MIKE AUBREY: Well, good afternoon, everyone. I want to kick things off today with a super bold statement.

[LAUGHTER]

Textile-based product design demands iteration to innovate. I want to kick things off with a second super bold statement. Recent advances in online software play a huge role in achieving that innovation.

Again, good afternoon, guys. Let's take back a second here and I wanted to just say, that my name is Mike Aubrey. I'm one of the Technology Evangelists here at Autodesk. And welcome to Autodesk 2016. Are you guys enjoying it so far?

AUDIENCE: Yeah.

MIKE AUBREY: Yes. That is the right answer. So every day I get the opportunity to work with customers like yourselves to help empower you to be successful using our tools. So I've been with Fusion since it became a product three, four years ago. [INAUDIBLE]. I've got about 10 years of experience. I'm a Mechanical Engineer by background, which I think is really unique for this set of people because my academic background is probably different from yours. But it's been really rewarding to be involved in this part of designing things. Because at the end of the day it's all about solving issues and solving problems. And so the types of things I get to work on, if you guys saw-- did you guys see the Extruder Bot. Yeah, so that's what I've been doing the last seven months. That, and if you saw the Hack Rod, that was another one of the things, that chassis, I did a lot of the modeling on that. So that's where I come from. But anyway, that's enough about me.

The real star of this afternoon is a guy named Mr. Bill Dieter. And he is an amazing badass. And you're going to like him. But I'm going to let him give his own introduction [INAUDIBLE]. Meet Bill.

BILL DIETER: Hi, guys. So I'll give you a little bit of my background. We'll-- I'm going to talk just briefly about my company, which we do things a little differently. And it's-- we've been using Fusion a lot lately. And it's really cool how it's been plugging in.

So Terrazign is a product design firm that's been around for 22 years. And our focus has always been textile based product design. And we also get into hard goods. And we're really

interested in that intersection between hard goods and soft goods, and how do all of these things work together? We'll work with all kinds of textiles. So knits, wovens, non-wovens, membranes, leathers, synthetic leathers, there really isn't a material we won't touch. But the-- and the projects that we get into are just as diverse. So we'll get into projects that are for consumer electronics, sports and fitness stuff, and aerospace. I've also done automotive. It's pretty much-- we'll cover the gamut, even get into medical stuff. But let's talk just briefly.

Oh, let me-- let's hold on that for a second. Actually, can go back a second, Mike? So what's different about us, as a firm, most design firms will-- the client comes in, they'll do a lot of sketches, and then they move into either renderings, or you'll move into CAD, and eventually you'll get to doing some prototypes. You may even send out for those prototypes. We go about a little differently. And there's a strong reason why. We may do few sketches. We basically move immediately into prototyping. And so prototyping is our primary way of drawing and sketching. And that's how we work. And you may say, well, why do you work that way? Because that's not the fastest way to work. Well, working with textiles, you can't-- you can draw it all day-- and I don't care what program you're running-- you can draw it all day. And until you start actually working with it-- because every piece has different characteristics, different stretches, and hands, and thicknesses-- and so we need to experience that and see what's going to happen. So over the years we have just gotten very deep into prototyping as quickly as we can. And we've added in a great deal of process that allows us to prototype very rapidly.

So let's go through some of the types of projects we get into. This is a harness that we did for NASA. And it's used to hold the astronauts to the treadmill on the space station. So the short answer is, why do you need to do that? It's like, well, there's no gravity. They need to work out. And they need the impact of running to maintain muscle mass but more importantly, bone density. So our job is very simple, hold them down. And we're going to hold them down to their body weight. But it has to be comfortable.

So this is a very interesting project that we went through quite a few iterations developing a comfortable harness that hit all of the requirements for flight materials. And that's actually the difficult part of this project is, materials that won't burn. The space station is oxygen rich environment, everything wants to burn. And on that project, we have actually become the manufacturer. So it's-- we're an unusual firm in that we can actually do manufacturing. But our only client that we manufacture for is NASA.

Most of our clients are large consumer goods. This is another good example. This is the UE Boom Speaker. And this project, the speaker itself was designed by an outside firm, but we were asked to figure out-- and we'd done a great deal of work with Logitech before. Logitech owns UE Boom, or owns UE-- and they asked us to figure out how are we going to wrap this thing? And this was going to be a very high volume speaker. And we needed to wrap it very rapidly in production. And it couldn't be a fussy thing. So we had two layers of fabric. It had to go in fast. And we went through a lot of different concepts of how to put it on accurately and quickly. And we ended up going with, actually loading the two pieces of fabric, in our injection molding equipment and shooting [INAUDIBLE] strips that allow it to just snap into place.

So we're looking at things beyond just sewing and bonding. And we're getting into all kinds of interesting processes. This is another one that's a good example. This is a new football helmet that is just now coming out on the market. And it's the Vicis helmet. It's a double shell helmet. And it's all about protecting the brain from football impacts. And we were very involved with the innermost padding system, which you can see up in the middle. And we went through a lot of tooling to figure that out and a lot of experimentation with different types of foam and in different impact tests as well. And we get into all that.

So our-- to do this, we have a very extensive-- if you're familiar with Pier 9, we have a facility very similar to Pier 9, except we go much heavier on the textile side. We have a very extensive machine shop. We get into water jet cutting, and laser cutting, and almost anything you can imagine, press brake, tube bending. And on the textile side we'll get into compression molding, and bonding, and fusing, and RF welding. And we play with it all. So we're a very vertical organization, in that we can do all these processes in-house. And for us, that's important because it's a big sketchbook. And that's going to be important for what we're talking about today, which is iterating quickly to try patterns, and getting into complex patterns, and then building them.

So we keep a lot of materials on hand. As we work through a project we'll start working with the mills to bring fabrics in, specifically for a project. But we also want to be able to play. And then our designers also work the whole way through a project. So for us, this iteration process is about exploration and learning how you're going-- the things you're going to learn as you go through the process. So our designers will actually be running the machinery as well and building everything. So we don't hand things off down the line. You stay with the project the whole time.

MIKE AUBREY: All right, time end. Why are we here? You guys know us now. Let's but what we're going to go through the class. So the objectives in this class today is, we're going to be showing you a workflow that we lovingly call, Project Vest because we made a vest. And the idea is, we wanted to build something functional, that everyone would easily identify with, and demonstrate how we could do a digital patterning workflow that was achievable-- with the caveat being, can we do it using almost all cloud software because Spoiler alert, I work for Fusion.

We're both based in Portland. We've got to be good friends over this stuff. And it was so rewarding to go out there and do real work with all the great people working in Portland. And this has been a really rewarding class to prepare for because I feel what we're about to share with you guys today is something that is-- it's frankly, it's red hot. When you look at the techniques that we used to do this, you're going to able to see applications of like, yeah, I've seen some tools approach it that way in the past. But then you remember one, how difficult they were to use, how disparate they were from the next tool along in the process, and then also, frankly, the cost.

This workflow we're showing you today literally didn't exist a year ago. And we're going to be showing you four different tools. And we'll get through what they are. But, yeah, as we're going through this, our point today is, we want to leave you guys inspired to go do product design with textiles and use some Fusion on the side, huh?

So everyone be cool. The first question I always get in these types of presentations is, can we have the videos? Yep, you can have the videos. Can you have the data set? No, you can't. This guy is proprietary. But this workflow-- hopefully, you guys take a look at how we got the scan. And if you guys are freaking out and you need your own human body stuff, I can help you go to GrabCAD and find one as well. But, yeah, we can't give you the actual data set. So as I said in the first thing, everyone be cool and we're going to have a great time.

Before we go too far, one of the things Bill and I were curious to know is a little bit about your backgrounds. I mean, how many people in here use Fusion? Yeah. I told you.

