piece. The adjacent piece is then moved and positioned in close proximity.

The provides users with a mental map that save time in subsequent steps.



Seams

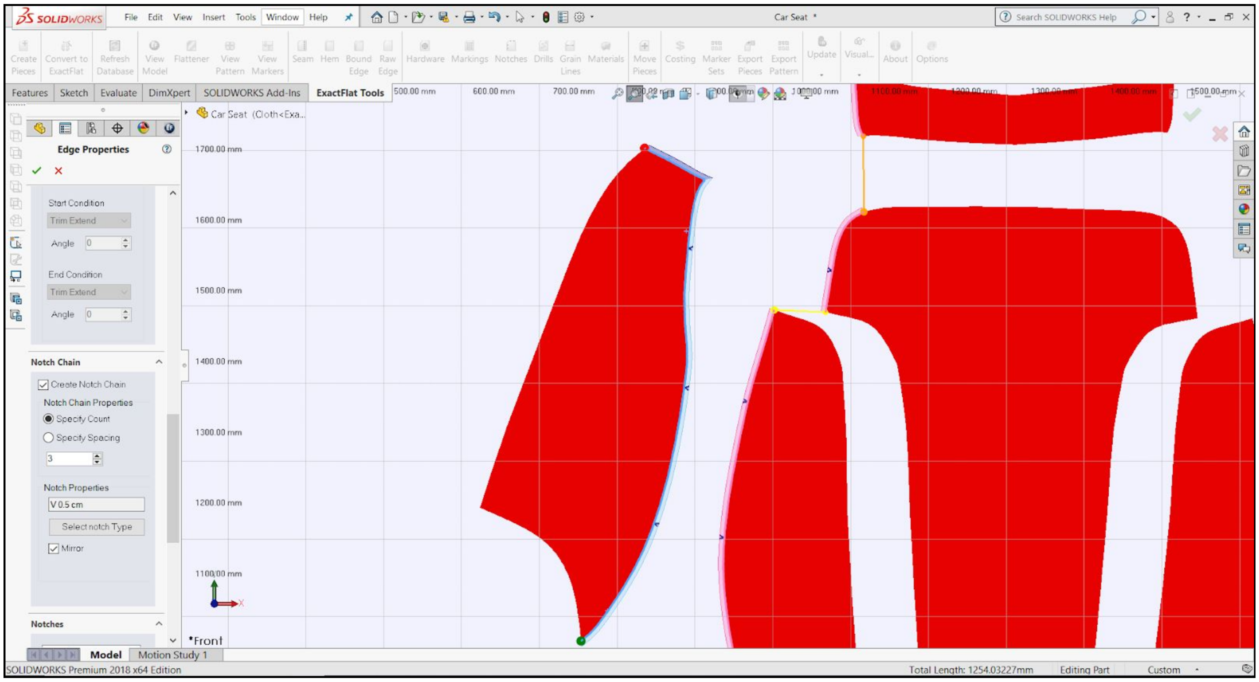
Seam allowances are added by first simply selecting the pre-defined seam type from your company approved standard list and then clicking on the edge to which the seam will be applied. Seam types can be applied globally (i.e. to all edges with one click) or individually depending on your production needs.

