# Transcript of ‘Waste in the Textile Industry’

## Season 3, Episode 37, Transforming Tomorrow

[Theme music]

**Paul:** Hello and welcome to Transforming Tomorrow from the Pentland Centre for Sustainability in Business. I'm Paul Turner.

**Jan:** And I'm Professor Jan Bebbington.

**Paul:** Today we're weaving our way through the textiles industry and re-imagining how we might make the shirt on your back.

[Theme music]

**Paul:** I don't wish to sound sexist, Jan, but how's your sewing?

**Jan:** Um, my sewing's very fine, thank you. Well, I was, I was raised to be a farmer's wife, so I was raised to be able to knit, to be able to sew. And I can also spin sheep yarn into something to knit with.

**Paul:** My next question is, why have you never knitted me anything, then? [Jan laughs] I'm not, I'm not impressed. I thought your sewing skills and knitting skills were minimal…

**Jan:** …look, if I knit you something and you don't wear it on this podcast, you'll be in so much trouble.

So there we are, the challenge has been laid down.

**Paul:** Yeah, let's pass on that then, yeah. [Jan laughs] I thought you'd knit me something and I'd just, you know, throw it in a corner somewhere. Say, thanks, that's exactly what I wanted, but just…

**Jan:** …a wee hat, a wee hat is coming your way.

**Paul:** Yes, I dare say when you have done any sewing or knitting, it's quite sustainable. Because it's just you, especially if you were out on the farm just ripping the wool off the sheep, [Jan laughs] as I understand happens, just bringing it inside, spinning it yourself on the wheel, or possibly having, you know, the little slave children that you had running around the house. I don't know how farmsteads worked in 18th century New Zealand?

**Jan:** Ah, well there you have it, we'll find out. Well, yes and no, because I think that that whole sort of handcrafting your own clothes has sort of really gone to something that's more in the past, um, within the likes of UK, within the likes of, of New Zealand.

So now we, we buy clothes that somebody has made somewhere. So it's still the same process, but it's maybe not happening in the household so much, it's happening somewhere else in the world in some sort of, um, you know, modern industrial setting.

**Paul:** We have touched on a couple of times at various different episodes, slightly, the garment industry, the fashion industry, how it operates. We particularly looked here in the UK around Leicester for one of the episodes we did, and the issues there are around sustainability.

But we've not necessarily looked at the methods of producing garments and how maybe there's a sustainability area to that too.

**Jan:** I think there's a big sustainability area and I know just the person we need to talk to to find out about it.

**Paul:** Yes. 'Cause today we're gonna talk to someone who has a PhD in Textiles Design from Herriot-Watt University up in Edinburgh, and whose work focuses on how to develop sew-free. S-E-W free [Jan laughs] - I need to say that because otherwise throughout this entire episode, people are saying, why is it really free? So free? Why is it just not a little bit free? - garments, and someone who also works in the Pentland Centre here in Lancaster, we're going to say hello to Dr Madha Ahmad. Hello Madiha.

**Madiha:** Hi. Hi, Jan. Hi, Paul.

**Paul:** Really good to have you with us here, Madiha. Now we have spoken, as I've said previously about modern slavery in the garment industry, but can you outline for us a bit more generally about sustainability issues more broadly within textiles, clothing manufacture.

**Madiha:** Yes, definitely. Uh, sustainability and textile is, uh, not just the social side of it. Uh, when we talk about the production side, we have the environmental side of textile, uh, sector as well.

So textiles can be resource-intensive and it can involve really high input, including the consumption of energy. It's raw material and it's transport. And

then there are also issues, uh, around emissions and waste generation, or short garment life, and textiles ending up in landfill.

So the, so the sustainability issues, um, are spread across the whole life of the garment from manufacturing until the post-consumer side. So after production, there are issues around, like, over consumption and short garment life. And we usually come across with the, uh, idea of, uh, the garments ending up in landfill. So this is very common.

Uh, so the one point I think which is important, uh, is that textile waste is not the end-of-life issue, only. We often think about clothes, uh, being thrown away by consumers. Uh, so waste can also be created during the manufacturing of the garment…

**Paul:** …mm-hmm…

**Madiha:** …um, before the garment is even worn. Uh, so for example, in garment manufacturing, or during the production, uh, fabric of goods which may be produced during the cutting process. And some of the material can be reused or recycled, but that still requires collection, sorting and more energy and cost to recollect and recycle it.

