Integration of Textiles in Fusion 360

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Super Bold Statement #1

- Textile-based product design demands iteration to innovate.

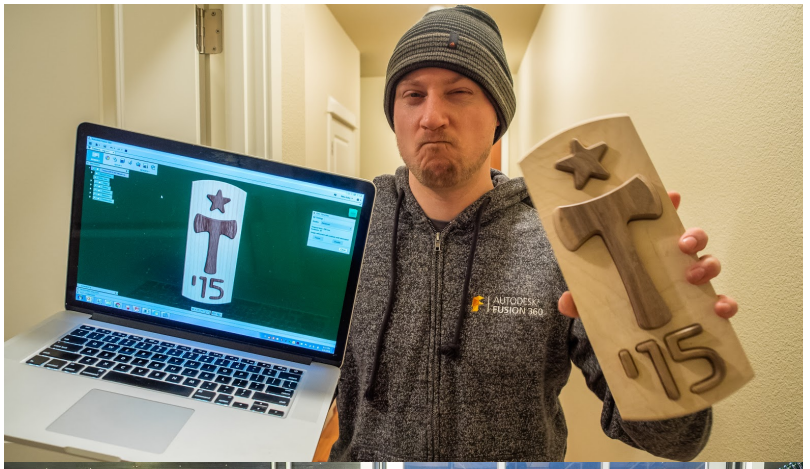
Super Bold Statement #2

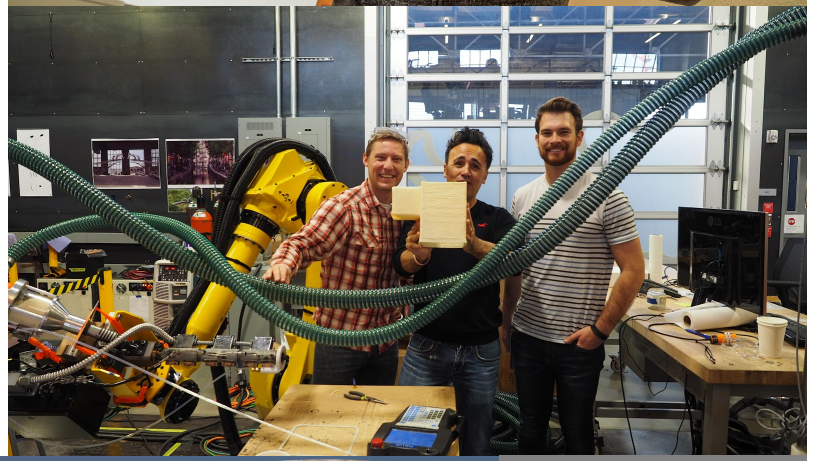
- Recent advances in online software play a huge role in achieving that innovation.

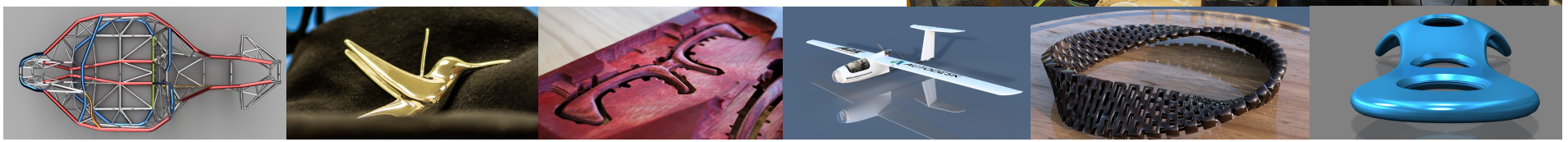
But let’s back up a second…

About Mike

- Autodesk Technology Evangelist
  - Mechanical Engineer
  - 10 years manufacturing experience
  - Been with Fusion 360 since the beginning

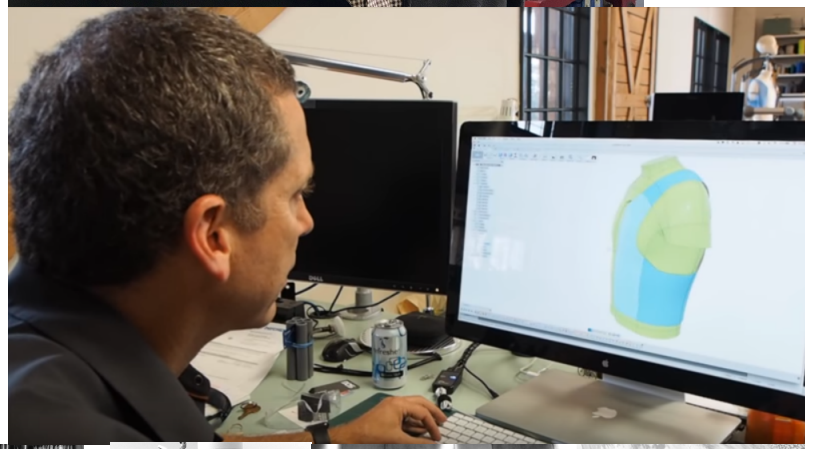


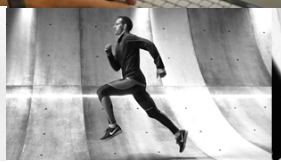


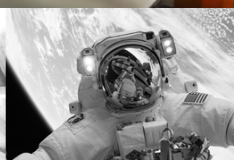


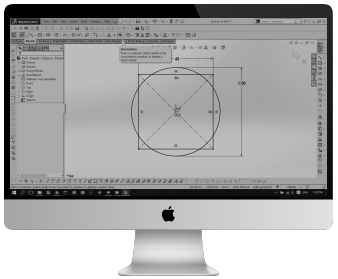
About Bill

- Terrazign President
  - Product Designer
  - 35 years experience
  - Early lover of digital pattern design
    - (among the 5 first ever users of Exact Flat)







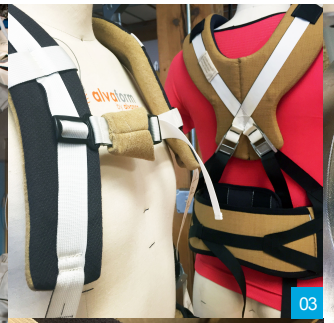


DESIGNED BY PROTOTYPE

Our approach is simple: design by prototype. Our studio serves as our sketchbook. We utilize machines and materials, especially textiles, in unconventional ways to solve problems. We start working with real materials immediately. Driving to a production ready solution and discovering new insights along the way. A process that balances form and function. A process producing functional simplicity and beauty.


01


02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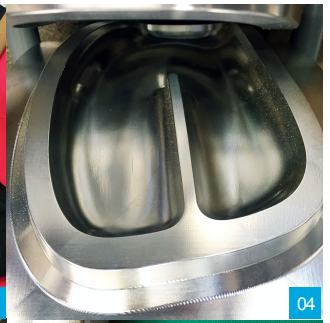
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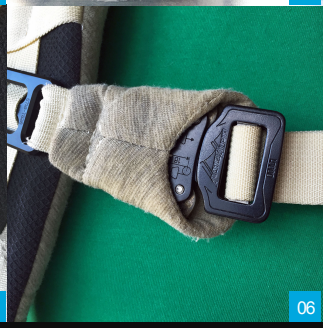
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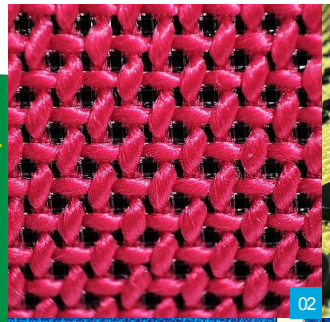
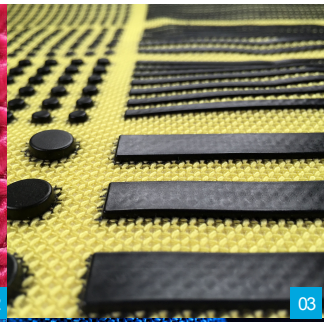
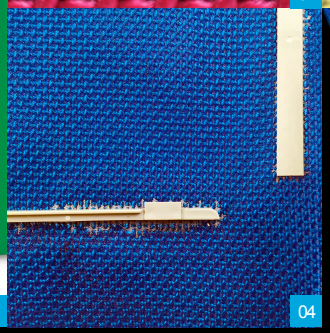
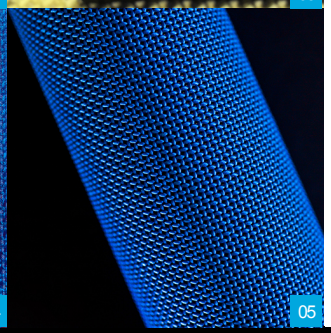
NASA Glenn Harness

01 IMAGE In the next 50 years, NASA plans to send astronauts to the Moon and Mars. These astronauts will need to perform a variety of physical tasks to accomplish their missions. Early assessment of medical data from ISS astronauts have revealed adverse health outcomes: loss of bone density, decreased muscle strength and endurance, postural instability, and reductions in aerobic capacity. All caused by the absence of Earth's gravity.
02 IMAGE Exercise countermeasures include treadmill use for running and walking to stimulate bone mass, cardiovascular fitness, muscle endurance, and the neurophysiologic pathways and reflexes required for walking on Earth. The astronaut is restrained to the treadmill by the Glenn Harness which is worn around the shoulder and hips. Working in conjunction with NASA Glenn Research Center and Cleveland Clinic, Terrazign created an entirely ground-up new construction for the Glenn Harness to address comfort and fit issues on both male and female astronauts.
03 IMAGE The red mannequin shows the modified shoulder strap geometry that shortens and narrows shoulder strap outward of the chest and attaches to the hip belt with two straps on each side.
04 IMAGE A hip pad product tool used to compression mold the hip pads in-house at Terrazign. The closed cell foam used is inherently fire retardant, moisture resistant and low weight.
05 IMAGE Terrazign builds all Glenn Harnesses in house and customizes for individual astronauts based on a standard sizing table. Harnesses are built in small, medium, large and extra-large for both male and female crew members. The Glenn Harness is fabricated and certified for flight in time for manifesting and launch.
06 IMAGE A detail shot of a sternum buckle tunnel used throughout the harness to avoid any buckle contact with the body for improved comfort.







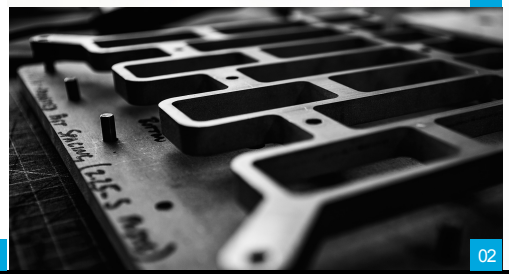


UE Boom Speaker

01 IMAGE The UE Boom's mix of materials and shape made it "one of the nicest overall design in its class," stated iLounge. Gadgetmac described the UE Boom as a "stunner, the first portable wireless speaker with a functional design that speaks volumes and is for once iconic" amongst a sea of sameness.
02 IMAGE The outer woven fabric was selected to balance both aesthetics and function. The top visible layer provides excellent abrasion properties and a high level of stability. In order to improve particle ingress protection, a base-layer monofilament mesh was included in the final package. Multiple iterations, patterns and attachment methods (heat staking, tension, zipper) were explored.
03 IMAGE Early engineering sample of direct-inject molding various shapes and durometers on different substrate materials to test T-Peel strength, tooling shut-off issues and overall feasibility.
04 IMAGE Development validation sample of direct-inject molding on final woven substrate. Shut-off bleeding issues were acceptable since these areas were not cosmetic and hidden inside the speaker.
05 IMAGE Finished outer fabric wrapped speaker. The stain-resistant material helps protect the speaker from the elements without affecting acoustics.
06 IMAGE Final production sample illustrating the simple fabric sub-assembly that was easily installed on injected speaker housing. The fabric assembly attached to the housing via locking tabs down the centerline and each end.