BILL DIETER: Awesome.

MIKE AUBREY: I told you. I told you. Good. So we're going to have a great time. How many people are directly involved in product design and textiles? OK, not as many.

BILL DIETER: No.

MIKE AUBREY: OK, this is good. So we'll try and curtail our speaking to be as educational for some of the new people that want to get into this stuff. I know there's a couple. [INAUDIBLE] on this.

Let's jump into it. So I guess, we always have to start off with why bother doing this? The textiles designing with patterned fabric stuff, that's existed for literally thousands of years, why change? Bill?

BILL DIETER: Well, I mean, as Mike said, it's 1,000 year-- I mean, we even know how old it is. But it's one of the oldest industries. And what we're seeing today is, we've got to move very rapidly to try things and experiment. And the number of materials that are being developed and what's happening on the digital side where we're starting to incorporate stuff, we've got to get in, try stuff, drop in circuitry, and see what that's going to do. Can we get to the fit we want? We get into a lot of wearable stuff. So we want to iterate quickly. And so using digital patterns and building models that are going to allow us to tweak those very quickly, we may spend a chunk of time, just as we would in more traditional patterning sense, building that first model. But after that, we're going to move very quickly and spit out a lot of series of patterns.

So as we started to imply, the industry is changing. It's evolving. So textiles used to be kind of a forgotten process. And there's a lot of people that just do not understand how fabrics, wovens, non-wovens, and knits are even made. But you're starting to see a lot more in the press. And there's several different things that are making that pop to the forefront. One is, things like embedded electronics. So you're seeing things like Google and what they're doing. And Google is by no means the only people working on that. They just seem to grab the press headlight on that one. But it's-- what they're doing is some very exciting stuff. You're seeing consumer electronics moving very heavily towards textiles. As things get smaller it's-- they become much more personal items. And so there's that tactile feel of textiles or leather. And so, how does that incorporate into the electronics that we use everyday? So it's a tactile piece.

And then, of course, the apparel side and the foot wear. We're seeing footwear with 3D printed outsoles. Nike's doing Flyknit uppers, which have completely blown the knit industry upside down. No one's quite sure what's happening there. But it is-- there is a complete revolution just within knitting. And so it's all very exciting stuff. And it's all moving very rapidly.

And so what we're going to look at today is, we picked a vest. And that vest represents an on

body piece. And it could be anything. I mean, if we were doing a band that we were going to monitor with, that's an on body piece. So we just picked this as a piece. But we also wanted to build a vest that had a lot of details and stuff. So it's got to the evolution of a bag. So we're showing zippers and stuff like that being put in as well. So there's layers and stuff going on, which is where it gets more complicated. And we want to see what that workflow looks like to really push that through the system of something that's more complex. So packs are pretty complex. T-shirts aren't that hard, in terms of nailing it, in terms of the number of layers and stuff.

So-- is this you?

MIKE AUBREY: It's you.

BILL DIETER: It's me. OK. [LAUGHTER]

So Fusion-- and let me just say, Fusion is pretty new to me. I started working with these guys-- I wasn't even really aware of Fusion till April.

MIKE AUBREY: That sounds right [INAUDIBLE] April.

BILL DIETER: So somewhere around there I had been looking at stuff other than SolidWorks. We'd been using SolidWorks and Rhino quite a bit. And I just wanted to see a different workflow. And SolidWorks wasn't giving us what we really needed in the speed. And so I started doing kind of exploration of what was out there. And someone said, you've really got to check out Fusion. It's pretty interesting.

And so Mike Prom and Mike Aubrey came over. And we spent two hours. And I was like, I'm in. This is-- I can do something with this on the textile side. And so, as I'm speaking, you're going to hear me probably mispronounce-- not mispronounce-- but say things with the wrong terminology because I'm still not-- I'm an expert user, whereas Mike knows everything inside and out.

But what's been exciting about Fusion is how fast we can move in it. And it's a very forgiving platform. And we're able to get into compound curvature stuff and surfacing that in SolidWorks would have been very difficult. And then the collaborative side, we're finding really awesome in our studio. Because we'll just walk over to someone's terminal, and just pop it up, and like, yeah, that's what I was thinking. And so there's none of this, oh, I've got a-- what file version are you on? And that part has been tremendous. So

MIKE AUBREY: All right, guys. We're now to the meat part of the meal, Project Vest. So as Bill was talking about, we started Project Vest to uncover and validate commercially viable ways of using our tools. And so we wanted to create something that was easily recognizable and functional. And over the course of months-- we've been hanging out a day a week. We'd go over and just kick some time and try things. And we-- it was one of those things, fail fast. Iteration was one of those initial things we said was important. We've come up with this amazing process for you. And this flowchart actually is what we're going to be running you through today in this presentation.

So let me just run you quick through what the steps are. And then we're going to dig into the stuff. We have example video to share. And it comes up with this idea that you begin with what you originally get specked out from your customer and what they give you to work with. So this is in the form of digital models, or maybe they actually give you the mannequin, or the test subject to work with. And from that you move into a designing phase where you are designing upon that digitally provided asset. And then from there, that is what actually becomes what you then infabricate from. It's not a disparate process. It's connected. And that's why we'll-- we'll get to our ExactFlat friends here who want to do it. And then we're moving on to the point where you're trying to move through these iterations quickly. So we talk about being a use cycle of like, you're trying to get first, does it fit? That's one of the theories we'd get. It doesn't always fit. You get through that one and then after that, it's just all fun. You're going into details. You're out and pockets. You're adding zippers, all that amazing stuff.

And that is Mr. Burns, by the way, if you guys notice that little Easter egg.

BILL DIETER: He has his vest [INAUDIBLE].

MIKE AUBREY: So there are some software tools we're going to be showing you today to give you a little foreshadowing of stuff. If you guys saw any presentations-- I know a couple of you guys were in an Autodesk ReMake session this morning. This is going to be more of that. And it's all good stuff. We'll be doing some Fusion. We'll be doing some ExactFlat, which is our third party partner here, we're thrilled to have working with us. And then we're going to show you a really interesting workflow that Bill uncovered along the way about ways of making his own custom mannequins using a tool called 123D Make. We've got actually, a lot of really exciting workflows here to share with you that are part of this bigger process. We're really proud to be presenting it to you. And we hope you get some value out of it.

So the first section that we're starting off is, what is the forming process? So this is when you're working with the customer, you're going out there, you're gathering all those initial details of what you need to create, but then also, they give you something to work with. There's an assumption-- in the past it was like, OK, here's our model, or here's someone that you're going to be designing to. And our model today, I want everyone to meet Dave. Dave is a size medium, literally he's a size medium. And that's what we're working with. Bill's customer has these digital assets that they're provided. And what we're doing in the forming phase is that we are preparing our digital asset to be useful in the designing phase and the manufacturing phase.

This is different from conventional ways of doing pattern design because, in those ones, you're talking about laying, draping stuff over top of the mannequin. In this case, this literally is the mannequin. And so we have to treat it that way. Now the advantages to doing it this way-- I mean, it is more work up front. You guys will see it and drink the Kool-Aid hopefully, on it-- but the reason why-- I always remember why-- is that this can be used again and again. Once you've got this, you don't have to do this phase again. The next one is just instantly customizable because how many of you are actually an adult medium? And then the other thing, of course, is it's-- yeah, OK, one. Smart [INAUDIBLE].

[LAUGHTER]

BILL DIETER: Liars, you're all liars.