So broadly, sustainability in textiles, uh, is about responsible production and consumption. And rather to recycle and reuse that, uh, offcuts, uh, during the manufacturing, why not, go with that production, uh, manufacturing techniques which are less waste-generating and which creates less waste during the manufacturing.

**Jan:** And so for many of us, we, we buy our clothes and we maybe don't think so much about how they're manufactured.

**Paul:** Speak for yourself.

**Jan:** Ah, do you think about it?

**Paul:** I really do.

**Jan:** Oh, well you'll be able to answer the next question. [laughs]

**Paul:** No, no, I'm not an expert it. I, I just think about how it's manufactured, the, the materials that it's used…

**Jan:** …yeah…

**Paul:** …where it's made, I'm not gonna come to be an expert on the area…

**Jan:** …aaah…

**Paul:** …no, it's, it's honestly, if I was to buy something, I've got lots of football shirts, for instance, I will not buy a football shirt now if it's not made from recycled materials…

**Jan:** …ah, that's interesting…

**Paul:** …and so many football shirt companies make football shirts now out of essentially recycled bottles and stuff like this…

**Jan:** …yep, yep…

**Paul:** …so I, I'm not wearing one now because I wouldn't wear one to do the podcast. But if I was wearing one of my football shirts, I'm essentially wearing the water bottle you drank from a few weeks ago.

**Jan:** Brilliant, well, I think you're… Well, Madiha, shall we relax and, uh, let, let Paul do the podcast? [laughs]

**Paul:** I just, you know, you said many of us and I felt I was being tarred by your brush there…

**Jan:** …no, I wasn't…

**Paul:** …I, I definitely pay attention to where manufacturing takes place and what materials are used in it.

**Jan:** Excellent. Well, let's dig into that a little bit more, in a little more detail then. And Madiha, how does yarn become a garment? 'Cause that's quite a bunch of steps that we might not necessarily always see directly ourselves.

**Madiha:** So the process basically starts before the yarn. It starts with the fibre, which is spun into yarn. And fibre could be so, uh, can be man-made or sourced from nature.

And then yarn is made into fabric, usually through weaving or knitting process. Then fabric may be dyed, printed, finished, and then, depending on the end product where it goes.

So for clothing purpose or garment purpose, the fabric then goes into garment manufacturing process. It is spread out in, in the conventional garment manufacturing, it is spread out in patterns and then cut out, the, the fabrics are cut out in pieces, and then they are sewn together to make the garment.

So the normal route is, first we have yarn from the fibre, then we make fabric, and then we convert that fabric into clothing. So the work often take place across different global supply chains.

One country may produce or source a fibre, uh, and spin the yarn, another may make the fabric and the production for garment take place in another country. So a garment that looks simple in a shop can actually be representing a long international production chain.

Uh, so, coming from Pakistan, just global supply is something, uh, which I can connect with personally. Uh, because, uh, Pakistan is part of that textile and garment manufacturing landscape, which I can connect that how textile in Pakistan works.

**Paul:** So much of what you've said there, Madiha, reminds me of a conversation we had a little while ago about Uzbekistan and the cotton industry there, and how the cotton was picked there.

And for a while, when there were issues around the cotton industry, it was almost smuggled out of the country and manufactured into garments somewhere else.

And therefore it had made in 'X' rather than made in Uzbekistan on there. But being able to see that from a different perspective, from someone who's done all the work on the garment industry is really fascinating as well.

**Jan:** So why is this, uh, industry of significance to the Pakistan economy?

**Madiha:** So, for Pakistan textiles, um, are hugely important because, it's one of the country's main export, and making around, $18 billion a year, and it's, uh, making Pakistan's, uh, more than half of its exports.

So when we talk about, uh, textiles in Pakistan, we are, are not talking about a small or niche industry, and it's a major part of our economy, and it supports a wider value chain. And from cotton to its spinning to weaving and processing, and then home textiles and garment manufacturing.

**Paul:** So you've mentioned cotton there, Madiha. Are there other fabrics as well that are coming out of Pakistan, or is it mainly cotton that's the, the major one?

**Madiha:** It's, uh, both the yarns as well, but, and the value-added products as well, in the home textiles, and the garments as well. So you can see various brands in UK as well, which are made of Pakistan or made from Pakistan.