01

02



02

04

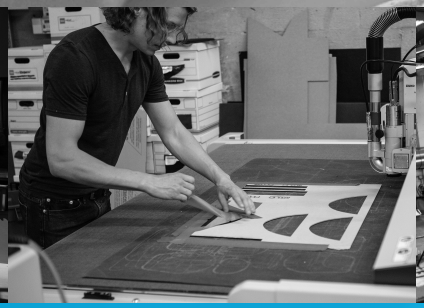
Vicis ZERO1

01 IMAGE Vicis engineers and neurosurgeons have developed a multilayered, highly-engineered helmet design that mitigates linear and rotational impact forces. The helmet system combines the Lode Shell, RFLX Layer and FORM Liner. The ZERO1 is a 21st century helmet that employs several longstanding principles in physics, starting with Newton's 2nd Law from the 17th century.
02 IMAGE Terrazign's work focused on design, patterning, grading and attachment of the FORM Liner into the Vicis ZERO1 helmet. Multiple liner architectures were developed for the Vicis team to evaluate. The final FORM Liner construction has been repeatedly praised by NFL Players as the most comfortable liner they have ever worn.
03 IMAGE A bonding fixture for FORM Liner Midline Pads. Bases are routed out of MDF, pinned and a water-jet aluminum top mold is utilized as a bonding element. Final bonded parts are diecut to their respective sizes.
04 IMAGE The Lode Shell absorbs impact load by locally deforming, like a car bumper. The RFLX layer employs a columnar structure that moves omni-directionally to reduce linear and rotational forces. The LODE Shell and RFLX Layer work together to reduce impact forces, leveraging well established engineering principles and materials long-used in stringent aerospace and automotive applications.

OUR SPACE

Terrazign is a product design firm focused on textile integration with hard goods, and other structural components. Anything and everything that touches textile-based product design is our specialty. We span a wide range of industries and work with clients at every phase of the product creation process.

To start working with materials immediately, you need materials right away. Our extensive material library of knits, wovens, non-wovens, leathers, foams, plastics and other synthetics allow us to get in the zone quick. Final assembly takes place in our other two main design studios.



OUR TOOLS

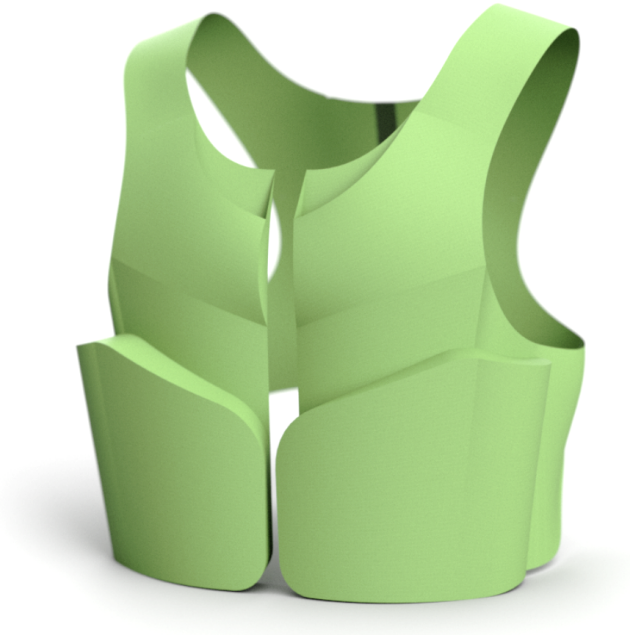
If you want to make great stuff, you need good tools. Bringing hard and soft design together well is no easy feat. We're well equipped to approach a design challenge from multiple angles with the right tools to cut, route, etch, grind, slit, skive, bond, sew, compress, form, mold, weld and if all else fails, bolt. The shop floor supports everything we do creating our fixtures for compression and bonding processes, building sub-components and mechanisms and whatever else you throw our way.

Time in…

Class Objectives

- **“Project Vest”**
  - Build a working tool vest.
  - Demonstrate the digital patterning workflow
  - (Use almost all online software)

- **At the end of this class, you will have:**
  - An understanding of why we design digitally
  - A methodology of how to do it



AUTODESK® REMAKE

AUTODESK® FUSION 360™

ExactFlat

AUTODESK® 123D®

Everyone Be Cool

- **Yes, you'll get the videos.**
- **You won't get the dataset.**

Why Change?

Why Change?

"**It's not just about fabric and patterns.**
It's about maximizing our time to iterate
throughout the entire product design process."

Why Change?

- Our industry is evolving and adapting very quickly.

Google Conductive fiber: http://www.dezeen.com/2015/06/03/google-smartphone-interfaces-conductive-threads-clothes-textiles-project-jacquard/

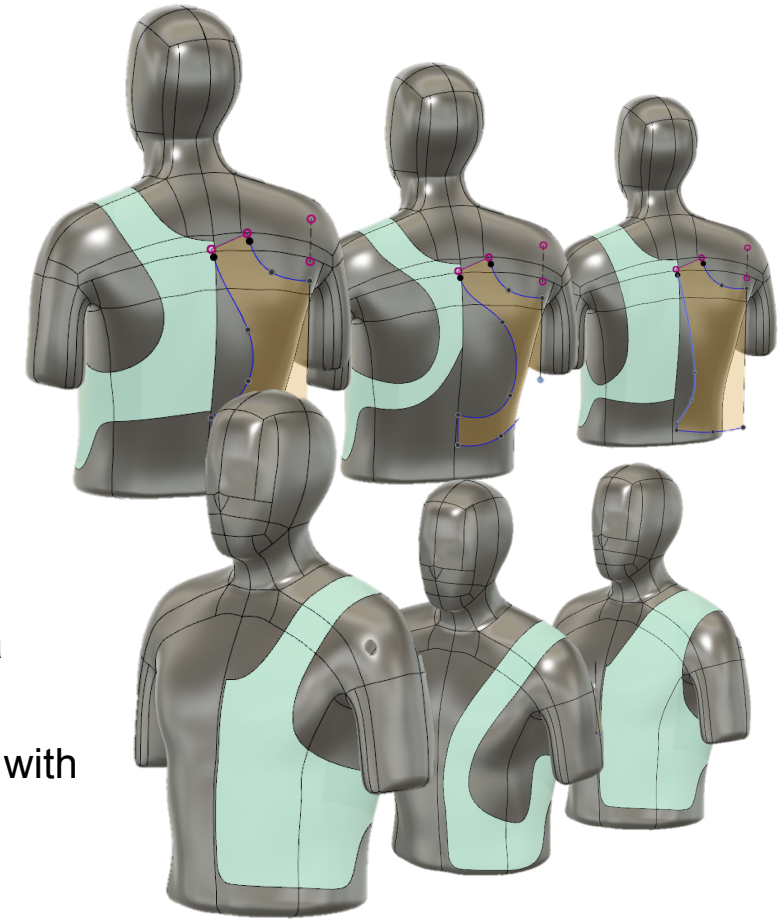
Under Armour's Architech https://www.underarmour.com/en-us/3d-architech

UE Boom: http://www.ultimateears.com/en-us/ueboom2#select-color

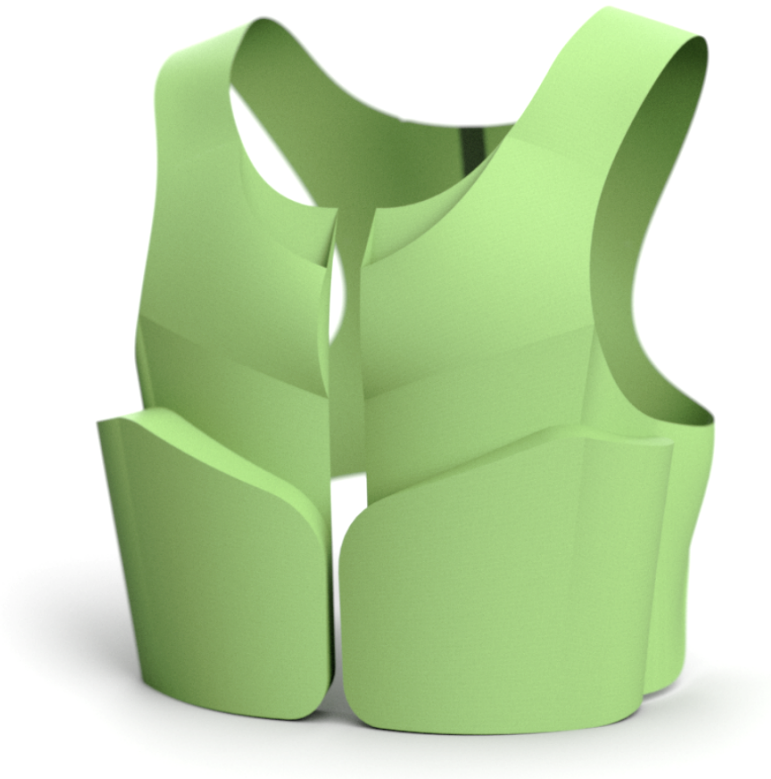
Advanced Materials | Evolving Manufacturing Processes | Integrated Hardware

Why Fusion?

- **Fusion is:**
  - Extremely fast to adapt models.
  - Tied to flattening.
  - Embedded CAM
  - Easy to access and share.
  - An entire manufacturing solution.
- **Solidworks is:**
  - Terrible working with customer mesh data
  - Difficult to do surfacing
  - Tied to Dassault and hard to do business with
  - (Plus, it's really expensive.)



Project Vest

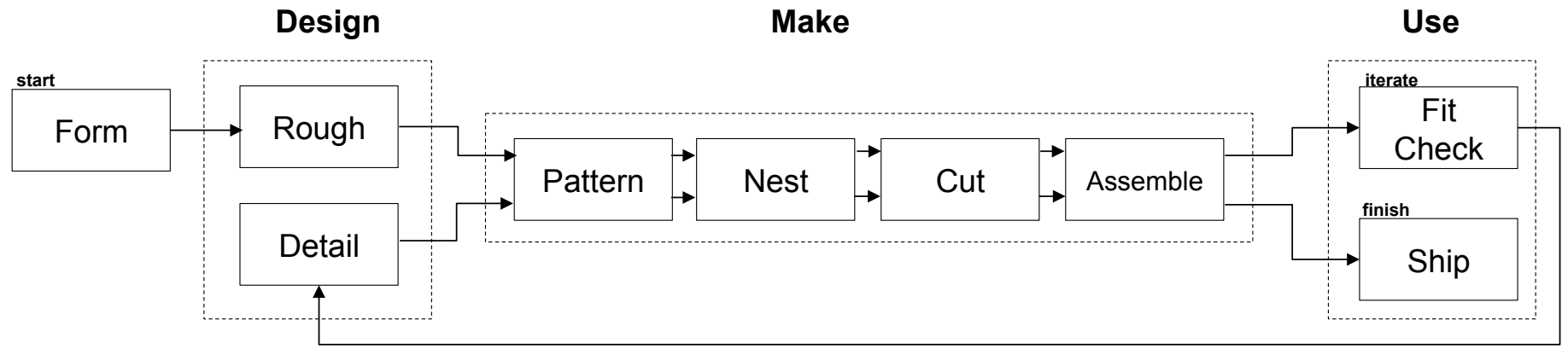


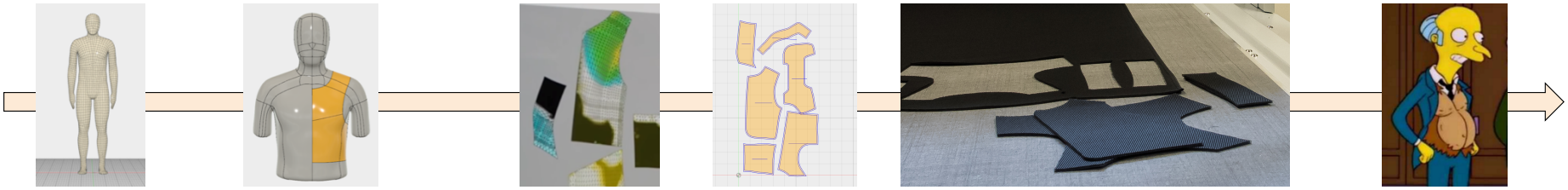
Project Vest

Goals:

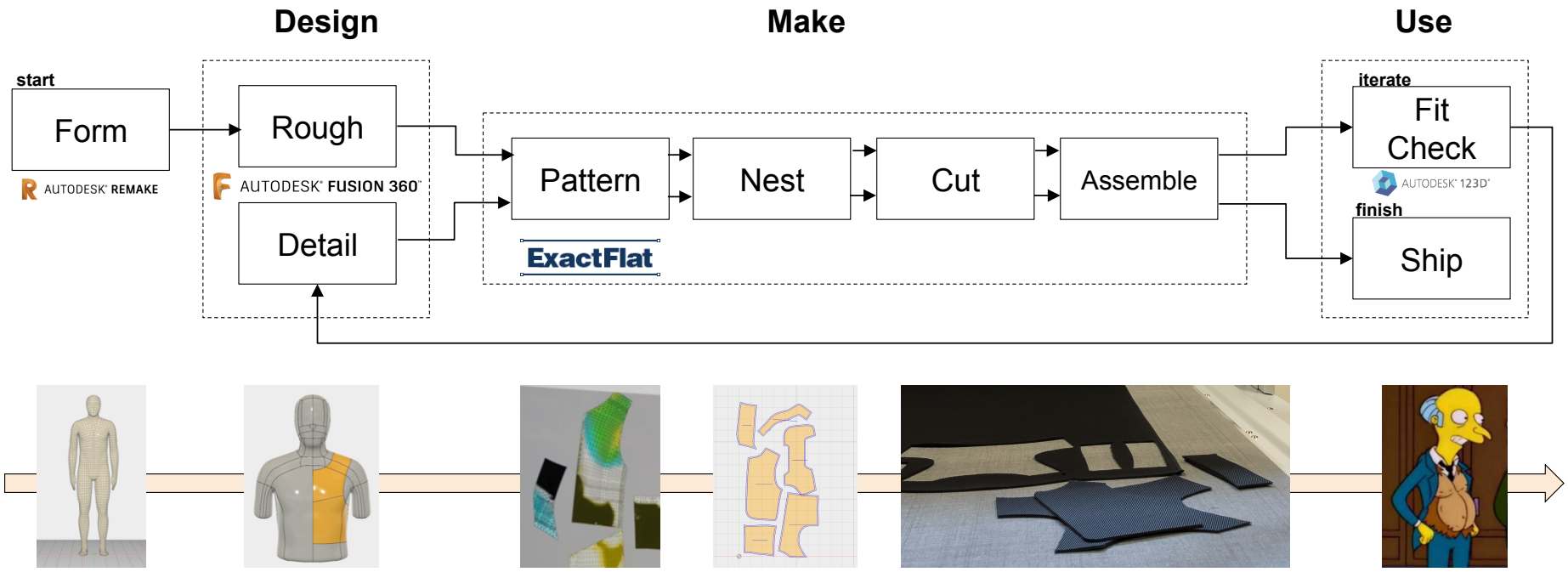
- Uncover and validate a commercially viable workflow using primarily online tools
- Create something easily recognizable and functional

Iterative Textile-Product-Design Process

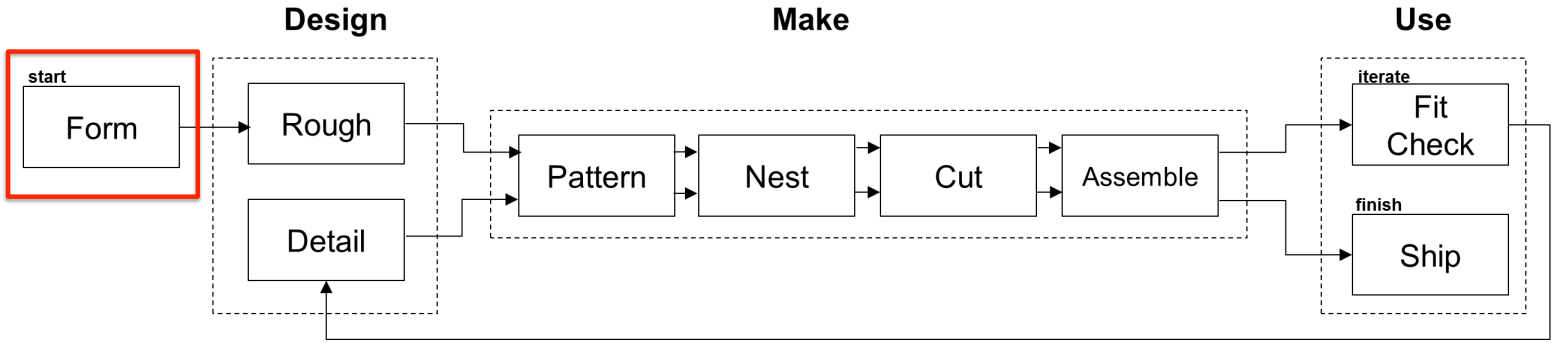




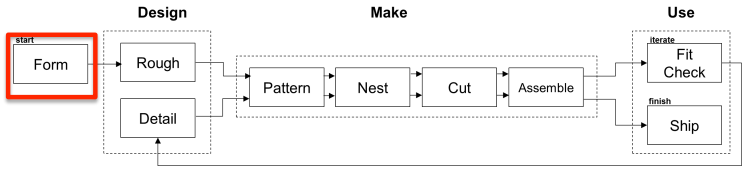
Iterative Textile-Product-Design Process



Form


Design
Make
Use
start
Form
Rough
Detail
Pattern
Nest
Cut
Assemble
iterate
Fit Check
finish
Ship

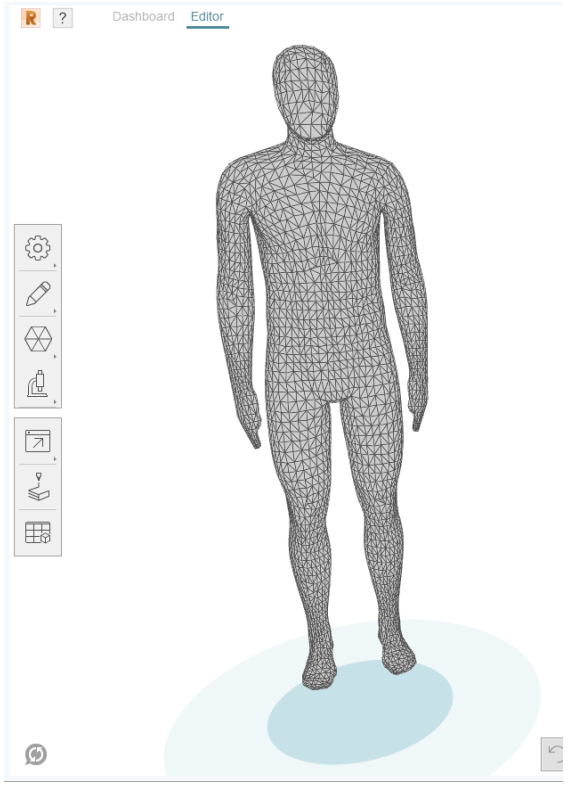
Form – Find Your Subject



Meet Dave.

The purpose of a scan
is to be the foundation of your design.

- Scans:
  - Can be used again-and-again
  - Or customized for each customer's needs
  - Infinitely storable



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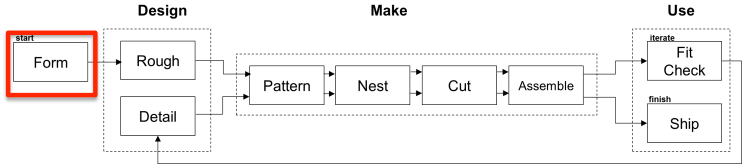
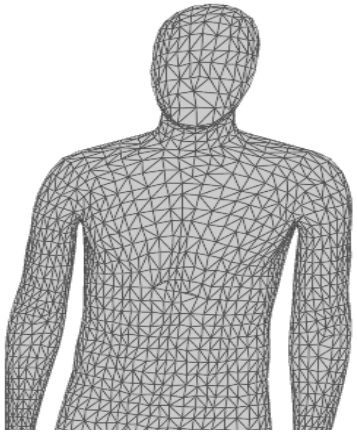
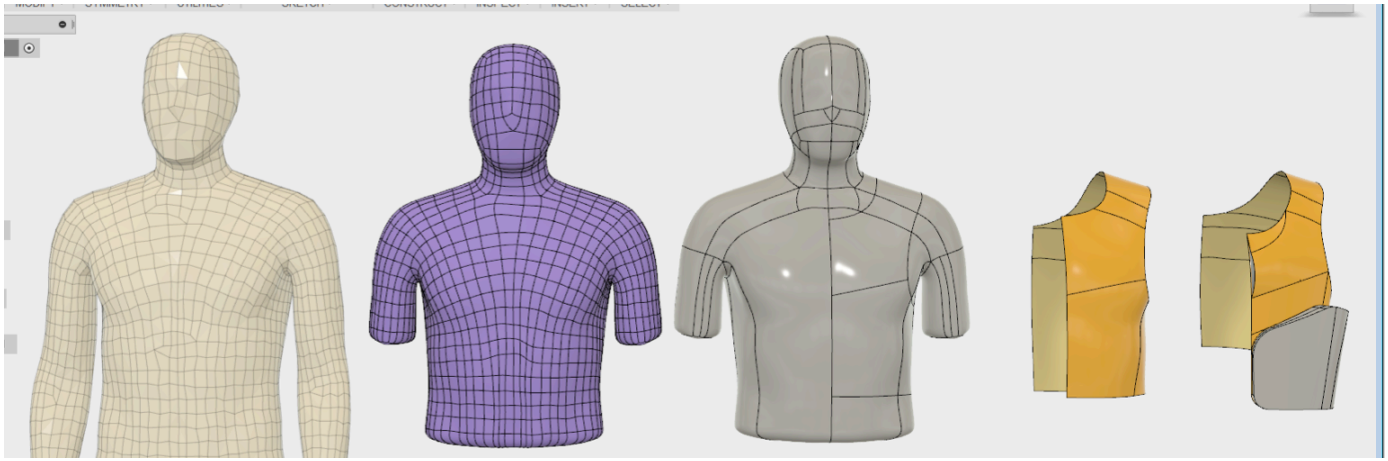


The scan will become the surface geometry of your design.



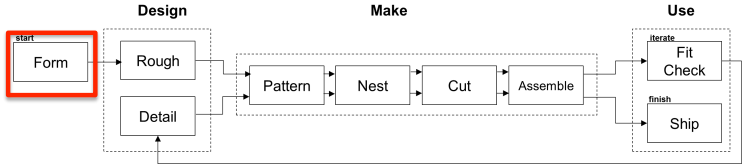
AUTODESK® REMAKE



AUTODESK® FUSION 360™

MESH (OBJ or STL) → MESH (quad-OBJ) → SCULPT (T-spline) → MODEL (B-rep) → PATCH (B-rep)

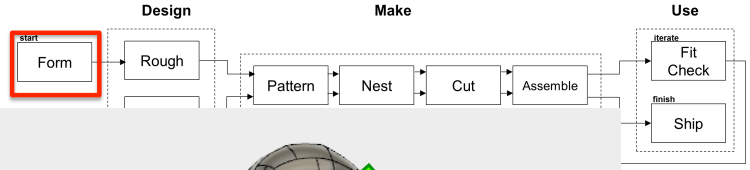
Form – Prep your model.



Poor initial geometry will compound problems later.

- Optimize the model to have a manageable amount of detail
- Adjust the scan to reflect how the fabric should actually lay.