MIKE AUBREY: And then the third part is, of course, it's infinitely historical. We had a slide here where I was talking about-- I had a creepy closet of mannequins that go in there and Bill told me to take it out because it was too scary. But you can just store tons of these things. So what we're going through in this phase is actually a process of saying that we need to take this, a mesh-- when we talk about file formats being an OBJ or an STL, those are what they most commonly come in. And we're moving it through this process of going in-- there's a conversion process to get it to Fusion. It's saying we take it from an OBJ to make it a quad-OBJ. That's literally as much as you need to know about this, by the way.

And then we're in the fun stuff, where we're in Fusion. We're making sculpted, the file format there is, it's called a T-spline. But that's where you get to move. And in this case, we're going to be refining or removing detail to make it more idealized for actual design. And then from there we move into where we're actually designing. So we're in boundary representations,

that's solid modeling. And then from there, that's where we go and we actually extract our services, which are also [INAUDIBLE]. They're just the services. So there's some technical terminology. I don't think you have to know much more than this to go through it. The devil's in the details, of course, and how you apply the different tools.

I mean, it is-- it's CAD modeling. And as I've said to Bill along the way, I can't think of any geometry that's harder than this from a modeling perspective when you think of all the crazy curves and the different shapes that come from it. I mean, this is some heavy stuff you guys deal with on a day-to-day basis. So I guess, props to you guys for digging into it. And we're not doing digger's here.

So in this phase, the forming, the preparation is everything. So everything compounds upon itself. So the further we go-- you might not notice a huge difference between these two models. But one, it determines how adaptable they are when we go to design. And the other one determines on how we're able to actually make them. Let me show you the examples.

So this extra detail right here represents a lot of these-- they're called star points, and we'll just go with them-- but if you're going to go and move different cuts between these different services that can cause instability in the models. So the less surfaces you can have in your upfront model, the more flexible and adaptable-- which was the point of why we're designing digitally in the first place. So do yourself a favor and invest the time to clean those types of things up.

The second thing you'll notice here, which might not be as easy to notice is, you'll notice that this guy's all super ripped out. He's got these sweet six pack abs. This guy's a little bit, well, it looks like he's wearing a shirt. Remember that the digital mannequin is literally going to become the textile. So you can't have all this crazy stuff. If your fabric isn't actually going to drape that way, you don't want your mannequin to have that. So those are two things that you have to look for when you're creating them. And so let's go through the workflow of what that would look like.

So we're going to be going into a tool that's called Autodesk ReMake. And what we're doing here is, it's basically the intermediary software that will allow us to prepare ourselves to go to Fusion. So I'm going to jump into this guy. So this is going to be the end result of what we finish with. And starting out, we use ReMake first off as, we call, a simplification tool. Fusion really likes to have less than 10,000 facets. I know it can do more. But ideally you want to have

less than 10,000 connections in there. And that's going to help out with your graphics card.

So the first thing I'm doing here is, I'm using ReMake to decimate the model. And so, in decimating, you're removing enough detail that it still resembles what you originally had in it but you aren't bogging down your computer with all the extra detail. So that's one of the first things. You use ReMake just to decimate. The second thing you're using this thing for is, we're going to export it. And so you see right here is, it's just-- we're changing it from an OBJ to an OBJ quad. So what that actually is, is you see how these are all a bunch of triangles-- it's called a tet mesh [INAUDIBLE]-- the sculpting part of Fusion operates off of quads. And so, by going and making this conversion to quads, we now have a scanned model that we convert to something that we could actually design in Fusion. This is magic.

[LAUGHTER]

It's for anybody who has ever played around with getting scan data into a parametric modeling tool. What we have right here is, you go into Fusion, you import that OBJ quad. And then up here there's the convert button. And we go to say convert. And it'll pull itself in. So the stuff that you've got to be careful here-- remember, you do want to remove as much detail as you can get away with because that'll make it faster. But then once you have it in, it's really-- it's there. You're playing with it.

And so, now that we have it here, we now need to see, what can we actually convert to make it into a boundary rep sawed-- remember, the stuff that we can actually design on. So the first thing I'm going to do here is just say, finish it, and take a look at it. Over the last year, we've actually built in a lot of tools within Fusion to help identify some of those problem surfaces. So it's when things right here-- you'll see like, right here on this knee, there's a-- can we see these edges come together, those little points right there-- that's called a star point. And so what a star point is, is I mentioned how quads are squares. Well, if those squares aren't able to perfectly lineup, they have to converge. And you'll see five have to come together. And that's actually where the majority of these challenges come when you're going to convert to try both simplify for designing flexibility, and then also for manufacturing facility. You want to eliminate those.

So in this video I'm going to show you two techniques of what I was able to do here to eliminate those star points, the unnecessary ones, some of them you need. So the first one is, let's simplify the model. So here we're designing a vest. So I literally don't need some of that

geometry that actually in all irony, is giving me the trouble. It's very convenient that it's the knee that is the problem. So let's just get rid of the knee. So where the technique comes in here, rather than just windowing the whole thing, like, just lop off half of it-- that actually takes about two or three minutes to do if you've ever tried to select that many t-splines at once-- but what I'm doing here is, I'm actually just double clicking in a circle to get that whole loop. I'm deleting that. And then down up here you'll see it actually creates basically, five bodies where there was one. And where that gets awesome is that when you start to delete them, it happens quickly. So just from a Fusion efficiency standpoint, this is a much better way than just going and windowing half of it.

So the next thing we have to do is, we're going to look and see-- because this thing is symmetric. We are still going to delete half of it-- which side is more problematic than the other. So you see, now it converts to a BRep. And you can see that the left side has a couple of extra star points, the right-- yeah, the left side, stage right. We're going to get rid of half of it. And we're going to then, go and troubleshoot the remaining ones. So in this case, I'm going to go through and get rid of the first half. So here it goes a lot faster because just there's a lot less surfaces to eliminate. And now we have-- I'm going to show you two techniques to eliminate the final star point that we need to get rid of. So this one you can see, just down up there. That's what we're going to get rid of.

The first technique is one where we're going to be building out some geometry and we're going to weld it together. The second one is, is we're going to actually remove geometry and then use a patch. So we'll run through two. These two techniques really are all you need to do. And it's-- yeah, so this first one is, I've gone and-- in both techniques, you delete the start point-- and so that's what I'm doing here. So I can see above it how there's two different squares. So now I'm going to actually just use that Alt-Extrude in the sculpting environment to create two new faces. And then I'm going to use an Insert Edge below it. Now I have an equivalent amount of surfaces. OK. We'll just go use weld. And like that, we've got rid of our star point. I think that's pretty clever about going through that.

But wait, there's more, so, another way to get rid of that quad in this workflow, if we delete some of the detail. So just double click on that edge and delete that. Now we really only need one. And we can use create face to get rid of the star point. There's two techniques you can use on much more complex, crazy stuff. And then we can add that geometry back in, if you want to have a-- t-spline's really reward evenly spaced surfaces [INAUDIBLE] so we can put it

back in. But we'll see-- see the difference when we convert it, how, whereas before we had this segmented up set of surfaces, and now we have one nice ISO body that goes through it. This is going to pay dividends down the line. And now, from this point, it's just all gravy. We're going to go and we're going to mirror it. We're going to do a bridge to connect things up. And then we're going to create that into an actual solid that we'll then go and start designing from.

So some stuff, just some of these quick little fun things, interesting stuff. When you mirror it-- because you know you have an equivalent amount of sides-- bridge is one of those tools that I really enjoy using because you know it's going to work. That's one of the ways that bridge works. So we can just go in there and connect it up. I kind of like this model, how it turned out anyway, it looks like it's already got a jacket thing going on. We might have just made that instead.