**Jan:** And just while, while you were speaking, I saw that you were looking at your label. I'm, I'm gonna go and find my label and have a wee look as well to see. [laughs]

**Paul:** Yes, I, I remember doing this when we had the Uzbekistan episode. I was looking at my label to see if I was wearing 'made in Uzbekistan' and I wasn't, and I'm afraid I'm not wearing 'made in Pakistan' either. Today I am 'made in Egypt'.

**Jan:** Oh.

**Paul:** And it's cotton. So whether that means it's Egyptian cotton, I don't know. All I know is it's made in Egypt from cotton.

So you've emphasised there how important the garment industry, the fabric industry is for Pakistan. But what about sustainability within that? What levels of awareness are there within Pakistan and the garment industry about sustainability issues?

**Madiha:** Yes, for sustainability issue in Pakistan, definitely, I'll, I'll frame it slightly differently. It's not only about the awareness now, because for many export-oriented manufacturers in Pakistan, sustainability is becoming part of their competitiveness, competitiveness, um, and many manufacturers in Pakistan, uh, because they supply international buyers.

So for those buyers, they, they are increasingly expect evidence of, um, responsible production, which includes the waste reduction or energy imports from where it is coming from, traceability, certifications and compliance.

So sustainability, that, it is becoming, uh, linked to market access and buyer confidence, to get, to get the buyer confidence. So it's not just a nice to have, uh, it anymore. For many companies in Pakistan, it is becoming part of staying relevant in international markets.

And at the same times, manufacturers have to manage cost, quality, delivery time, and production speed. So the solutions, um, need to be very practical. Uh, and this is why I think, uh, process level improvements are, uh, important.

And, because if a method can reduce waste or reduce unnecessary production steps, or improve efficiency, then sustainability become, uh, more achievable for industry.

**Paul:** Again, this ties back to what we heard from Uzbekistan and how it was international influence changed a lot of the issues there around the cotton picking and cotton manufacture. And how that international influence forced change, albeit with some desire from within the country as well.

But you wonder how much sometimes would happen if there wasn't the international supply chains that are operating here, there and everywhere. Meaning the rules from one region are not restricted to those regions, which again, ties in with many conversations we've had around things such as the EU omnibus, and other things such as that.

**Jan:** Yeah, yeah.

So you've indicated to us that there's this increasing level of awareness about sustainability and particularly process-orientated improvements, which sound, you know, like really smart thing to do as a business.

What are the major sustainability issues with more traditionally produced items? And, and there, um, I take it that traditionally produced is that, uh, fibre to yarn to fabric being either woven or knitted and then, um, turned into garments.

**Madiha:** Via, cut and sew method.

**Jan:** Yeah, cut and cut and sew method. This is all good new language that we're using here. [Madiha laughs] Thank you.

**Madiha:** So, yes, sustainability for, there are many sustainability issues related to, uh, textiles and clothing industry, uh, social side or environmental side. So for my area, the main issue is, um, for my particular research areas, uh, fabric waste during garment manufacturing, especially in traditional cat and sew method, which is around 20 to 25 percentage of wastage during manufacturing.

So, as I mentioned earlier, woven fabric is usually produced, um, first and then cut into garment pieces. So the challenge is garment are, uh, shaped for the human body, and the woven fabric is a flat piece of rectangle, uh, coming out of the weaving loom. So, loom is the machine on which the weaving, uh, takes place.

Uh, so when you cut curved shapes like arm holes or, uh, waist sections or trouser panels, there is often fabric left between these pattern pieces. So those left, uh, leftovers do not always go directly to landfills, and they can be reused or recycled. But, my point of research is why, uh, why not omitting that waste from the beginning in the production process?

So there are useful approaches other than, uh, sew-free garment, like improved marker planning and zero-waste pattern cutting. But they can be difficult to scale from one size to another or, um, from one style to another.

So my research looked at a different route that, instead of only asking how we can cut fabric and efficiently, can we design the woven fabric in a way that helps create garment shape during manufacturing? And can we produce a sew-free woven garment in the current weaving infrastructure?

**Paul:** Before we get onto what sew-free is what you've just said there made me think. So, yeah, if you've got fabric and you are cutting out and you've got waste bits, you said not all of it goes to landfill, and some of it can be reused.

Now I have an image in my head, not from making clothes, but from baking. If you've got spread out, you're making scones, you've got the mixture, you put the cutter in. When you've taken out all the shapes, you've got lots of holes, but lots of bits left over. You just rub 'em all together again, and then you roll it out again, and then you cut it out.