Form – Good Cleanup EX:

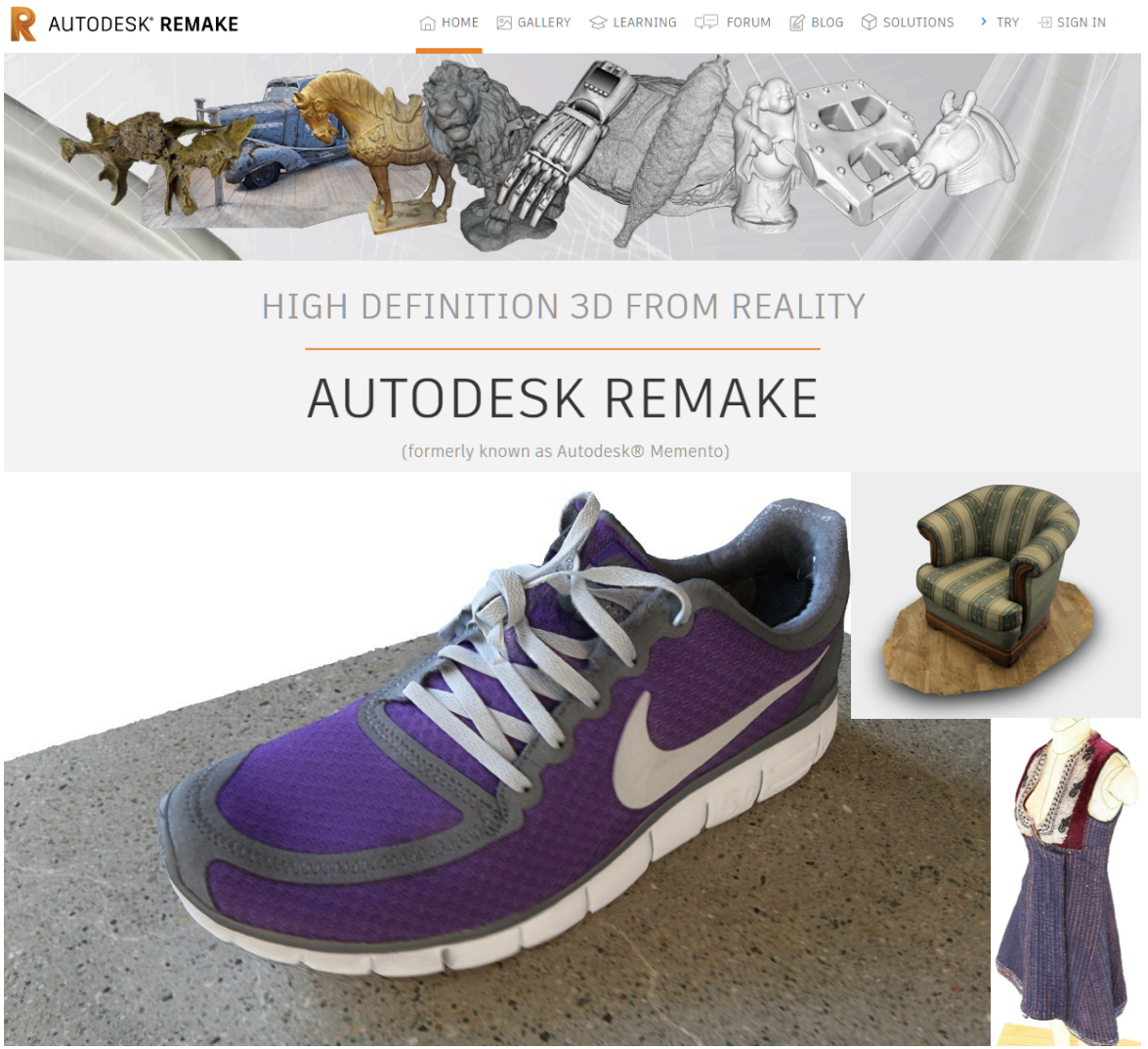


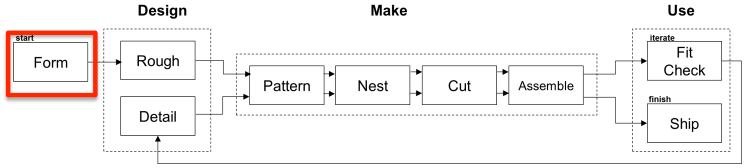
- Too many surfaces.
  - Will be less stable within Fusion
- Too complex a surface
  - Will take longer to flatten in Exact Flat
- Minimal / Smooth surfaces

Autodesk Remake

https://remake.autodesk.com/try-remake

- Desktop / cloud-based reality-capture to mesh conversion tool.
- Converts Mesh (“Scan”) data into a Fusion friendly format (OBJ-Quad).
- Free trial
- Free version is fine for most models. $30/month (for Pro)

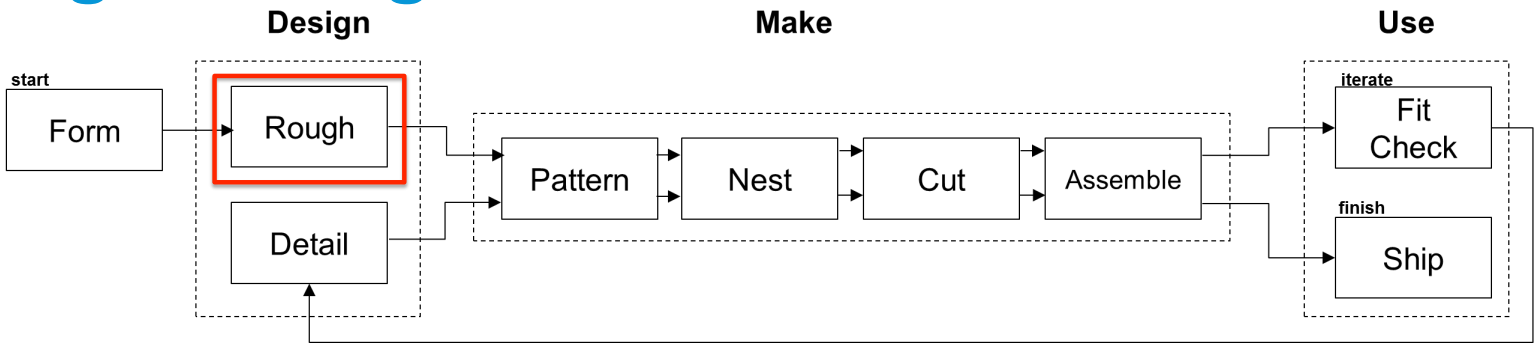




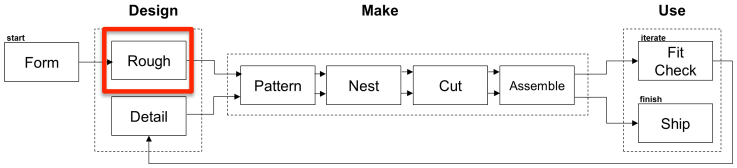
Form Preparation & Refinement Video

https://youtu.be/Qu_FiU3Hevs

Design - Rough

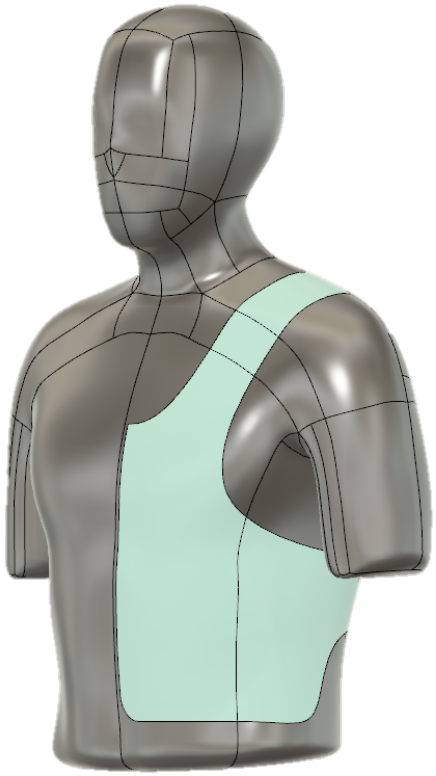


Rough Design – Outline Your Shape



The purpose of the rough design phase is to create the fundamental surfaces of your design.

- Strive for adaptability over perfection.
- Fail fast. The point is to iterate.
- Take the time to link sketches parametrically.
- Use symmetry where appropriate.



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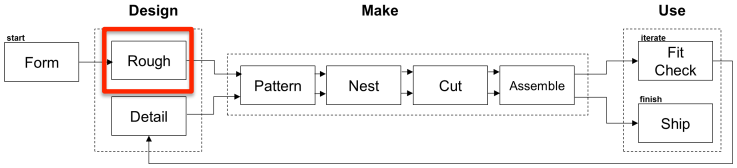
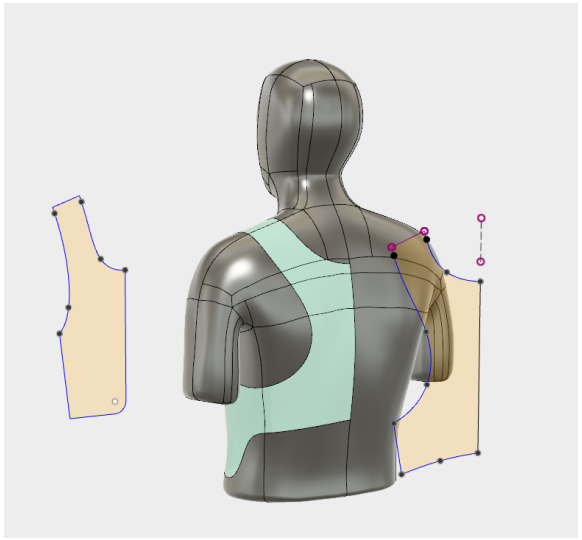
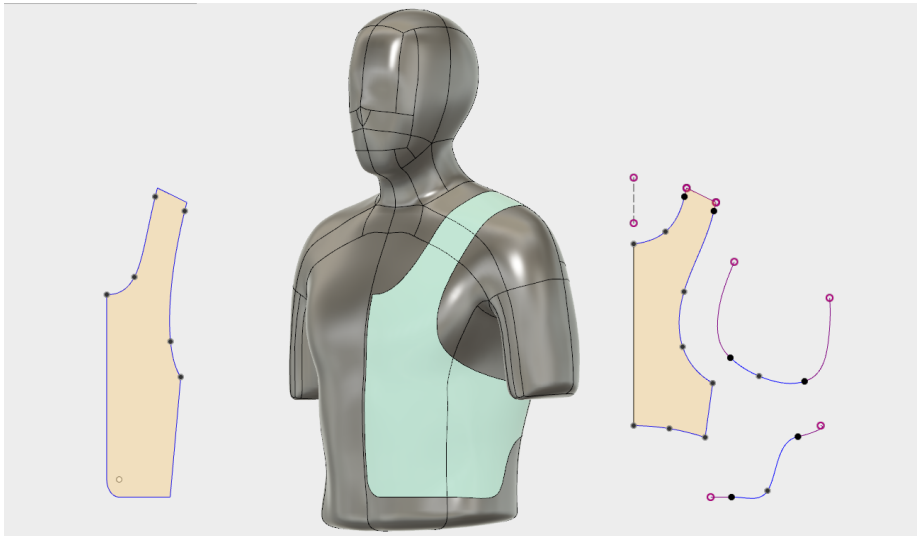


Front, Back, and Side Sketches are used to create surfaces

- Sketches are parametrically linked to allow for quick updates





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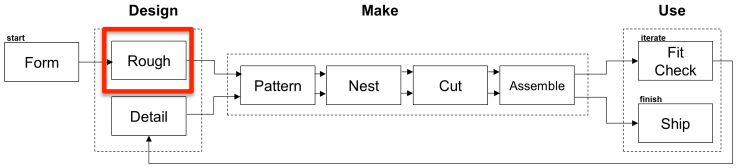

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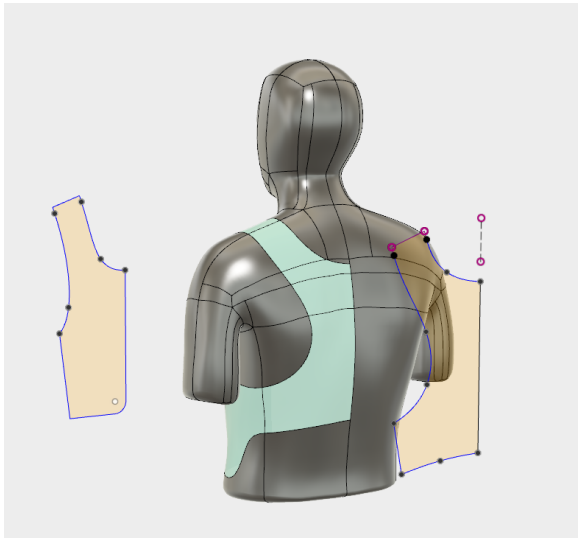