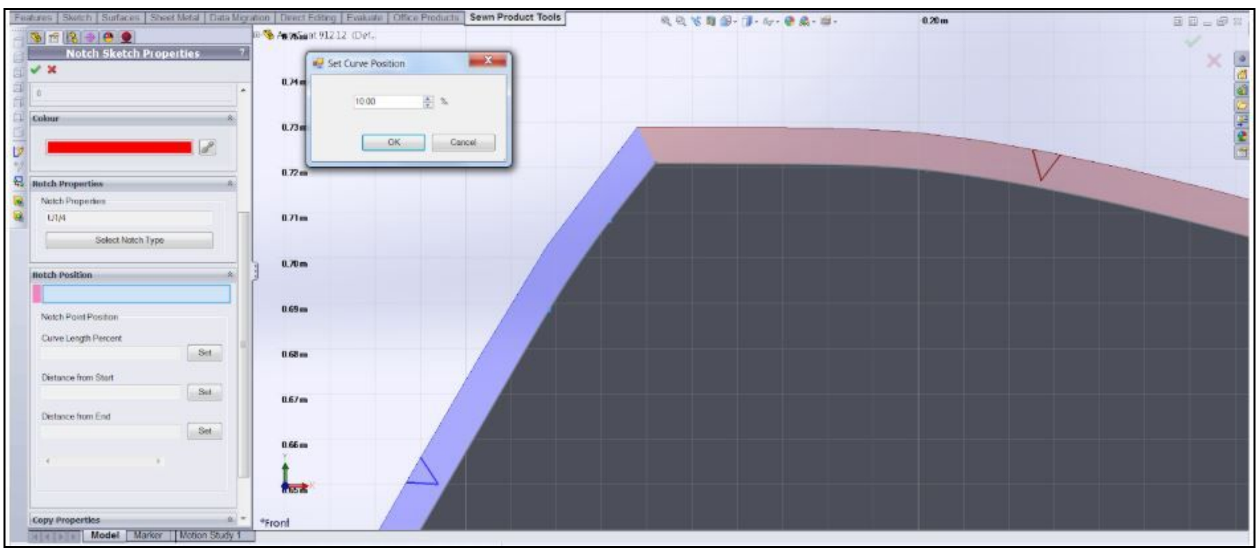


Notches

ExactFlat provides access to a wide variety of notch types and styles. Notch arrays and parametric notch positioning are also supported. Pattern piece edges retain information about the neighboring edge from the 3D model. This means that when a notch feature is added to one pattern edge, a matching notch is automatically added to the corresponding location on the adjacent pattern piece.

Practices such as walking the pattern to manually “eyeball” alignment of notches in no longer required. Exactflat tools are not only faster, they are also far more accurate.





Hardware

Hardware (buttons, zippers, snaps, etc...) are specified using 3D models, blocks, or lines and points and then transferred and accurately positioned in the 2D flat pattern. The database in ExactFlat is used to store the hardware items and can be searched at any time in order to find the right component.

Finishing the Patterning Processes

Preparing fabric and leather pattern pieces for automotive trim production requires just a few steps:

- Design
- Patterning
- Material and Labor Cost Analysis/Optimization
- Manufacturing (Cut, Sew and Assemble)

The legacy manual methods for the Patterning and Cost Analysis/Optimization consume most of the time and cost of in the overall process. These valuable steps can be automated and, in most cases, streamlined and executed in a fraction of the time, 10x faster is not unusual. Digital patterning software solutions like ExactFlat for SOLIDWORKS provide a practical way to automate and accelerate these business-critical tasks.

Once the initial 2D pattern has been generated, the next step of the process is to incorporate all of the details into the cut file (marker sets) and assembly drawings. Using ExactFlat, pattern detail and marker standards information for your company is stored in a shared database. Seams, materials, hardware, costing models and manufacturing process requirements are all organized such that this information can be applied directly in the drawing environment.

The integrated database method allows standards information to be shared or customized across your entire organization and supplier network. This ensures consistency which minimizes production errors and costs. The database is pre-loaded with ready-to-use industry standard information. All of the data can be edited and expanded to meet your specific company requirements.

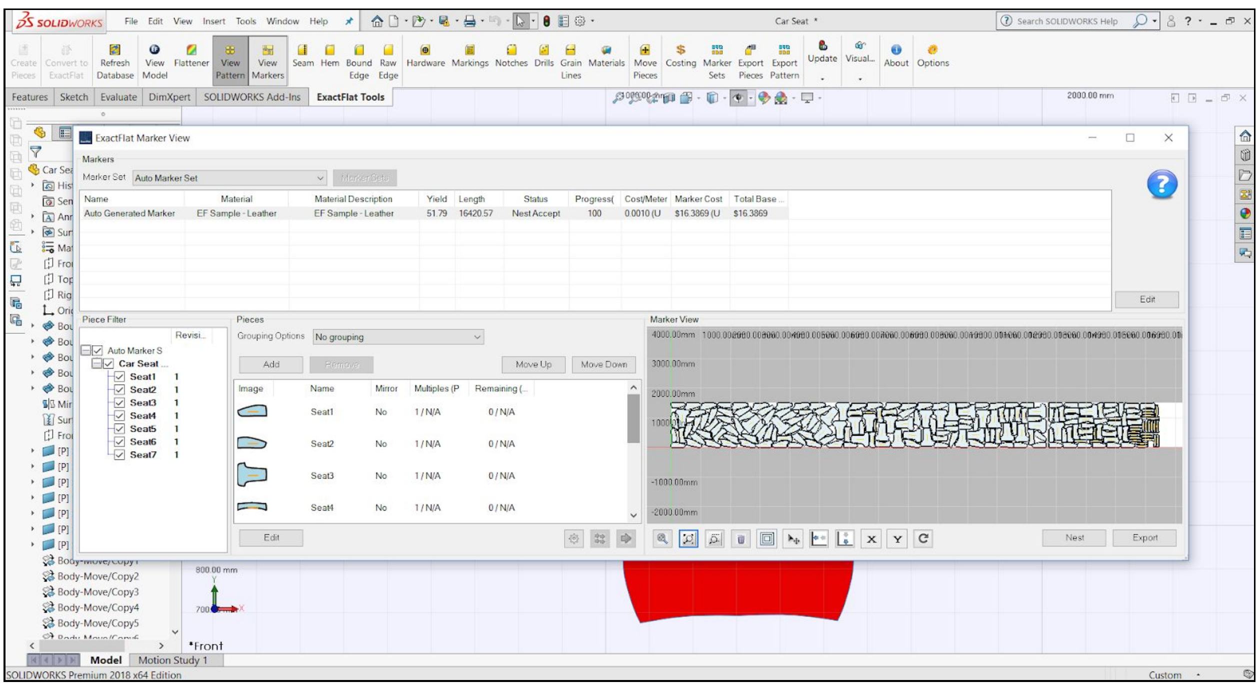
Step 5: Nesting, Costing and Documentation