You can't do that with fabric, surely. There must, when you say therefore that it doesn't necessarily all go to landfill, how could it be reused? The cuts that are there?

**Madiha:** It could be reused and, but again, it will cost you the price and again, all the processing because it will, again, go through it's, um, mechanical degrading so that it can be, uh, converted into fabric again, or any other useful purpose.

**Paul:** So you have to take it back down to its base element then put it back it back together again, yeah. So there's a whole process in there. It really isn't as easy as just, uh, rolling the scone mixture back together

**Jan:** I thought you were gonna go with patchworks. So [laughs] that's what, that's what you used to do…

**Paul:** …but my skills are not around anything to do with patchwork, [Jan laughs] but more around to do with scones…

**Jan:** …right, right, yeah.

**Paul:** That's all you need to know.

**Jan:** Okay. Um, uh, we'll come back to your scones, 'cause I have a view on them.

Um, so given all of that, and you've kind of teased us already about sew-free garments. What are they?

And, um, I don't think I'm wearing one, but I'm now really curious as to whether or not myself or any of our listeners would be wearing sew-free garments, and would we even notice we were?

**Madiha:** So a sew-free garment is basically, uh, a garment made with little or no conventional sewing. Um, so instead of cutting many separate pieces, uh, and switching them together, the garment, or part of the garment is formed more directly through the textile construction process.

So yes, uh, we probably have, have worn something similar like seamless socks, seamless undergarments, leggings, sportswear, or some knitted trainers, which can be, uh, made with very little sewing.

But this is already quite common in knitting. Um, so knitting is more flexible because it is, uh, made from loops and it have an inherent stretch and, uh, it can shape more easily.

Uh, but when we talk about, sew-free woven garments, it's weaving is quite different from the knitting process. Uh, woven fabrics are made by interlacing warp and weft yarns.

So warp are the lengthwise yarns, and weft are the cross, uh, crosswise yarns, which are interlaced at, usually at right angles. So they are more stable and less flexible, but that stability is exactly, uh, why woven fabrics are used for shirts, trousers, or denims or jackets or other structured garments.

So the reason to explore sew-free weaving is not to compete with seamless knitting. It is because a large part of our clothing is still woven, and woven garments still depend heavily on cutting and sewing method.

**Paul:** I can picture a few of my t-shirts that don't have as many seams on. Um, the one I'm wearing now is not a good example 'cause I can feel seams everywhere. Now obviously this Egyptian cotton required lots of seams, uh, but…

**Jan:** [joking] …they're not as sophisticated as the Pakistanis. [Paul laughs uncertainly] We could start a small diplomatic incident, couldn't we, via the podcast…? [laughs]

**Paul:** …I'm not, not getting involved. You, you carry on. You carry on. But I'm not getting involved.

But I can picture some that have, essentially, I've remembered wearing them and thinking, ooh, there's no seam down the side. There's no seam at the shoulder. It's all kind of one thing.

**Jan:** And I'm, I'm imagining our, our listeners, 'cause I'm resisting doing it, 'cause no one needs to see this. I want to now look at my socks.

Um, so I can imagine people listening to this podcast, you know, sort of checking out their clothing, looking at their socks and everything, to say, oh, I'd never thought about how that was produced.

**Paul:** The worst thing that would ever happen on this podcast would be for you to take your shoes off, lift your bare foot [Jan laughs] onto the table, and start studying your socks.

**Jan:** Yes, indeed. I won't do it. I'm just thinking about it.

**Paul:** Thank you, thank you.

So what did your work entail then, Madiha, around the design of sew-free garments?

**Madiha:** So my, uh, PhD looked at engineering the design for sustainable woven garment manufacturing. The main idea was to explore whether, uh, we can have woven garments, which can be produced more directly on the looms, um, the weaving machines, uh, and on the current existing weaving infrastructure.

So the challenge is that a loom is, uh, normally produces a flat fabric. And since the body, human body, is three dimensional, um, and in traditional garment making, the shape is created through either sewing, cutting of the fabrics, darts, or seams and stitching.

So I explored whether some of that shaping, uh, methods could be influenced through the textile structure itself. So I studied how yarn properties, uh, and weave structures affect the, uh, shape of the garment or the shape, shrinkage and stretch of the fabric.

So these behaviours are important because they influence how fabric changes after weaving, finishing, and can help to produce various shapes or dimensions. So, for example, one area of fabric may shrink more while the other could be, would require more stretch. Uh, so the difference can create the shaping or curvature. Um, and in common terms it can work a little like a dart in tailoring.