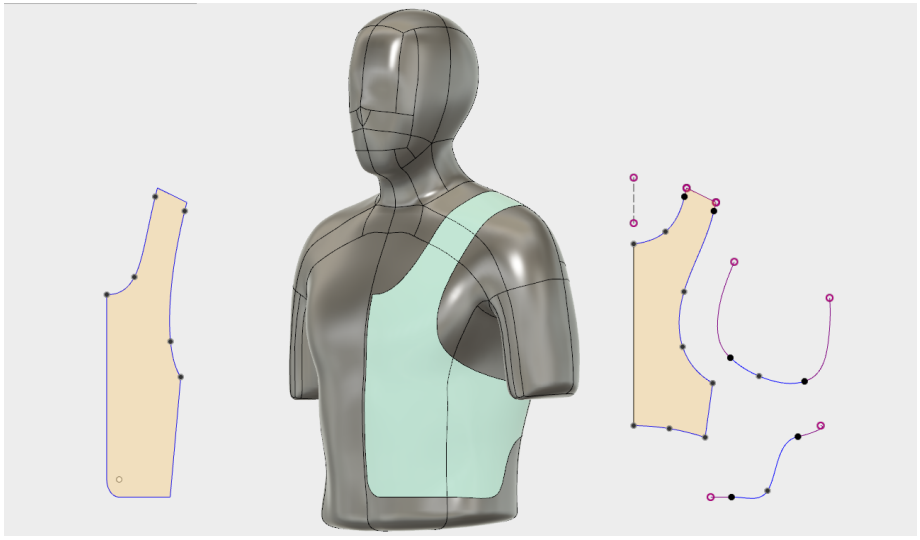

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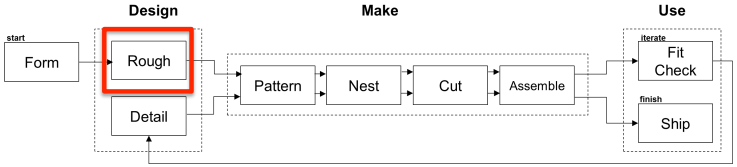
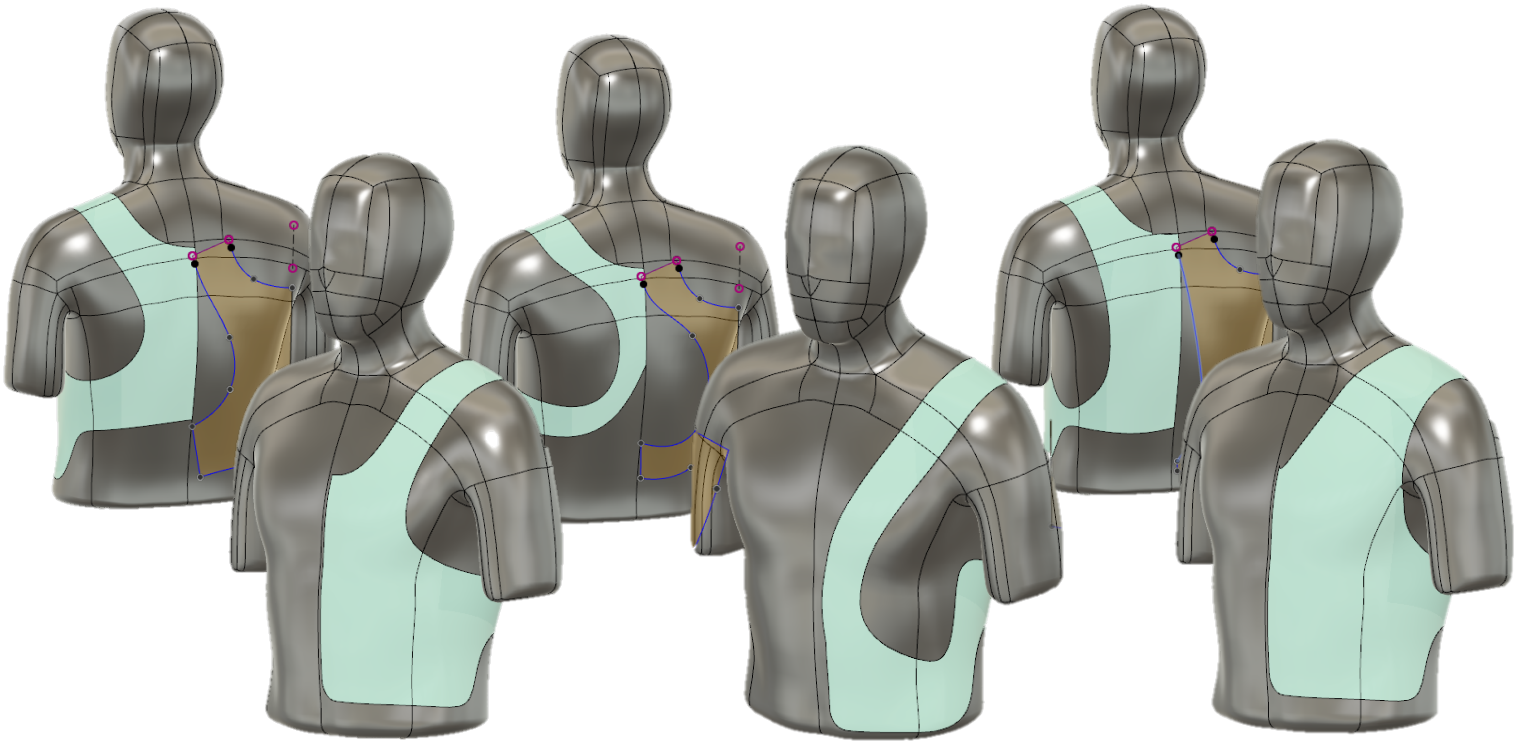
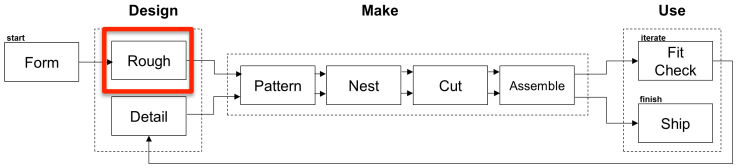


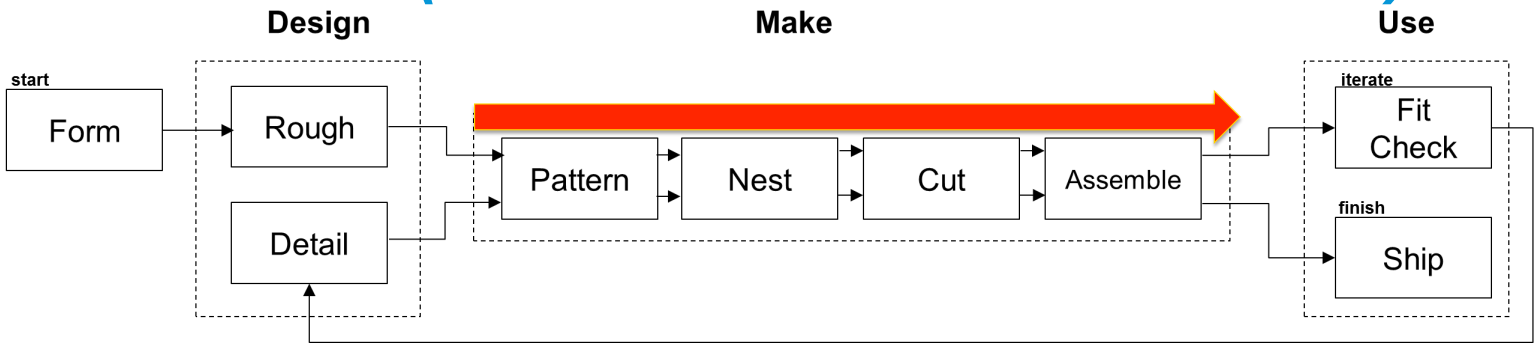




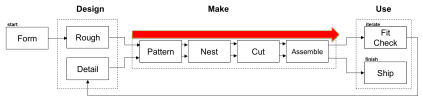
Rough Design Modeling Video

https://youtu.be/6AVn01F2uVo

Fast Forward (we'll come back to these!)



Fast Forward *(we'll come back!)*



Pattern

Nest

Cut

Assemble

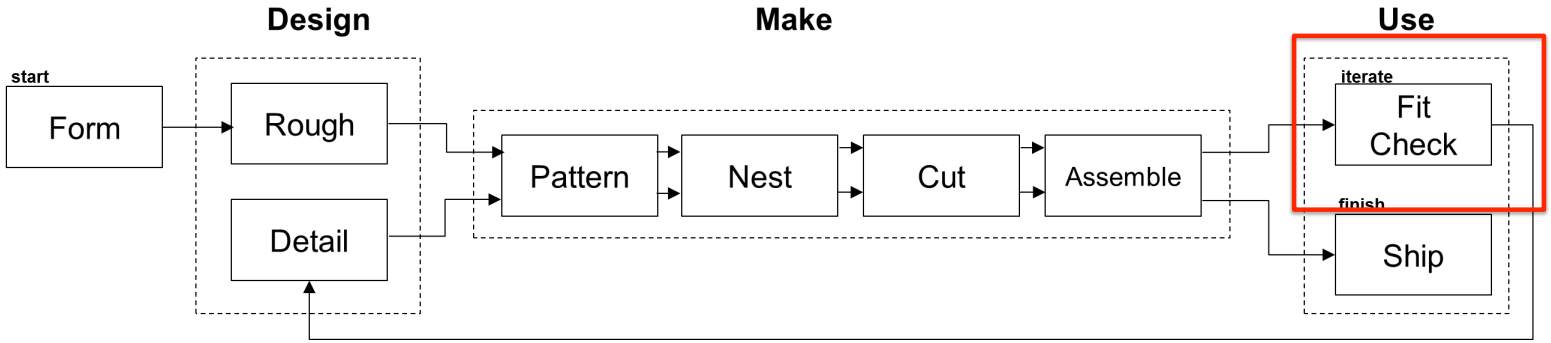
Exact Flat Pic of Rough Pattern

Nested Image

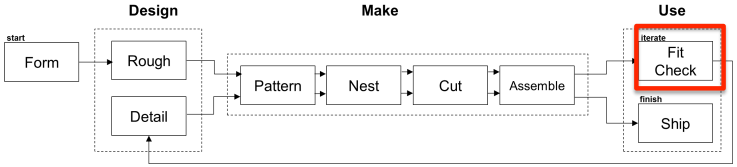
Scraps

Assembling Pic

Fit Check

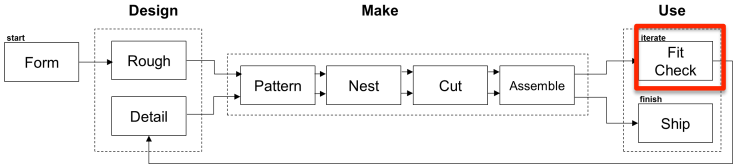

Design
Make
Use
start
Form
Rough
Detail
Pattern
Nest
Cut
Assemble
iterate
Fit Check
finish
Ship

Fit Check – check your design

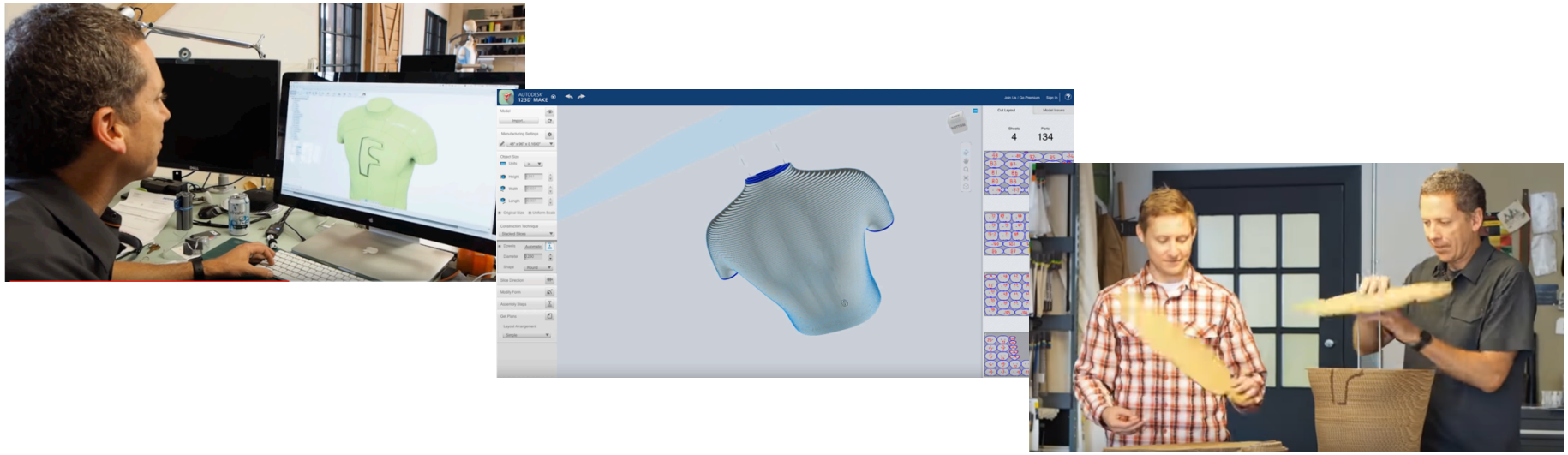


The purpose of the fit check is to ensure the digital model matches what the physical world requires.