[LAUGHTER]

Yeah, so that's basically the workflow here. That's the workflow it takes to make it so you can design upon it. Remember, I talked about how we also need to make the design so that you can manufacture from it. And so, what we have here is, we still have Dave in all of his infinite athletic glory that isn't going to be transferable to it. So here, I've just got a little bit of cleanup work here on the final end. Let me push this forward. Don't mind the man behind the mask. And what we're going to do now is, we need to remove some of the extra, I guess we'll call it the lumpiness, in there. We won't keep giving him credit for that. And so what we can do within Fusion now is that we can use some of the surface analysis tools to help us identify where certain geometry is that we'd like to remove.

So under the insert-- sorry-- under the inspection options, you can see a couple of different tools that are really useful. One is, in this case, just the curvature. So this shows the absolute curvature. So you're looking for individualized hotspots and things. And the other one is, draft analysis. And the difference between the two is, draft is you actually give it a plane and it'll tell you about the rate of change along the angles. Both these are really useful for figuring out where the differences are. And so the ways we can remove some of this extra geometry, in this case, it's a simplification workflow. I'm going through and I'm removing just some of those different lines. And you see right there, as the colors start to get simpler and they're more uniform, it's getting smoother.

The other stuff we can do is then, using edit form. Just by going and choosing the different

nodes you can go and select those points and then just rock your way back and forth. You're not going to be able to get rid of all of them, nor do you want to, because the curvature is what makes your model. But just from those common sense areas where you're like, yeah, let's see if we can-- yeah, we don't want the red, eh, a little bit more. Good enough. And these types of things, it might seem like you're doing a little bit more now but also the difference between a nice surface like this and versus what we originally had can make up as much as an hour difference when you go into ExactFlat. So it's very much worth your time. And it's going to be more accurate too. So you'll have less prototypes. So, yeah. So there is Dave in all its glory. And now we're ready to start designing.

Back to you, Bill.

BILL DIETER: All right. So at this point, we're ready to start drawing on Dave. And we want to create a 3D drawing on his body form or the mannequin. And to do that we're going to use 2D sketches that we're going to project. But what's going to be really fun about this is, we're going to project three sketches, basically simultaneously. And they'll all be connected together. And so, as we update one, the next will update as well.

Do you want to start our--

MIKE AUBREY: Oh, you're ready to jump in now.

BILL DIETER: Yeah, let's--

MIKE AUBREY: Why not? I guess, remember--

BILL DIETER: Yeah, so this is a good example of-- so if you take the time to get rid of your star points and get to a clean model-- and then we're going to build this sketch-- these are all just variations that we did with the existing-- and some of them are just kind of wacky-- but variations that were done just by moving a few control points in our sketches. And you'll see how we do that. And it's a very fast process. So we're going to spend a little time to build this first sketch. But it's completely parametric. And we can go back later and redesign or adjust lines as we see fit. So we've got Dave. And

First thing we're going to do is going to build three sketch planes. And I like, rather than putting it at the world origin, in the middle of Dave, I want to put them outside. Because we're going to start manipulating this around in orthogonal view and stuff, and we want to be able to zoom in and see what we're doing. And we're looking at it in 3D but we're going to be drawing in 2D.

So the first thing, we know it's a vest. We're going to have a shoulder strap that's going to go up and over the top. So we want to get-- this is going to be important because it's going to be projected through to the sketch on the back-- so we're going to spend a little time to get this dialed in. And you can see we've got some perpendicular lines coming off that shoulder. We're going to get it positioned just where we want it and that's going to be important to make a really nice smooth connection as we move up and over the shoulder with this projection when we split the face. So the faces are all the-- and most of you guys probably noticed but the faces are all the individual components. And so by eliminating those star points we've saved ourselves a lot of time for when we go to start splitting the faces to create the patterns we want.

So right now we're putting some splines in. And I highly recommend going with just a three point spline, so that you have just smooth, easy control. We can always add points in later if we find we need to add some more curvature or detail but this is just very fast. We're not even worry about where we're putting it because we're going to be able to move this all. Once the entire three drawings are built and they're going to be all connected, we'll be able to start moving things around and seeing what this actually looks like in 3D. So on the side that front panel will be one of our faces that will get split but we're running the drawing off the edge.

And we're working head on, or on the pure front view. We don't want to be working askew because it will be hard to see what we're landing on. And we also want to add tangency to those-- any line that's going to cross over-- so those little, short, perpendicular lines that we have at the top. We've added tangency from that spline because that's going to make everything flow very smoothly as it comes up and over the shoulder. So in this area we've just projected through those three lines that were very important to us in that first drawing. And we're working on the back plane right now. Those have been projected through. And then we're going to just throw in some rough spline lines again to just start defining what the back of this is going to look like.

And the more time we spend on this, the better just because we want it to be good and clean. You can also see this back panel, or that back face, that will be the face that we're working with. And you're going to see what happens when we project and split that face, those lines will stop. And that's going to allow us to connect to this side sketch. And it's when these three sketches-- and this workflow could be more than three sketches that you're connecting together. We could have actually created a sketch just for the top shoulder if we wanted detail

up there as well. So again, throwing in some tangency, constraining those, we'll make some adjustments here.

Now there is a good example that comes up here where we actually moved the line outside of an area that is going to be split. And you'll see that in a second. And that's not a great thing to do. And we actually didn't catch it till later. But the-- I'll just point out when we get to it. So we're going to collect the faces that we want to split. We want to do this head on so that we see what we're splitting through, collecting those projected points. And then we're going to split the face. And I always turn off extend splitting.

And so you can now see that we've projected that 2D sketch onto Dave. And we're now just going to go around to the front and project the front sketch, which is 2D. And it will have now a 3D sketch on the mannequin. And we'll also see in the next shot how smooth it is as it goes up and over the shoulder. It just has a very nice smooth connection. Now going around the side, we want to add some detail in there that we could not have projected through from just a two plane sketch. So we're actually going to use this side sketch. So there you can see how we have just a nice fluid line as it goes up and over the shoulder, which is exactly what we were looking for in that spot.

So this sketch is on the left side of Dave. And the first thing we're going to do is project those lines that were the split faces. And so we've now projected those onto our sketch. And we're now going to put splines connecting those points together. And again, we'll do a three point so that we can have some manipulation. And we'll do a spline at the bottom as well. And so what we're building right now is the base pattern that we're going to work from. We're ultimately going to offset this because we don't want this to be skin tight. So again, throwing in some tangency because we want this to be smooth as it flows around the body.

And at this point, we're ready to split this face. So we'll select the face that we're going to split, which we'll get to the second, and there's our sketch as it's projected. And so having it sitting really far off is actually-- at first it seems awkward-- but it's actually really nice because you can then see what it looks like in 3D. And it's completely out of your way. So we just projected. And you can see how smooth that connection is.

And we're going to turn these sketches back on and we can start moving control points around of those splines. And this is a completely stable line and split. So we've now created something that we're going to go through several iterations of this and-- actually once we built it, we

decided that the back line that we created was way too high. And so we just went in, grabbed some points, moved it down, and reran the pattern. And it was, I mean, it was literally minutes to adjust and have a whole new pattern set. So this is using three sketch planes. Again, you could have more than three sketch planes all connected together.

And we're now going to do-- I think we're going to-- yeah, so the adjustments we're doing are on those sketches. And having those sketches setting off, keeps them out of our way. So you can see how everything connects up, just nice tangency as it runs through the body, which is exactly what we're looking for. And so it's all style lines at this point.

MIKE AUBREY: Bill, you wanted to make a point about the lines, the edge of this one. You wanted to make a point here. If it's going to fail--

BILL DIETER: Right, so--

MIKE AUBREY: This little guy right here, when you cross boundaries--

BILL DIETER: So we crossed a boundary that we had not selected as one of our cutting faces. And so we're going to see a notch in our pattern, which, it was so small we didn't even see it. But there's an easy fix is to just go back into that split face and just add that as one of our faces to split, or just stay away from that point completely. Because again, this is textile stuff. There's a certain amount of leniency in some of the things that we can do for this particular type of projects. So we have this very parametric model now that we can just go to town on.