So, but instead of removing fabric through stitching or cutting method, uh, in, in sew-free woven garments, we, we shape the, the shape is coming from the behaviour of the fabric after the weaving and after the finishing.

So I looked at the factors such as the yarn, uh, for yarns. I looked at the factors like yarn composition, yarn twist and weave structure, and the density of fabric. Uh, using these principles I developed sew-free woven garments, prototypes, including the shirts with sleeves and pockets, and trousers.

So the work was not just about removing sewing, it was about understanding how these characteristics, the yarns and the weaving, um, can control the fabric behaviour. And so that woven garments can be produced in a more resource-efficient manner.

**Jan:** That's incredible, isn't it? 'Cause again, I think the, the, one of the big things I'm taking away from our conversation is the extent to which we don't pay any attention to, to our fabrics.

And yet when you look at it, there's all sorts of incredible possibilities for sustainability, by being actually more intellectually smart about what's in them and how they, they react to which.

**Paul:** Did you discover if there's certain types of apparel that are more suited to this, that might be more easily done with the sew-free technology?

**Madiha:** For the sew-free technology, the most common can be the skirts, which have lesser shapes or lesser cuts.

**Paul:** Mm-hmm.

**Madiha:** And it'll become more challenging when it comes with, uh, the shirts with sleeves, and the trousers and the details, like pockets or zippers.

**Paul:** So if we all just wore a tube of fabric, it would be a whole lot easier. Is that what you're trying to say?

**Jan:** Ah, I think, then, the tube of fabric once treated will give you a waist.

**Paul:** Well, a tube of fabric with a belt.

**Jan:** Ah…

**Paul:** …yeah, a tube of fabric and a belt. That's it.

**Jan:** I think we should go back to the experts.

**Paul:** [laughing] Are you suggesting that, [Jan laughs] yeah, actually, no, I'm not even gonna try and make the argument that I'm some kind of fashion expert [Jan laughs] and that my suggestion is, is a goer, and that everyone in the world would want to wear just a big tube of fabric and a belt…

**Jan:** …mm, yeah…

**Paul:** …maybe some shoes. I'll let them wear shoes as well. You don't wanna be walking around the hem.

**Jan:** Yeah, I don't think either you or I are going to be, um, good advisors in this area.

**Paul:** No, after what you've said earlier to me today about my quote, garish outfits, no, I…

**Jan:** …that was, that was off the recording. You can't now tell people what we chat about when we are not, um, on the podcast.

**Paul:** Yeah, I refer to it as bright. You just came out straight with garish. [Jan laughs] Thank you very much.

**Jan:** Madiha, can you tell us more about weave structures and why they matter?

**Madiha:** So weave structures are the way, uh, the fabric, the fibre, the yarns are interlaced together. So, uh, fabric may look simple outside, uh, but at the yarn and structure level, it can behave in different ways. And weave structure plays a very vital role in that.

For example, uh, if, if we see a denim, uh, so most people have own jeans, and if you look closely at denim, um, you often see diagonal lines on the structure, uh, on the surface.

So the, that comes from the twill weave structure, which, uh, which is commonly used in the denims. So even in something very familiar, the fabric is not just defined, uh, by the fibre and colour, the way the yarns interlace, uh, it

also matters, and the weave structures that that affects the surface and the handle of the feel of the fabric and how the fabric behaves.

**Paul:** Does it affect how it wears as well? Because I think you mentioned denim there and there's certain types of denim that deliberately, sort of, fade and wear in certain places. Is that all to do with the weave structure in some cases too?

**Madiha:** Ah, no, that, that is related to the finishing of the denims. So the weave remains common in the denim. It's always the twill weave in the denim. It could be two by one twill, or it can be three by one twill. Uh, it's a different weave structures. So, but, uh, weave structure always remains same in the denims.

**Paul:** Okay.

**Madiha:** So to make the weaving understandable. So in weaving, we have warp yarns and weft crossing them. So if we change the yarn, we can change the behaviour of the fabric, how it behaves. And if we change the weave structure, we can, uh, we can also change the behaviour of the fabric.

So in my work, I used, uh, the same basic principle that, but in a more controlled way. Because some yarns give more stretch, some yarns give more shrinkage, some structure allows more movement.