Fit Check – check your design



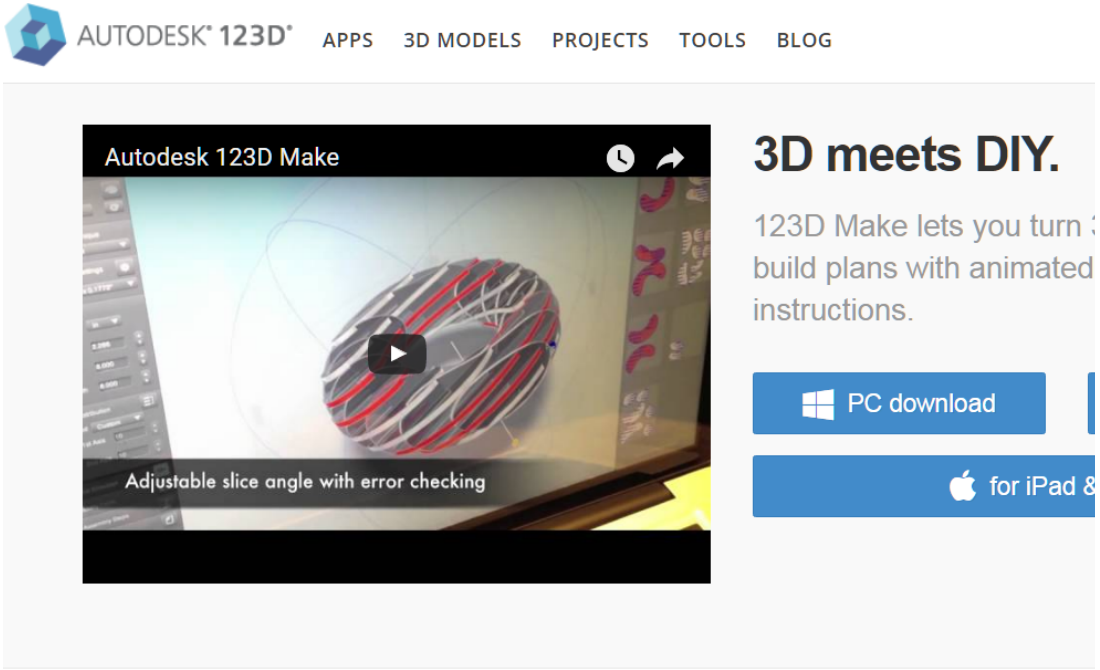
Mannequins of the original scan can be easily made using layered cardboard.

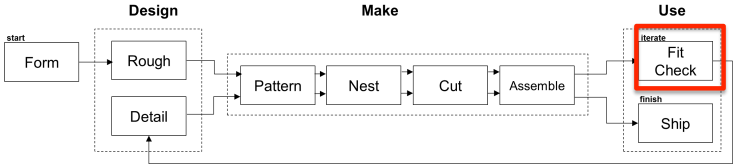


123D Make

http://www.123dapp.com/make

- Tool to make mannequins
- Converts 3D models into sliced surfaces
- Free version works great with this workflow
- (Premium is $9.99/month)

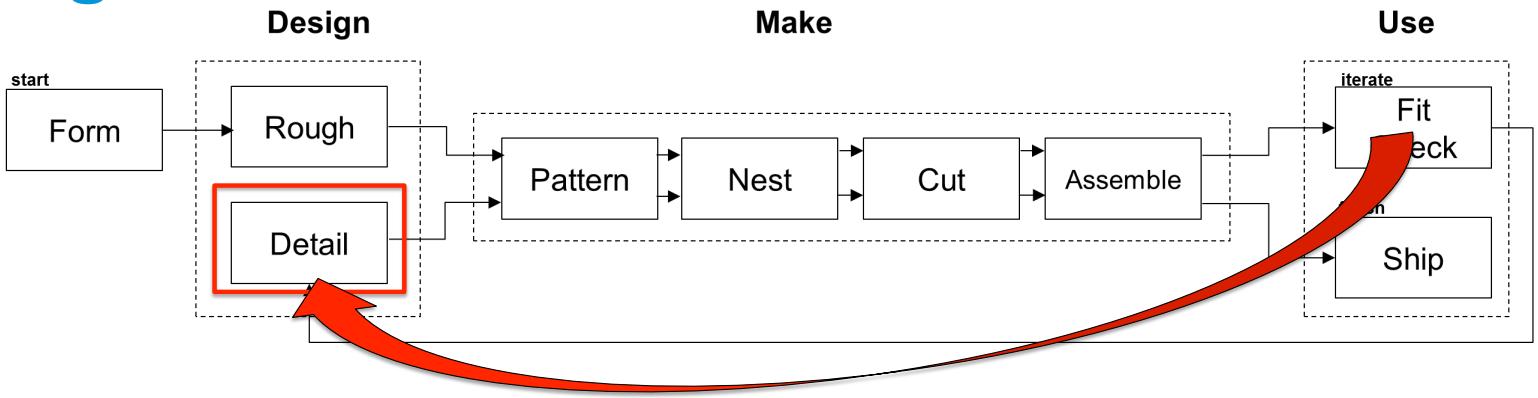




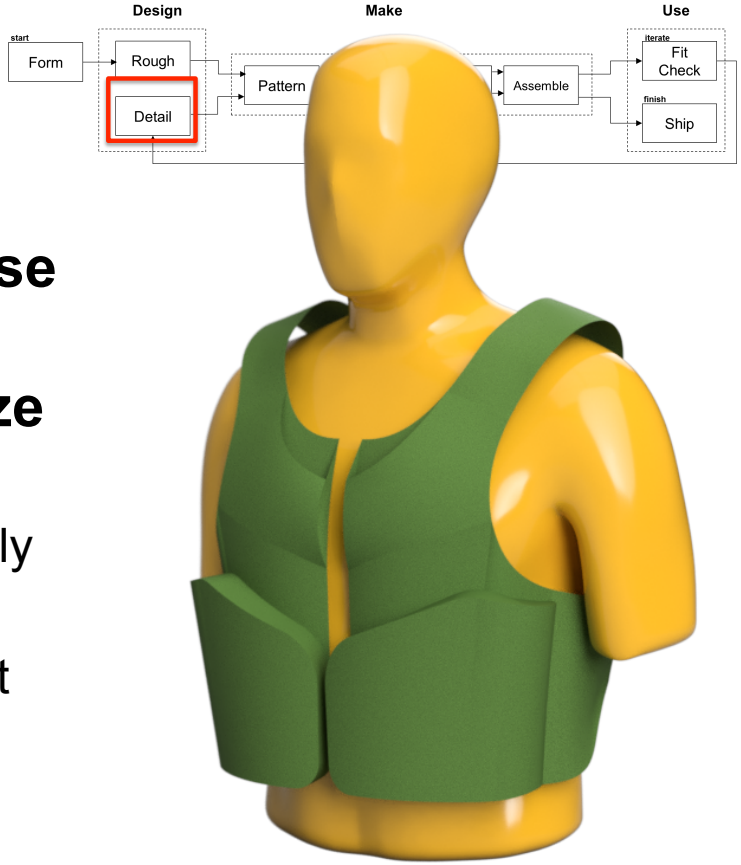
Create a Mannequin in 123D Make Video

https://youtu.be/0-_9-b6tkMU

Design - Detail

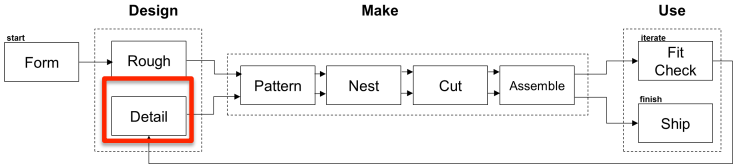


Detail Design – Finalize the design



The purpose of the detail design phase is to add pockets, accommodate for material stretch/ thickness and finalize fitting details

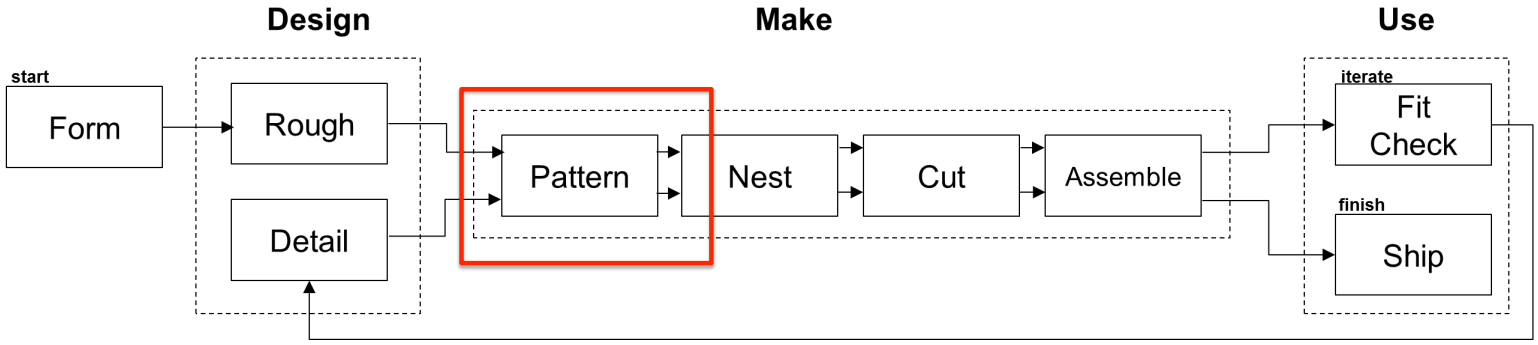
- Keep it simple. Don't go crazy building overly complex surfaces
- Keep the design based in the reality of what can be made
- Plan out your design



Detail Design Modeling Video

https://youtu.be/n4bUng5iqTk

Pattern


Design
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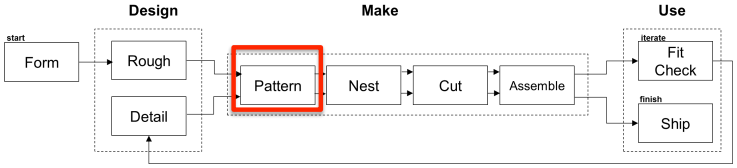
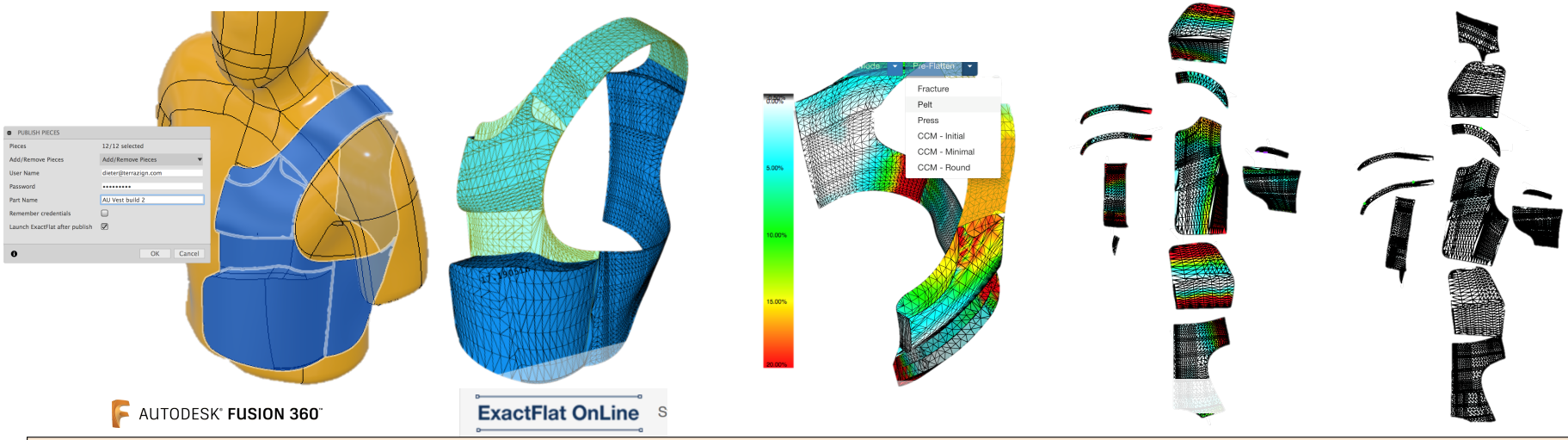
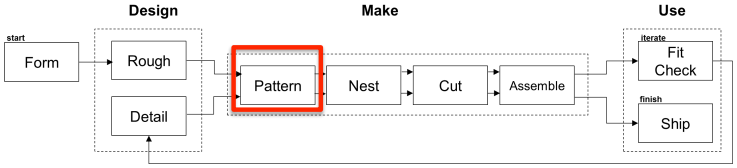
Pattern – Flatten Your Shape



The purpose of patterning is to convert complex 3D surfaces into flat shapes than can be cut.