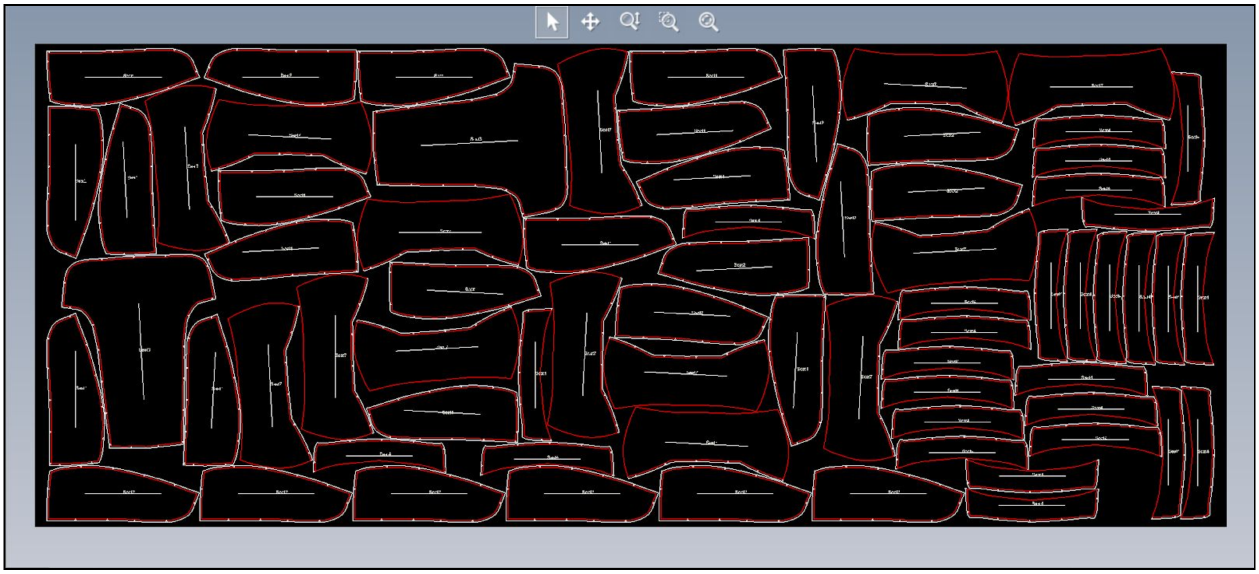
Nest to Optimize Material and Labor Costs

Understanding labor and material costs across a variety of designs and well in advance of committing to production can mean the difference between successful project and potential profit loss. Cost parameters are assigned and then managed in the results manager feature within ExactFlat.

Current results can be saved, and history results can be viewed. This allows users to compare and analyze the cost impact of different process and material selections as well as design changes or family-of-parts options. Cost information can be viewed in a summary, or detailed results can be viewed by drilling down into individual features and operations.

Once complete the tabulated cost information can be placed on drawings or exported for use in other tools. ExactFlat for SOLIDWORKS also includes material optimization or Nesting capabilities. These tools are used to automate discovery of the marker set with minimum material waste.