So in different areas of the fabric are designed with different behaviours. And the whole fabric does not behave in one uniform way. Because in a garment you have some areas narrow, some areas broad.

But the critical point, uh, in it, in this is that it cannot be random shrinkage or it cannot be random stretch. We need to have a controlled shrinkage in the, uh, different areas, and we need controlled stretch in different areas.

So the fabric has to shrink or stretch in a way that still aligns with the garment pattern and garment dimension and the body measurements. So at the same times, we cannot compromise the important fabric characteristics like durability or the fabric cover, uh, the cover factor of the garment.

So the challenge is, uh, not just to create the shape, uh, but to create the shape while keeping the fabric suitable to wear and use, while using the existing looms or existing infrastructure.

And I have also, um, used the double-weave structures. So for, the double weave structure is different from the normal weaving because in normal weaving, we are having one single layer. In double weave structures, uh, it allows two layers of fabrics to weave together, and we can have them to be connected or separated in different ways through weave structures.

So when those behaviours, when we planned carefully the, the weave structures, the yarn characteristics, so we can bring, uh, the, the 2D dimensions to 3D dimension form of the garment.

And a simple way to explain this thing is that different parts of the fabric can give different functions.

**Paul:** So, this is all how it works in the garments industry. Are there applications for techniques such as this beyond textiles and fashion?

**Madiha:** Uh, yes, there are plenty. There are plenty, like most of us hear the word 'textiles' and think of mostly clothing or garments or fashion or home textiles. But textiles are also inside cars, aircraft and different medical products or protective equipments.

Uh, so a really interesting example is in aerospace, uh, like the aircraft engine. So some modern aircraft engine fan plates are made using this 3D woven, uh, 3D woven carbon composites. So, which incorporates the 3D weaving mechanism in it.

Uh, so we don't normally imagine woven materials inside an aircraft engine, but in that case, the textile is not, that's just a clothing fabric. It is a strong fibre, uh, structure that becomes a part of a lightweight composite, uh, material.

And the, and the reason the reason aerospace uses it is because of its lightweight and its, uh, um, other mechanical properties that it, uh, they are incorporating the 3D weaving into the, these in the, in the aerospace.

**Paul:** So can it be manmade fabrics or threads that are being used as well? It doesn't have to be natural?

**Madiha:** Yeah, it usually have graphene or carbon, uh, yarns to be carbon composites, and not the cotton. [laughs]

**Paul:** Mm-hmm. No. I don't know if I'd want an aircraft engine made out of cotton.

**Jan:** No. But isn't it fascinating to think that, that there's, yeah, yarn, there's knitting…

**Paul:** …yes…

**Jan:** …inside. I'm, I'm sorry. I'm just like, you know…

**Paul:** …you're off on a knitting expedition.

**Jan:** [laughs] I'm now thinking my knitting is not very sophisticated at all, 'cause it's not inside a, a, an aircraft engine. [laughs]

**Paul:** I wouldn't want to fly on any plane that you had knitted any part of. No offence.

**Jan:** [laughing] That seems fair. So to bring this all together, do you see sew-free as becoming the norm?

**Madiha:** I think sew-free, uh, manufacturing, uh, it'll, it'll become more important. Um, but I will not say that it will completely replace the traditional cut and sew because for the clothing industry, it's very diverse, it's, the purpose of clothing is very diverse.

And like, for example, from a basic t-shirt to a jacket, to a structured, uh, to sportswear or, so, all these clothings have different requirements. And so for sew-free woven garments, I, I see it as an important direction, not the only direction.

And for, for example, for knitwear seamless production, it is already more established. Uh, but for woven garment, it is more technically challenging because of its, um, because of its manufacturing limitations. And, uh, but that is exactly why it is an interesting area for future development.

And I think, sew-free woven garments could be useful where they offer clear benefits like waste reduction or cost efficiency, or the energy efficiency.

**Paul:** Can you see other changes coming to the garment industry, sustainability-related, from what you've seen in your work?

**Madiha:** Yes. Um, for I think the future, there will not be a single solution to it. Um, it'll be about combining the sustainability with practicality. And for some products that may mean better pattern efficiency. And for others it may mean seamless knitting. And for some woven products, it may mean, uh, exploring sew-free or reduced sew-free approaches.

And for many products, it will simply mean designing the process more intelligently from the beginning. So for this research area the next step would be to explore more garment types or more complex shapes. Uh, full scale industrial testing and stronger links with a garment measurement like 3D body scanning methods and fit requirements.