Pattern – Flatten Your Shape



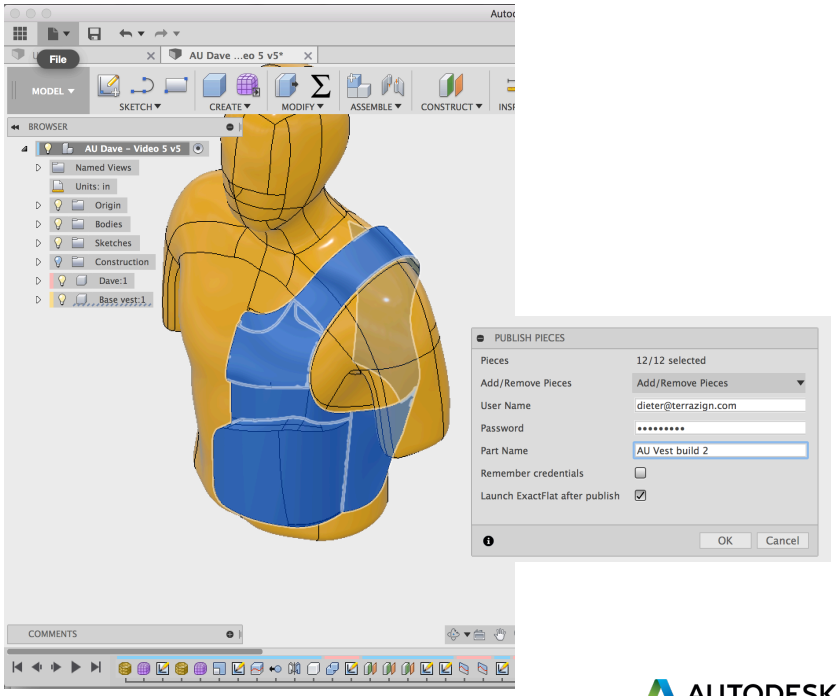
The purpose of patterning is to convert complex 3D surfaces into flat shapes than can be cut.

Fusion 360:

- Remove unnecessary surface boundary edges.

Exact Flat:

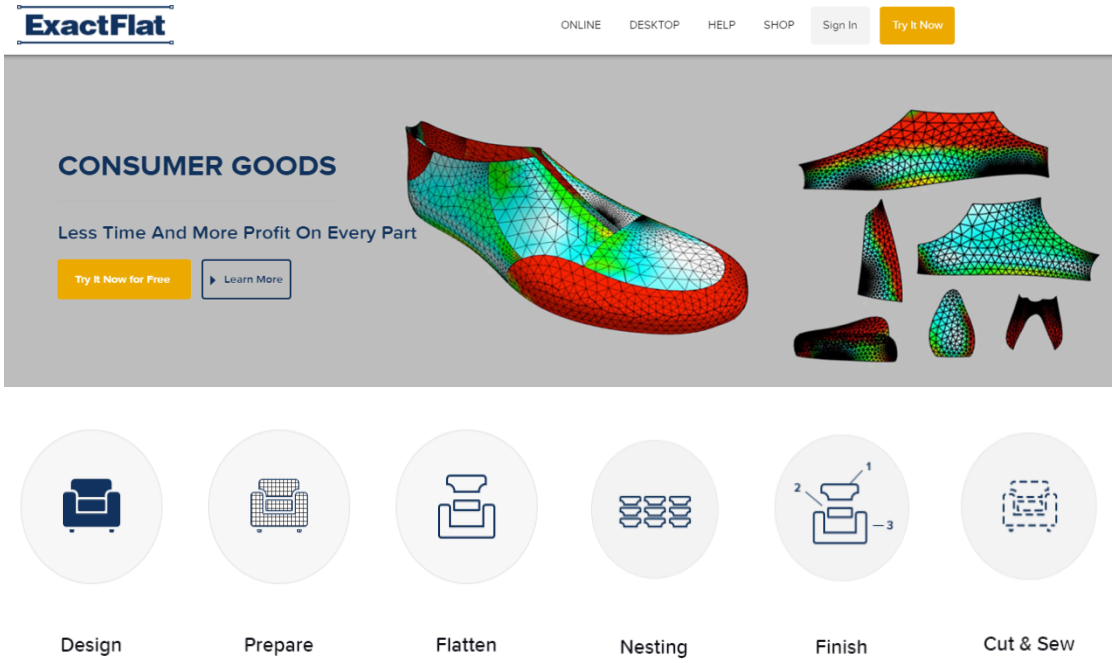
- Use “Pelt” to flatten
- If optimization projects to be more than an hour try to simplify geometry in Fusion first.

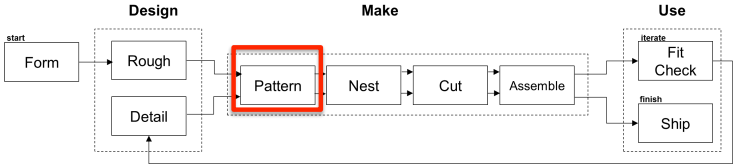


Exact Flat Online

http://www.exactflat.com/product/exactflat-online/

- Converts complex 3D surfaces into flat patterns
- Cloud-based
- Integrated w/ Fusion 360
- Free trial
- ($69.99 / month)