So the next thing we're to do is offset this because we don't want this to be skin tight. This is going to be worn over clothes or a sweater or something. And one of the things we ran into is, when we offset this front face, there was enough compound curvature that we were consistently crashing Fusion. But we put a split in that face and all the problems went away. So if you have a problem, just throw a really quick line in there and break it into two pieces. And so now we're able to offset it. And we went with a half inch offset just to accommodate for t-shirts or whatever you're wearing. The vest that we're building, by the way, it's a CAD vest. So it's for-- you're working in the shop and you're going back and forth to CAD and then machines. So you're carrying all the tools that you need. We carry scissors and stuff, micrometers, whatever you may need. And so it's a tool vest for us, people that make stuff.

MIKE AUBREY: We'll come back to that guy.

BILL DIETER: OK, so we've created this shell, which is going to be our base pattern and-- is this you?

MIKE AUBREY: [INAUDIBLE] is, yeah. He's slopping up my slides. So guys, we are going to show all of these amazing features here. But actually, when we get to the detailing, these actually become a lot more interesting. So trust us. We're going to fast forward now. And as he said in that slide way back, everyone be cool. And we're going to go through this. And we're going to talk about, OK, now that we've made it-- and we're going to go into our first fit check. And that's where we're at right now.

BILL DIETER: So we took that. And you're going to see us run that pattern but we're going to run it later. What we're going to do first is, we want to do a fit check because we're very interested in how does this actually fit in the real world? So this is something we have to wear. And at this point, we're going to be making Dave.

MIKE AUBREY: Yeah, we're making Dave.

BILL DIETER: So we need to have a mannequin because we need-- if no one in the studio was a perfect medium, we want to have someone who is a perfect medium. And so we came up with this process just using some of Autodesk software and 123D Make to develop our own mannequins. So we have commercial mannequins in our studio but this was a real game changer. And I'll just give a little-- hang on a second.

MIKE AUBREY: [INAUDIBLE] sure.

BILL DIETER: So we had a project in the studio where we needed to build a completely custom mannequin. And I was just like, I think we could do it with Fusion and with everything that we could do. And so we went in and the project was, we were working on a new bra. And so we needed to take the cup design that the company had us working on and marry it to a mannequin who was a female medium. And so we meshed those two together. There was a fair amount of cleanup to do. But then we, following this same process, which you're going to see, we had a completely custom mannequin that met the customer's requirement. And so in our studio, we didn't have anyone who fit that size, we could now try this on. And you could use this process for so many different things. And it's just a really fast way to get a fast model of a buck that you could do something with. So we felt it was important to show as this process.

So what we have here is-- the first thing we did is-- so we have Dave, which you saw how he was made-- the first thing we did was burn a big F, the Fusion F into his chest. From there we just need to make an STL. And so we're just going to make STL. Most of you guys probably

know how to do this stuff. And we'll export it-- sorry-- save it. And then we're going to open up 123D Make, which is--

MIKE AUBREY: So 123D Make--

BILL DIETER: --free.

MIKE AUBREY: Yeah, what we're using here is actually the free version of it. So it's, yeah, just an install. Just go do it.

BILL DIETER: So we come into 123D Make. Everything looks right except he's not oriented correctly, we move it around to the way we want to look at it. We need to select our material that we're going to work with. We have a cutting table that can handle four by eight material. This is using knife cutting. And so we've got it set up 123D Make to cut four by eight corrugated cardboard C flute. If you're doing this, I highly recommend doing a stack check to make sure that when you compress whatever material you're doing that you're actually getting to the thickness you think. We're then going to make sure that we were cutting to the original size. And then we need to select the method that we want to have this thing sliced up.

So we're just doing a-- I think it's a stacked slice and, which basically, is exactly what you're seeing here. And when this one came in it was oriented incorrectly. And so we changed the slice direction. It's very simple. You can see there's a control node there. And we're going to rotate that around the axes to bring it-- so right now it's on a vertical slice orientation. We want to switch to a horizontal slice orientation. On the right hand side, you can see what all our pieces look like. So we're rotating that around. And in real time it will switch. And so you now see all that slicing. The red is all the numbered, so it's giving us a floorplan of exactly how to put this back together.

And we want to check this. So we want the base to be flat. So we're going to rotate it around. You can see we've got striation in there, which means we're not completely on vertical. So we're going to move that control node just a little bit more to get to flat. At this point, we're ready to-- and this is a pretty darn quick process. You're going to spend a lot more time cutting. But you can build a mannequin. And there's other methods within 123D Make. It's really very fun program to play with, especially if you have means to cut stuff.

So we're now going to throw some dowel points in because we're not even going to glue this together. We're just going to use all thread. And so we did a hole pattern through the whole

thing. We positioned those to be where we wanted. I wanted them going through the neck. 123D Make automatically just throws it in when you turn on the doweling option. And it's just kind of random to what it thinks is correct. And it's easy to move it around. But you can see everything updating on the side. And this is not sped up at all. This is all happening pretty much in real time.

At this point, we're ready to send these sheets to export them. And then we're going to cut them on our ZUND.

MIKE AUBREY: Actually, hold on. Talk amongst yourselves. I've got to load that one up real fast.

BILL DIETER: OK. So any questions to this point? Are we good? Wow. That's good.

AUDIENCE: Did you have to upsize the diameter of the hole for the--

BILL DIETER: I didn't.

AUDIENCE: [INAUDIBLE]

BILL DIETER: No. You could. I mean, you could easily just plug in a new number. It's a really fun little program. And they've had it for a while. I'd played with it and then-- but this is the first time I was like, oh, this is like-- this is actually a really powerful tool because having a mannequin, a physical thing-- I mean, we build physical stuff. Let's put it on something and see how it actually fits and works. So-- and then be able to in t-splines go in and start adjusting something, it's so easy to make those adjustments.

So here we are. We have a ZUND cutter. We're stacking it. This is real time. We can actually move that fast.

[LAUGHTER]

So there we are. We're done.

[LAUGHTER]

MIKE AUBREY: It takes me longer to put the wingnut on than it does to put it together.

BILL DIETER: So this was our very first fit check. And this is why fit checks are really important. This thing didn't fit at all. So Dave, we knew was right, but our original model that we had started this project in had scaled in wrong. And so we just went back in and made an adjustment. And

then everything was fine. So we-- the blue vest you see here was the second fit check. And we're like, OK, that is-- we can see the volume that we were looking for. And that was-- this is super simple stuff. And then it's going to get more complex as we move into putting in the details and stuff.

So you can't go into this just thinking this is going to solve all of your textile problems. You have to understand what it is to work with textiles and the methods and madness around it. So if you're going in thinking that it's going to figure it out for you, that's not completely true. You've got to know what constructure looks like.

MIKE AUBREY: Rock on.

AUDIENCE: What caused it to not fit, again?

BILL DIETER: All right. There was something in scaling. So we were moving-- when we originally moved Dave in, he actually came in really tiny. He was about this big. And so we had to scale him up. And we thought we had scaled him to the right size. And he was a little bit short. And so that was an issue that's actually been fixed, I believe, in ReMake.

MIKE AUBREY: Yeah, the reason why he came in short was because it wasn't recognizing the units--

BILL DIETER: Yeah.

MIKE AUBREY: --of the other program. And actually that one's been-- I'm sure we'll screw it up other ways.

BILL DIETER: Yes. So it's really important to check things. And doing these really quick checks, totally worth it. I mean, because I was like oh, god. What's wrong? But then you realize. And then you get in and you start measuring your model and it's like, oh, this is completely fixable.