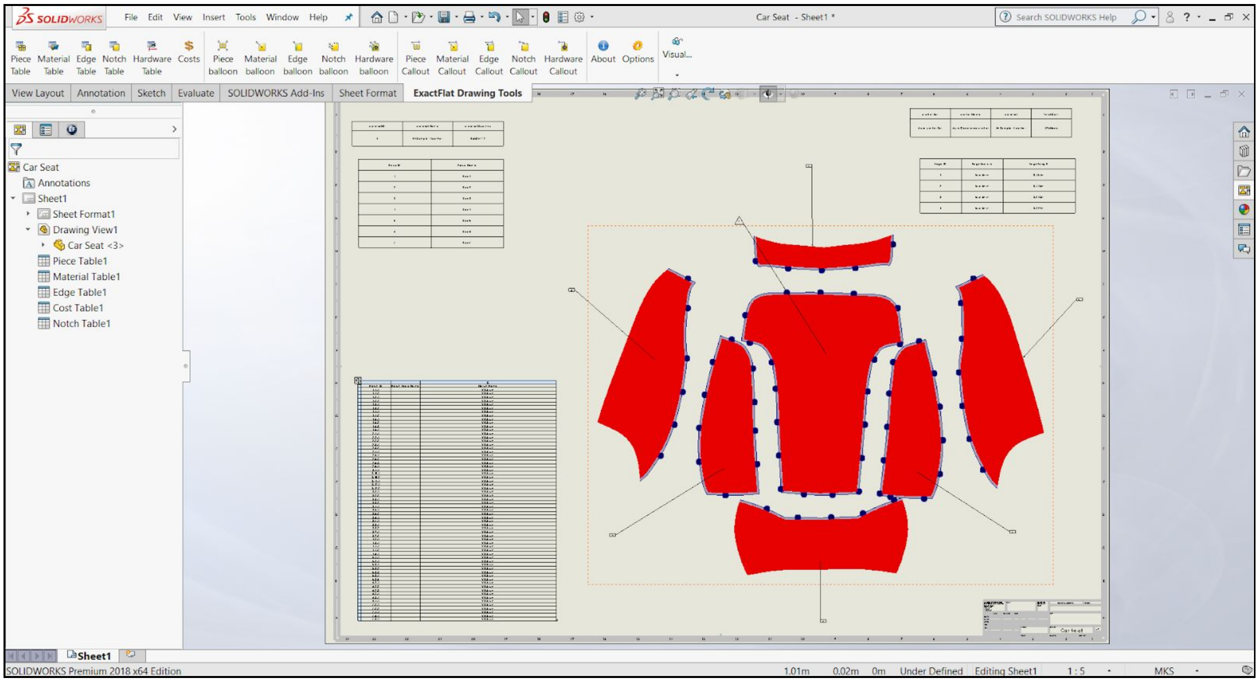
As with all of the digital patterning features, Nesting integrates directly with the 3D design and 2D patterning environments. Users simply

- select the pieces to be optimized
- assign the grain line information
- execute the nesting routine

Nesting scenarios can be tested, and the most optimum nest can be exported. Cost information for nested parts is based on actual nested data, perimeters and up to date material costs. The optimized nested marker set is production-ready and in most cases can be sent directly to the CNC cutter for production.

Create Documentation

Drawings can be created automatically from the 3D model and 2D patterns. Drawings remain associative with related 2D patterns. When a design changes, the drawings automatically update to reflect the changes.   In addition to the actual pattern features specific production data can be incorporated into the drawings.



Edge Table

Edge tables allow the user to display a table of properties for each edge feature, label and length applied in the part file.

Edge Balloons and Piece Callouts

Balloons and Call Outs are used to help identify specific pattern pieces or features on the piece. This data can be invaluable when helping designers communicate instructions to upholstery and assembly teams.

BOM's

Bill of Materials (BOM's) information captured in the 3D model or 2D pattern piece definition can also be incorporated directly on the drawings. Users add these and any of the drawing features using the parameters specified in the ExactFlat Drawing Feature Editor.

Summary

3D to 2D digital patterning has been around for over 10 years. It is now entering widespread and mainstream adoption. This is because it offers significant advantages over older manual pattern development and 2D CAD processes.

Companies who adopt 3D to 2D digital patterning will experience the following benefits:

- It is faster pattern development
- Easier to complete projects
- Easier to share work
- Easier to train new people
- Easier to make changes or revisions to work in progress
- Easier and faster to create costs and documentation

These benefits can be achieved because 3D to 2D digital patterning has the following features:

- Pattern and edge associations in 3D are maintained throughout the process so they don't have to be recreated for every downstream activity.
- 3D to 2D digital pattern flattening is accurate and much faster than hand patterning.
- The work in done in a digital workflow can be centered around using a database to ensure standards are met and information is shared easily with all related personnel.

To Learn More About 3D to 2D Digital Patterning:

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