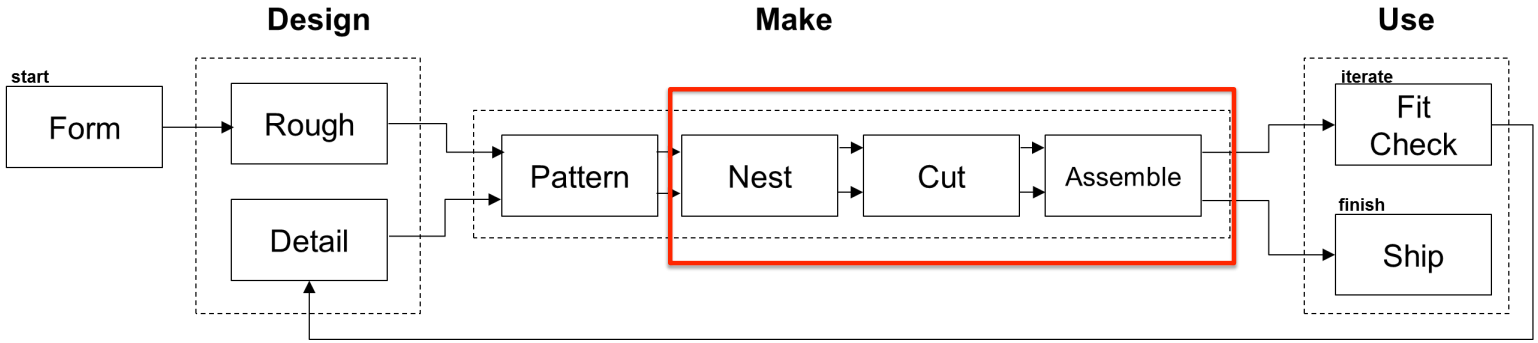




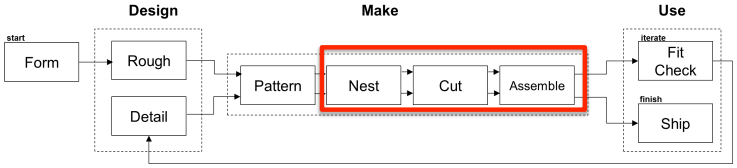
Patterning Using Exact Flat Video

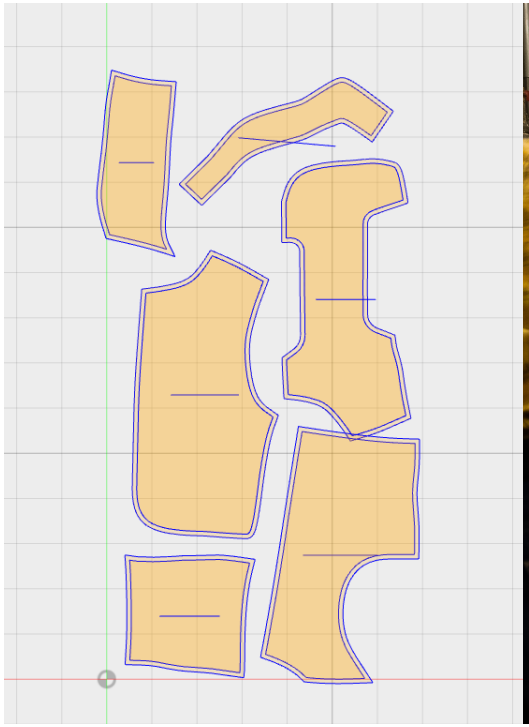
https://youtu.be/q7wqB5YsrKs

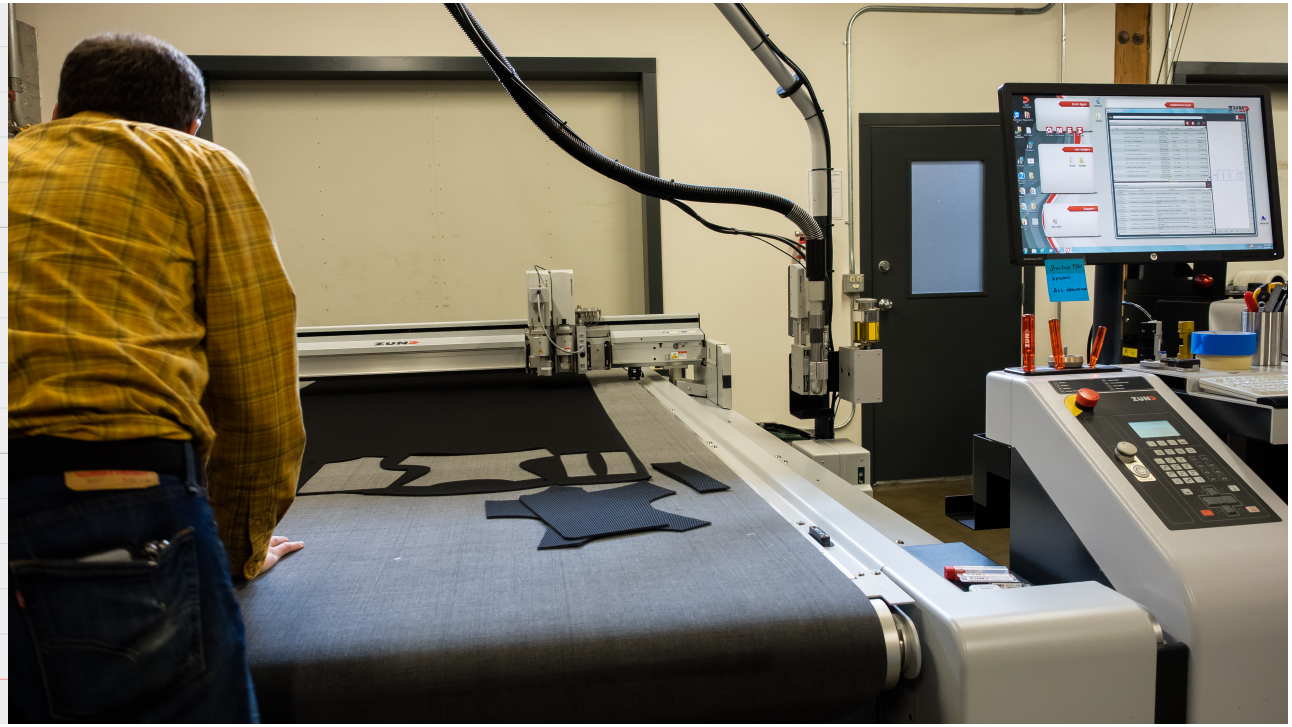
Nest – Cut - Assemble



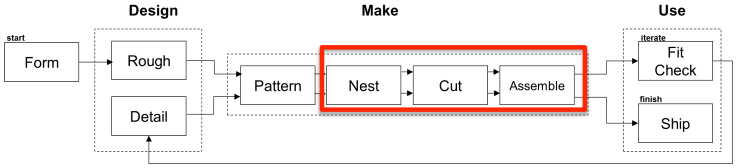
Nest / Cut / Assemble







Nest / Cut / Assemble

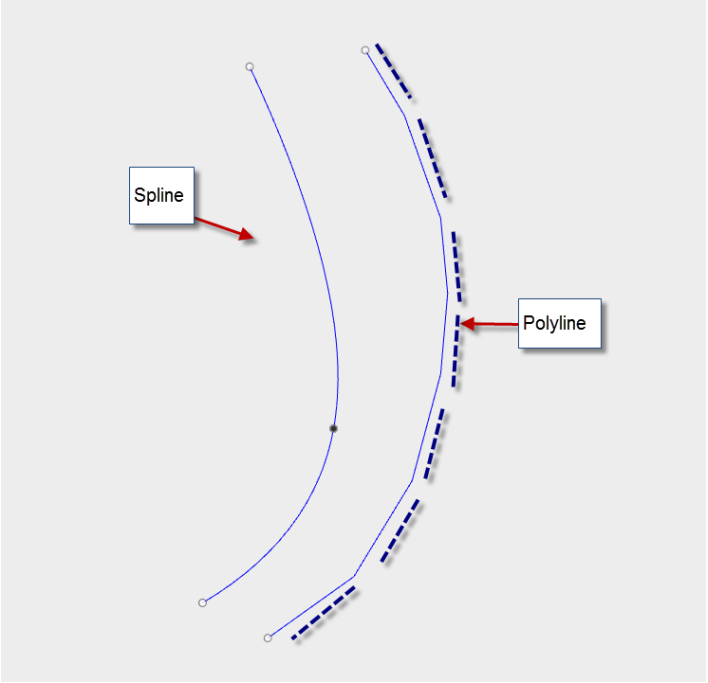


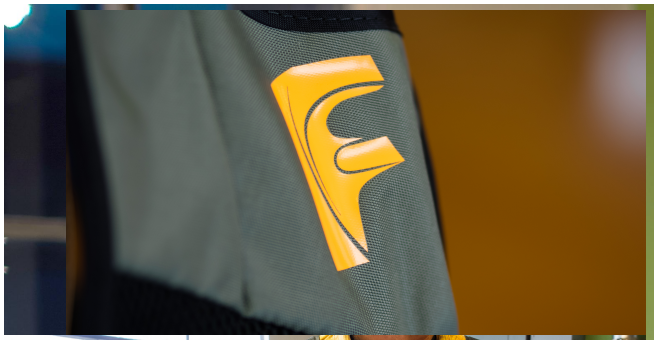
Note: Some cutters have trouble handling polylines

Exactflat will be adding the option to export as a spline soon

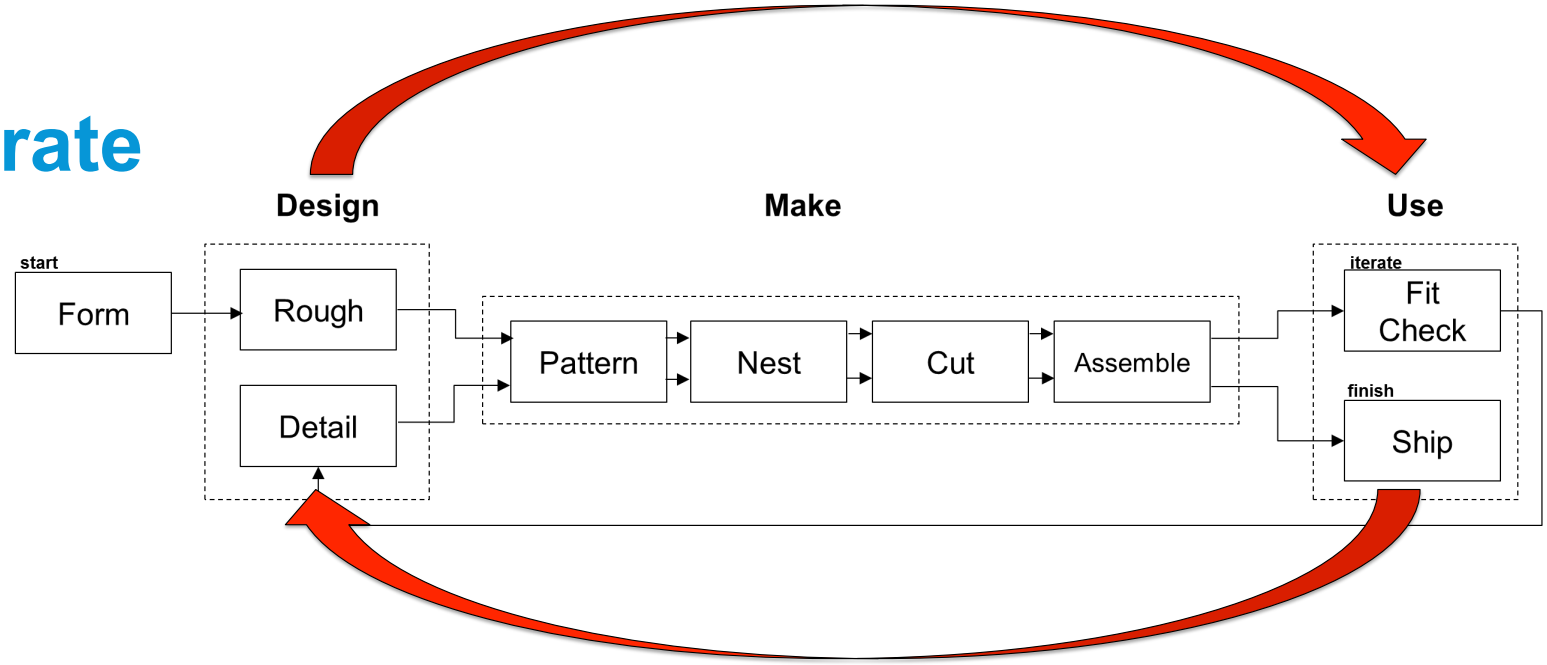
Fusion does not yet convert a polyline to spline (it can do spline to polyline though)

Use AutoCAD or Rhino to do this conversion if this is needed.





Iterate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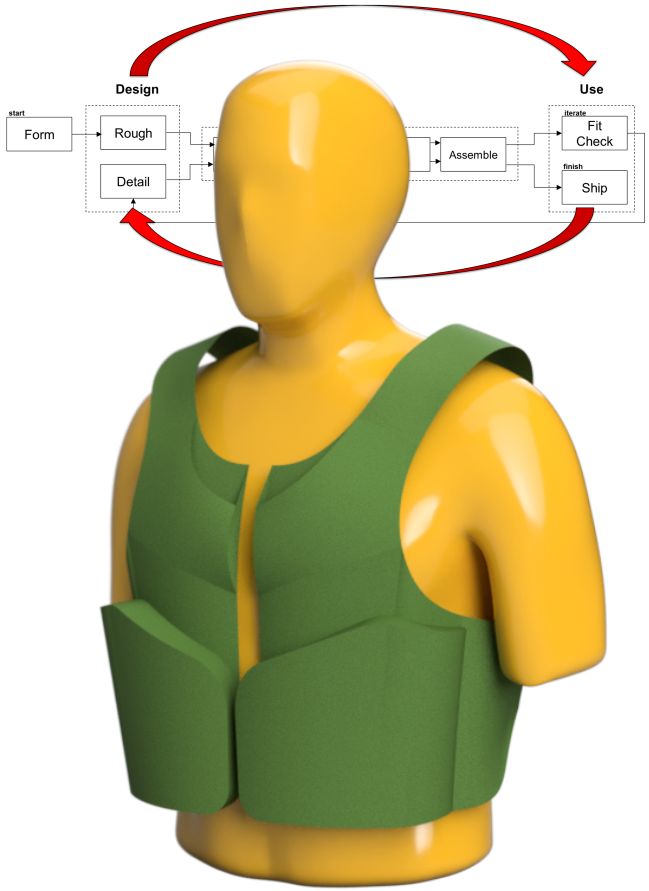
Ship

Iterate– Adjust

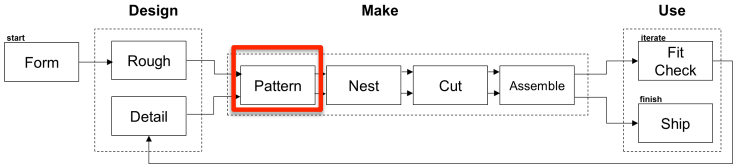
Iteration is imperative to innovate.

- Adapt to the fit and stretch of the material.
- Adjust to user preferfences.
- Try stuff!




Widen pocket
Change material to be less “fish- vest”


Lower backline



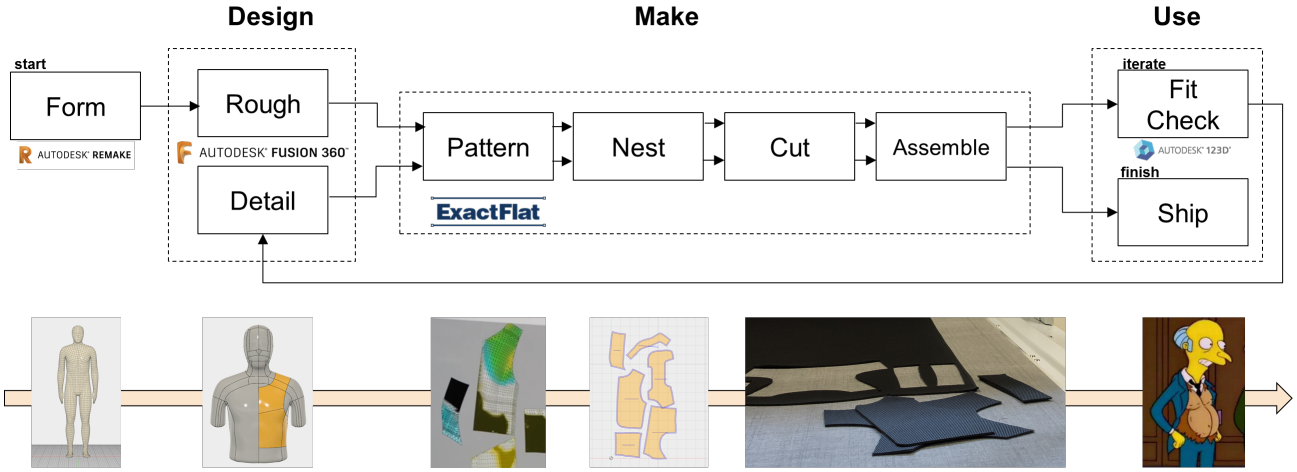
Final Assembly Video

https://youtu.be/HMhouGfMADU


JUKI

Summary

- Textile-based product design demands iteration to innovate.
- Online software plays a huge role in achieving that innovation.



How did we do?

- Your class feedback is critical. Fill out a **class survey** now.
- Use the AU mobile app or fill out a class survey online.
- Give feedback after each session.
- AU speakers will get feedback in real-time.
- **Your feedback results in better classes and a better AU experience.**