MIKE AUBREY: So we fixed it. And now we're able to start designing over top of it. We've got the scaling right. We've got all this stuff. And now we're doing things like pockets, and zippers, and stuff like that. So in the detail design phase-- there's a couple of key things that we're talking here. First off is, as much as you can, try and keep it simple. I mean, your job is hard enough as it is. As I mentioned the beginning of the class, this type of design from a geometric standpoint is, you really can't get much tougher than this. I mean, look at all the crazy curved surfaces, the layers, upon layers, upon layers. This is hard stuff.

So don't go crazy overly building your surfaces. I mean, a little bit-- yeah, just lead with that.

And keep the design based on what you can make. I know that some of you work in industry and you understand that. Some of you are getting into it, you'll get to learn over a couple of these things. But yeah, if you're trying to design something that you're fighting physics on, it's not going to work. So that's just my general disclaimer to you guys. I mean, know your fabrics. And then the other ways is, best you can, plan out how you're going to design it. I mean, there's certain things like, when I went back and did that first fit check removing certain surfaces, that makes quite a bit of difference. You'll still get there, it's just you'll get there a different way.

So here I'm going to show you a couple of different workflows here to create out those pockets and whatnot. And let's go and jump into those. So in this workflow-- let's see here. OK, so now that we've done the first part that Bill was talking about in separating out the surfaces, the next thing we need to do is, we're going to actually be using a technique that's very similar to build the front pocket from. In that, we're going to be using planes that are off of the body. We're going to be using the same split face and push off. So this will look very-- this is good for both repetition and also to show that you can use this technique for different types of things. And so actually, we are going-- it's just--

BILL DIETER: You'll get there.

MIKE AUBREY: I'll get there.

BILL DIETER: You're almost there.

MIKE AUBREY: Yeah, let's go through. So we thickened it.

BILL DIETER: You're there.

MIKE AUBREY: And now we're-- yep, there we go. And so we're going to start building out our geometry. And so this is one of those things you can do either with splines, you can do it with explicit lines. And the big thing to remember this is don't go too crazy on over detailing these sections because it is a textile. And so this isn't like you're doing an automotive Class A service here that needs to have everything perfectly lined up. The areas that have to line up I'll be showing you here. The big thing that's important in this type of workflow is know where your actual connection points are. In the previous workflow, Bill was doing an awful lot with projections. And we're doing that here as well.

And so in this case, we're just doing that same split face option again. And then we're going to

do a thicken. Things to notice about this when we go in thickening options is, we'll go in and he'll be able to do some really slick things with fill it to go in and remove some of those extra curves, things that you can't actually have in a-- you can't have hard edges in curves. When you're doing this, you're doing it over top of layers. So the next thing you'll notice here is that after we add this fill it, we aren't actually done. You've got to remember that there's still the fabric that's going to be behind it. And that's what you're going to see with this. You need to remember to turn back on those surfaces because that fill, it's not necessarily going to go and go find that other surface.

And so, in this case, what Bill was able to do is, he went in and was able to just go and use project to get that boundary. And that's just an extra extrude to get rid of it. So in layers you have to think that way. And remember what's behind what I'm modeling. Fusion rewards what's visible. And you guys might have had somewhere before where you extruded something and it didn't get everything. Well, it's the visibility that matters. So that's one of those things that we learned and, or relearned, I guess. We did know it before.

Next thing we're doing here is, we're adding our zipper. And the way that we're accomplishing this is, we pick our faces, and then we're using what's called, just an offset face to do that. And so then, offset face, we're going in pushing that down into the middle of where you want the zipper to be. And then we will be splitting face again. But the way to make this work-- Fusion really rewards having an explicit separation between. It really doesn't like to just be at the surface. It likes to be through the surface. And so, as an extra move here, what we're doing is we're using a tool called extend to make it so it's really going through it. And that's one of the things if you want to-- if you're talking about making a nice, robust, stable model, just a little extend, that little extra thing makes it all the easier to then go and do that split face to get your zipper boundaries. It's a good pro tip. So that's the first technique of how to create that pocket. And the reason why I use that technique is, that's a pocket that's based off of the geometry of your mannequin. So we can get away with basically using the same technique.

This next technique with where we're going to have the cell phone is something that the pocket geometry does not mimic what the mannequin is. And so things get a little bit harder in this workflow. First off, we're creating a plane at an angle for our initial geometry. But we're going to need to connect up this fabric piece to something that's not even on that plane. So we're going to be using, first off, a use of the projection first to make sure that we have the correct starting point. Because remember, we want to make sure that we have all these

surfaces that we can play around with. That's key.

And the next thing we're doing is, after we go and we create an arc for our first thing, we're going to connect this up using a lesser known part of Fusion. Have you guys ever used the 3D sketch before? Oh, we got a couple of nods. OK. Well, include 3D geometry, which we're about to do here, I think is one of the slickest, most awesome things we have in Fusion. By including the geometry of that back point, we can then go and make a spline between the two of them. And all the challenges that you've had with old parametric software about saying, oh, god, how do I get a plane to line up with where I want to go? Screw that. Just go make a spline and move it. And you see that we now have a boundary where we can go create our new plane, our new surface.

So the surface we're going create, by the way, that's called a patch. And so in order to make the patch work, the patch really likes to use a sketch geometry for our UX people in the room, make note of that if you want to. It doesn't like edges. So we're using include geometry to go choose where the rest of that patch is going to be. And then we'll go in and we'll create our shape. I just think this is the slickest thing ever. You go in and you just choose your edges. And now we've got this patch that lines up. I don't know if you guys saw, there's a little bit of bleeding towards the edge. And-- but the benefits of having this parametric model is, we just go in there and you start moving things.

So if you guys haven't used the 3D sketch environment before-- the 2D point, that's the same. You just go and grab that point. The way you move things around in the 3D sketch environment is, it's a right-click move. But it's the same thing. You just go and you just move it around using a manipulator. You know sculpting. You understand the spline tool. And there, now we've got it. There's still a little bit of bleeding at that bottom edge. And this is one of those things like, it's geometrically OK to work with. But remember, this is one of the seeing the forest through the trees, it's going to be touching anyway. And we're going to correct that in manufacturing. So that's something we can go ahead and leave.

The next thing we need to do is create a patch for the gusset because I'm now a great textile designer. Basically, you've got to make it so that the cell phone doesn't fall out when you put it in there. And that's what that is going to be plopped into. So just go in there and make a patch there. And then we'll have our two pieces of fabric that we'll need. OK.

So with that-- now that we've done this-- we're now ready to start actually making it.

Remember I said, everyone be cool, we're going to fast forward. While we're not fast forwarding anymore. We're now digging into, we have our geometry that's ready to go and create. And we're moving into the patterning phase.

BILL DIETER: So patterning is building those pieces of fabric in the orientation that we want as it's going to lay over the body, in this case, Dave. So what's important is, we want to know where our seam's going to fall. And we're thinking about that in terms of yield. So if we've got just one big massive piece, we're going to have horrible yield on this particular thing. If it's just a square, it would be Fine So we're going to think about it from a production standpoint and break it up.

So the purpose is to convert this 3D geometry into something that we can now work with flat and then ultimately send to our cutters.

MIKE AUBREY: So I actually just said that. So ExactFlat is one of our partners that we're working with. If you guys haven't met Mr. Clifford Brown-- I don't know if you want to stand up and say hi. He is an awesome guy. Actually, he's an old Autodesker too. If you guys are curious about this workflow, definitely approach him after class. I'll be sure to remind everyone about him as well. But yes, so this is something, it's its own standalone software that exists. Actually, you access it through the browser from that. And it's subscription based. And, well, actually, I'll leave it there. The main point is, yeah, you're creating a flat pattern from your design. And we'll get into how it happens.