So, I would say this, that the textiles are not just material we cut and sew. Um, they can be engineered and if we engineer, if we engineer them intelligently, we can reduce the waste and the production costs.

**Paul:** Well, Madiha, thank you so much for joining us today. It's been a real delight in learning so much more about your work and textiles.

**Madiha:** Thank you for having me.

[Theme music]

**Paul:** I'm glad to have had yet another perspective there, Jan, on fashion fabrics, textile manufacture. From, again, a total different perspective to that we had when we talked about modern slavery in the UK, in the system, and then when we talked about cotton production in Uzbekistan.

**Jan:** It's, it's just amazing because, again, it's one of those things that, you know, just part of our everyday life and yet really when pressed, we don't really know how, how fabric comes into being…

**Paul:** …mm-hmm…

**Jan:** …or some of the techniques, and so, like, double weave structure and twill and all sorts of things that I thought, I don't know if I absolutely know what that is and yet it's part of my everyday life.

**Paul:** And to know that the sustainability issues around them go from when they're being grown in a field and picked all the way through the various stages of manufacture, then onto people wearing them, and then what happens to them after they've been worn, used, thrown away.

**Jan:** And so clever to have that engineering and design framework in there to really, you know, maximise the use of the materials. That 20, 25% of waste, um, that arises when you're cutting and sewing garments together. I mean, that's a non-trivial amount of waste. To be able to take that out of the process is phenomenal.

**Paul:** Yeah. And then for Madiha had explained as well, if you do want to reuse that, you've essentially got to go right back to the start. You've got to deconstruct, go back to the start, so you've just got the basic raw material and then assemble it again.

So you're doing the manufacturing process twice, but then you've got to consider, of course, 25% of *that* will be a waste product. So you'll go through the procedure again, and then 25% of that, and I'm, I'm sure there's gonna become a point where you can't deconstruct and reconstruct again.

**Jan:** Yes.

**Paul:** There's always gonna be waste unless you start adapting some of the processes that Madiha has talked about.

**Jan:** And I was thinking about your scones.

**Paul:** Yes, yes. [Jan laughs] You've mentioned scones and you said you'd come back to it and you didn't. So go on. What do you want to know about scones?

**Jan:** So when I make scones, 'cause I'm a little bit rough and ready, I get, like, a slab and I just cut them into six. So, square…

**Paul:** [indignantly] …that's not a scone…!

**Jan:** …it's a square sort. It's a sew …

**Paul:** …what the heck are you doing?

**Jan:** it's a sew-free square scone… [laughs]

**Paul:** …look, you don't come over here from New Zealand with your bizarre scone ways. No, you're, you 're meant to have them round, so you're meant to have cutters that cut them into round shapes…

**Jan:** …ah, I just think that's not very…

**Paul:** …you do not have square scones.

**Jan:** I don't think you're very pro-sustainability there. [laughs]

**Paul:** But as I pointed out, you can roll it all back together with a scone and it doesn't matter. But you can't do that with fabric.

Square scones! That's a crime against humanity.

**Jan:** Well, dear listeners, when you're out and about, have a look. Pick the square scones 'cause they are more, um…

**Paul:** …pick them…!?

**Jan:** …they're the same…

**Paul:** …you'll never see one! [Jan laughs] They could shop for a million years and never find somewhere that sells square scones…

**Jan:** …now, now, every time you go somewhere, you're gonna see square scones from now on. And I'm going to…

**Paul:** …square scones.

**Jan:** [laughing] Who, who are we talking to next, Paul? I feel like I need to move you along, 'cause this, this topic has clearly disturbed you significantly.

**Paul:** Hopefully someone who doesn't eat square scones. I'm sure they eat square sausages 'cause they're up in Scotland and…

**Jan:** …ah, well there we are…

**Paul:** …I don't mind the square sausage. I'll live with that. But square scones.

Honestly, Jan, this is gonna bother me for the rest of the day. [Jan laughs] It's gonna bother me until we welcome Laura Giles next week to talk to us about the conclusion of the project with the Lake District Farmers on sustainability, net zero and all of that, within farming.

**Jan:** Good!

**Paul:** Good. I bet farmers don't have square scones. Right. Until then, on a very disturbing note, it's goodbye from me, Paul Turner.

**Jan:** And goodbye from me, Jan Bebbington, the square scone manufacturer. [laughs]

[Theme music]