BILL DIETER: So ExactFlat's created a plug in for Fusion. And you can go to the add in store. I guess it's a store. And you can download that add in. And you'll see it up in my toolbar up there. So we're ready to start creating some patterns. And the important thing to remember about patterns is that with ExactFlat we want to select all the individual faces that are going to make up one pattern piece. So we're going to do our first pattern piece, which is the back panel. So I've just selected those four. And then I hit the plus sign because I'm ready to move-- this is how fast this goes. It's very quick. And I'm already moving on to my next pattern piece, which will be the shoulder. So I have-- and I'm naming it. I'm going through and I'm saying, shoulder, side panel, and collecting each of those individual faces. And you're going to see those show up in ExactFlat as the pattern piece.

So speaking to this, now the other thing you'll see that I did is that we're patterning this entire piece at once. So we're going to send the entire model to ExactFlat. We're not going to send it in pieces. We're going to do the whole thing in one shot. So I've turned off bodies of pockets

and stuff. And we're working from the inside out. So we're slowly turning bodies back on so that we're collecting all of the pattern pieces because we don't want to miss anything. And we've got-- there's layers on layers in here. So there's a pocket that creates another pocket when the first pocket is sewn on. And so there's all these things going on. And this is where I really wanted to see how far could we go with ExactFlat and Fusion and building all this stuff. So we're going to work through. Ultimately, we build 12 pattern pieces. And we're going through, selecting each one, hit the green plus sign, give it a new-- you don't have to give it a new name but I think it's just good practice to label your stuff. And so at this point, we're ready to now publish this.

So the next tab over on the ExactFlat is, we need to go into the publish and we-- let's pause for just a second. So we've, in that-- so in that published mode we've set up an account. And we need to go-- we're logging in. And it sees that we have 12 pieces. We're going to name that because we're going to have a whole list of files in our ExactFlat online experience that will list of all our projects. Because we can come back and rework them later if we want to rerun the pattern for some reason. So again, label your stuff. It's worth it. Otherwise you're just unnamed, I guess is what it would show up as.

So we're now in-- let's go ahead and play-- so we're now in ExactFlat online. And so it immediately took us into this window. And we can see our entire model, all the pieces that we selected. And as we mouse around there's-- as pieces turn green, those are our pattern pieces. So we need to flatten-- we're going to select all the pieces that we want flattened. So anything that's blue has not been identified yet to be flattened. So you could-- if you wanted to like oh, I don't need that piece anymore, you could just leave it out. But we want to make sure that we collect them all. So we're getting them all. And then we just go over to flatten. And we hit flaten. And it's going to flatten it but it's not actually flattened. Let's pause here for a second.

So we've-- it's broken it into its pattern pieces. So on the left side, we're seeing the model. And on the right side, we're seeing the model exploded out. But those pieces have not been-- they've just been separated out and laid out in a nice orderly fashion but they have not gone through any kind of flattening yet. And if we look on the left hand model, which is the fully assembled piece, we can see a lot of red. There's a lot of strain going on there because we have not flattened it yet. So what we're going to do is, we're now going to move into pre-flattened. And most of the-- and Cliff, you can correct me-- but I use pelt for almost, I'd say 95%, of my flattening. And that's, if you're working with surfaces that are developable. So if

you've done something really outrageous ExactFlat can probably flatten it. But there's other flattening algorithms that would be better. But pelt is going to get you pretty far. So you can see how all that strain went away.

And now we're going in and we need to-- let's pause for a second again-- we're going through and we're selecting-- so each of those patterned pieces have been flattened out but they haven't been optimized yet. So what we're doing now is, we're going to say, we want to optimize all these. Now if you-- and that's going to be another math algorithm to really check the entire piece and make sure it's truly flat. If you've had a pattern piece that has a lot of curvature to it, at this phase right now, it'll look really crazy. I mean, it'll be twisted and stuff. But there's a good chance-- and I've run some stuff that it's like, there's no way it can flatten this. And it flattened it. So you're going to optimize it. But if you don't have-- if you have stuff that is pretty much-- if you're just working with flat surfaces and you just want to roll them out flat, you don't even need to run optimization. Because the pelt just does such a good job if it's a piece that doesn't have any compound curvature and stuff.

So at this point, we're running optimization, 12 pieces. This took, I gave it 10 minutes to run it, it did it in under two minutes. This is sped up so we don't have to watch it for two minutes. But it was pretty impressive how quick. And then we're going to move into the next phase, which is, we want to put some notches in this, or markers. So if you guys have experience with sewing, or bonding, or anything, we need to be able to locate, especially as we're working around stuff. So we're going to go down and turn on create notch. And all we have to do is select a node that is between two pattern pieces.

So as we work around-- and if you're on-- if you select a node that is not between two pattern pieces, it'll just say, unavailable or something like that, it won't work. But you're going to see a little link show up. And that's also showing up. We can't-- if we were zoomed in, you would see it on the right. But those little-- and that's going to leave a notch in our pattern piece within our seam allowance once we go into doing seam allowance. So

We're just putting notches in. So if you have experience with sewing, as you're sewing, there's all kinds of movement and stuff. We want to use those notches to get alignment so that by the time we get to the end of the seam we're dead on at both ends. So there's a lot of trickery in sewing. And you can see all those notches. And they're all labeled. Because I went through and I just when A, B, C, D, to identify those notches. I didn't put notches on things that didn't need to have a notch. And again, some of this is coming from experience, looking at it and

saying, this would be really helpful to have a notch here.

So at this point, we're ready to export. And we would hit the export button, which then we have the option to export, right now only as DXF. And we now have a DXF. It goes to your download folder. If you're-- I'll just tell you guys this. And this is a Mac issue I think-- it's the one I have-- where it comes in as an unknown file. I rename it whatever I had the pattern set. And then I give it the suffix of DXF. And then you're off and running. But it'll-- the first time you're like, oh, my god. It's not here. I have no ideas. And then you call Cliff and suddenly realize it's not that big a deal. So this is something they're working on.

And let's go back one slide. So there's a couple of other-- one more slide, I think. No, maybe forward the other way. Ah, here we go.

PRESENTER There it is.

MIKE AUBREY: Yeah.

BILL DIETER: So right now the export from ExactFlat is polylines. That's changing. They're working on it right now. And what-- it doesn't matter too much unless you're looking at your equipment. So we use a ZUND cutting table. It really hates polyline. So when you see it running, it's going to be going [AAA]. It's a very jerky motion. We want to see a nice smooth spline line. So that's something that's coming. So one of the things we've had to do is, we take the pattern sets and actually then go in and draw over them, which is slow. But that is going to be changing.

For the DXF side of this, we've been using either AutoCAD or Rhino. The goal is to go back into Fusion. And we're hoping that in the not too distant future, we'll be able to bring that whole pattern set in and work with it. I've done a fair amount of exploring and playing with doing pattern sets in Fusion. There's some things that are really fast about it. There's some things that are really difficult about it too. So we've been just staying and using either AutoCAD or Rhino just as a DXF manipulator before we send stuff out.

MIKE AUBREY: [INAUDIBLE]. I need to go find the video. I forgot about it. I have a video--

BILL DIETER: So this was the first vest we made. And this again was just an experiment to see how quickly could we do this? And in doing it, there were some things we didn't like. The volume of the pocket could be bigger. And this is where it got really fun because the model is completely parametric. We went in and just grabbed that front plane and pulled it out a quarter of an inch, made it a little bit bigger. This back line was sitting high. And so when the vest was on it

actually slumped forward a little bit. And by lowering that back, we felt there was a better fit. And again, we lowered like an inch and a half. But it's-- you saw how easy it is to move those lines around then just send it right back into ExactFlat. And we cut it out. And then we moved into--

MIKE AUBREY: Actually, I got ahead of myself. Yeah.

BILL DIETER: Yeah.

MIKE AUBREY: So we went through all this.

BILL DIETER: Yeah, there we go.

MIKE AUBREY: Yeah. So we had a lot of great stuff going on in this design. I don't know if we want to pass it around. It's going-- be careful with it, it's our baby. We loved a lot of things about it. But the big one is, [INAUDIBLE] the back line was, it just didn't-- it just wasn't perfect there. We needed to widen the pocket. And we-- he had just finished designing a fishing vest and then everybody at his office came in there, hey, nice fishing vest. And he's like, it's not a fishing vest. So he got really mad, said we need to change the material. So that's where we moved on from that. And we're talking about, the point is iteration, all this stuff. And so, yeah. We were able to go in-- we will submit you guys looking into our-- hopefully, you guys have taken that these are very adaptable models. So we went back in there and made our changes. And from that, this is the result of being able to go in and produce that second iteration. There were go.

So here Bill's-- we're using that ZUND, which is actually, for me, one of the coolest little pieces of machinery I ever got to see on this stuff. It just hauls through everything. And it's absurdly precise. And then we cut through-- what is it-- this is ballistic grade nylon, is that right?

BILL DIETER: This is a variation on ballistic nylon. It's actually used for the fuel tanks on F16 fighter jets.

MIKE AUBREY: Yeah.

BILL DIETER: It gets urethane coated heavily to create a soft bladder because they can't have rigid tanks for the amount of vibration and stuff they see. So it's a very tough material. And so we're just kind of speeding through sewing it. And it went together-- the thing that's so exciting about Fusion and using ExactFlat is the stuff just goes together. And there's-- we're hitting our marks. It goes around. Every now and then you'll make a slight tweak. But I mean, it's so slight. And the patterning experience is very easy. And it used to be you'd spend hours and, if not days on a

pattern. And now it's minutes developing a pattern. And then putting something together is as fast as you can put it together. I can't actually sew that fast. But--

[LAUGHTER]

--almost. But going through this, it's this iterative process of-- but making the physical thing. So everyone's always talking about iteration. While we want to iterate in the real world because we're going to see how those materials behave and how they react and stuff.

MIKE AUBREY: Yeah, pretty cool. So we've been talking at you for a while now. I imagine there are a couple of questions. Is there anything you guys wanted to get off your chest?

Yes, Klaus.

AUDIENCE: Access to academia?

MIKE AUBREY: Access to academia. Well, everything, all these videos were given to you.

AUDIENCE: Also I'd like the ExactFlat [INAUDIBLE]?

CLIFFORD BROWN: I can [INAUDIBLE] questions.

AUDIENCE: ExactFlat, is that also for academia [INAUDIBLE].

CLIFFORD BROWN: Yes, there's a special program for academia. Just ping us, sales@exactflat.com or I have my business cards here. And we will set you up.

MIKE AUBREY: Other questions? I don't believe you.

[LAUGHTER]

AUDIENCE: When the-- for example, when you went through the first prototype and then you wanted to change [INAUDIBLE] and you made the pockets deeper, in the-- part of the process was parametric and easy to go in and change. There was the still the exporting through ExactFlat in this area. Is there like a remembering process in ExactFlat that we can leverage?

BILL DIETER: I reran, I recollected all those faces. I use the word collect. I don't know if that's the right term to use but selecting all those faces that are going to make up my pattern. It doesn't take very long. And I just instinctually do that. It does remember the last thing. Like, so when you go out

of ExactFlat or Fusion, and you shut down and you turn it back on, if you've run that pattern, you could send it again to Fusion. So is that-- does it--

CLIFFORD BROWN: So if it's parametric, as long as you don't change the typology, the pattern pieces are persistent. So they become part of your Fusion model. If you change the typology though, then you have to rerun it. So again, that's the 3D pieces. The 2D pieces, if you were to make a change and you now want a new 2D piece, you have to run that part of the process. But the 3D pieces are persistent. They're part of the Fusion model.

BILL DIETER: Yes.

AUDIENCE: So if you were to make something that wasn't form fitting to the body, say like, a suit jacket, would you have edited the mannequin before you started?

BILL DIETER: That's the way I would handle it in Fusion. There's Optitex, and Gerber, and Lectra, and there's another one, and those are-- they are completely dialed towards apparel, so they're designed for draping. We don't use them because we don't really work on apparel, per se. We're working on more textile based equipment and stuff. And we need to be able to move into working with-- we build tons of tooling. We do tons of compression molding and stuff. And so to be able to pull tooling from our models is really valuable. You can't do anything even close to that in those programs. So if you were to use Fusion, yes, you would modify in t-splines, or start pulling and pushing to create the form that you would want. And it wouldn't be that bad. It would be-- I've been playing with that on some footwear stuff.

AUDIENCE: Thank you.

MIKE AUBREY: Also, I would add to that, if you really aren't going to be creating your flat pattern from that, we can bring the scan in and you can dimension around that as well. So I bet you could get away with doing actually quite a bit less.

BILL DIETER: Yes.

AUDIENCE: [INAUDIBLE]

BILL DIETER: Yeah. Yeah, actually-- and that's not in here. And so there is a super slick way to make a dart. So if we had-- does everyone know what a dart is?

MIKE AUBREY: Who doesn't? I had--

BILL DIETER: OK, so we've got a piece of fabric and we want to do a dart. So that's a dart. So it's still all this piece of fabric. And it's either going to be a dart or a tuck. So can everyone see what I'm doing. I'm just pinching the fabric. But this is all one piece. So if you've got a line in there, which might be naturally occurring in your model, or you could draw it in, use the pipe tool. And you're going to click on that line. And you're going to create a pipe. And you're just going to do it at like 1,007 inch, or 5,007 inch. And it will be this little pipe. And you're going to use it as a cutting tool. And you're going to take that material away. And in textiles we're not looking to have this completely watertight structure. We don't need it because of what fabric is going to do. So we're OK with there being a split. And so it's going to then go into ExactFlat and it's going to say, oh, those two edges aren't touching? And you're going to see this perfect dart. It's so fast.

MIKE AUBREY: Yeah, we actually debated if we wanted to show a darting example. And we had a fear-- and it worked out actually OK. But yeah we-- you should come talk to us afterwards and we can--

BILL DIETER: It's really fun.

MIKE AUBREY: I think we have video.

BILL DIETER: Because doing darts is actually pretty difficult, and doing them accurately.

MIKE AUBREY: Well, I'm sure you guys probably have some more questions, other stuff, definitely when the class is up come up and chat with us and stuff. If you want to check out Dave and Dave's ballistic vest, definitely feel like you can come up and chat with us. This has also been a really fun part of this process making Bill feel awkward as I take pictures of him.

So guys, the summary, I start off with my super bold statements about how textile based product demands iteration to innovate. And hopefully, one of the themes you guys are getting throughout all of Autodesk university is that were here as your partner to help make that go faster. So online software, where we're seeing all of the software industry go on this stuff, that plays a big part in this innovation. I'll remind you again, this workflow literally didn't exist a year ago. You guys are seeing some bleeding edge stuff here. And I hope you appreciate that, and you seize the moment, and capitalize on it, because you among the first to do. And that's pretty special.

So the process itself is yours to use. But I mean, what you create is-- that's why we're so excited to bring it to you. Because you guys do amazing stuff. So with that, Bill and I thank you,

and Cliff. Thank you very much for coming to the class today. And we hope to work with you guys in the future. Thank you.

[APPLAUSE]