KINETIC GARMENT CONSTRUCTION

REMARKS ON THE FOUNDATIONS OF PATTERN CUTTING

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“Essentially, all models are wrong, but some are useful.”
George E.P. Box (Box 1987:424)
ABSTRACT
Fashion designers are presented with a range of different methods for pattern cutting, and the interest in this field has grown rapidly over the past few years. This growth is both due to the publication of a number of works dealing with the subject in different ways and the fact that a growing number of designers emphasise cutting in their creative practices.

Though a range of methods and concepts for pattern cutting are presented, the main body of these methods, both traditional and contemporary, is predominately based on a theoretical approximation of the body that is derived from horizontal and vertical measurements of the body in an upright position: the tailoring matrix. As a consequence, there is a lack of interactive and dynamic qualities in methods connected to this paradigm of garment construction, from both expressional and functional perspectives.

This work proposes and explores an alternative paradigm for pattern cutting that includes a new theoretical approximation of the body as well as a more kinetic method for garment construction that, unlike the prevalent theory and its related methods, takes as its point of origin the interaction between the anisotropic fabric and the biomechanical structure of the body. As such, the research conducted here is basic research, aiming to identify fundamental principles for garment construction.

Based on some key principles found in the works of Geneviève Sevin-Doering and in pre-tailoring methods for constructing garments, the proposed theory for – and method of – garment construction was developed through concrete experiments by cutting and draping fabrics on live models.

Instead of a static matrix of a non-moving body, the result is a kinetic construction theory of the body that is comprised of balance directions and key biomechanical points, along with an alternative draping method for dressmaking. This methodology challenges the fundamental relationship between dress, garment construction, and the body, working from the body outward, as opposed to the methods that are based on the prevalent paradigm of the tailoring matrix, which work from the outside toward the body. This alternative theory for understanding the body and the proposed method of working allows for diverse expressions and enhanced functional possibilities in dress.
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1. MOTIVE PART I, STUDIO PRACTICES
This research endeavour began with practical work in various design studios so as to deepen my understanding of the concepts that had formatively shaped me as a designer. I worked with tailors in the bespoke tailoring company A. W. Bauer & Co. in Stockholm and as a pattern cutter for Vivienne Westwood in London, and I also spent time in the atelier of the French costume designer Geneviève Sevin-Doering in Marseille.

This on-location work framed the area of research, helped to define motives for it, and to outline how this research should contribute to knowledge. As such, this part of the research was carried out as a form of participatory action research (Reason and Bradbury 2008) with the aim of understanding methods and principles of garment construction by taking active part in the different working methods across various studios. These cases typically involve an interpretative approach to the activity of pattern cutting and are attempts to make sense of, or interpret, acts and artefacts in terms of attitudes, design models, methods, and theoretical frameworks. As such, the motive section is not focused on developing new propositional knowledge but, rather, on outlining how this research should contribute to the body of knowledge within the field of garment construction.

Throughout this thesis, the use of the word pattern, unless otherwise stated, refers to cutting patterns for garment construction.
1. MOTIVE PART I, STUDIO PRACTICES

Overleaf:
Fig. 1 [p. 16] Basting by hand
Fig. 2 [p. 17] Chalkmarking seams
Fig. 3 [p. 18] Tailor cutting trimmings
Fig. 4 [p. 19] Jacket ready for the second fitting
1.1 Cutting at Bauer Tailors.

Setup:
Working as a tailor alongside the cutter and tailors at A. W. Bauer & Co.

Location: Bauer Skräddare, Brunnsgatan 4, Stockholm
Duration: 2 months, March–April 2010

A. W. Bauer & Co. is located on Brunnsgatan in Stockholm and produces first-class men’s bespoke tailoring in-house. The process of cutting and tailoring has changed little in the past century. Clients are measured by hand, patterns are drafted with tailor’s chalk on brown paper by utilising a strict cutting method, and – to a large extent – the tailoring is done by hand. Every jacket is fitted three times on the client, and approximately one week of labour time goes into every jacket.

The procedure of constructing the body pattern for a jacket at Bauer Tailors is outlined on the following pages. Vertical and horizontal measurements are taken while the customer stands in an upright position. From these measurements, a diagram of guidelines is chalked on pattern paper, and the pattern pieces are drafted within this matrix. The pattern pieces constructed within this tailoring matrix are then further adjusted for certain body types (e.g., particular postures, uneven shoulders, etc.) as needed.
Fig. 5
The client’s measurements are noted in inches, as the cutting system is in imperial units. The measurements noted are as follows: chest width, waist width, seat width, scye depth back, distance neck – waist, jacket length, half back width, scye depth front, balance front (centre back neck to waist at front), and sleeve length (inner seam).

Then in text: 2 buttons, side vents, chest pocket, slanting pocket.

These are followed by the measurements for the trousers: waist width, seat width, outer leg seam, and inner leg seam, together with notes indicating 3 pleats, button fly, internal buttons (used for suspenders).
Thick cardboard block patterns of different sizes are used, and the customer’s chest measurements determine which size will serve as the foundation for the pattern. These templates differ slightly from industrial ones in that they have no seam allowance at the centre front and centre back, nor do they have any added hems or vents. Starting at the centre back of the jacket, the first step is to chalk mark the outlines of the back-part template.

The scye depth (armhole depth), the position of the waist, and the length of the jacket are measured from the centre back neckline and are chalk marked according to the measurements. Lines are drawn 90° to the grain line at the scye depth, the waist, and at the jacket length mark. The back width is measured and, if needed, adjusted according to the client’s measurements. The original template is used to draw a new line if the back width has been adjusted. The back piece is now complete and will be cut out.
In the same manner as that used for the back piece, the front template is now copied to the pattern paper, which serves as the foundation for the individualised pattern.

Depending on the client’s shoulder shape and whether or not shoulder pads need to be used, the inner shoulder seam point may now be adjusted, either upward or downward. The back piece is then placed on top of the front piece, connecting the two inner shoulder seam points, and the scye depth, waist, and jacket length are transferred and marked out at the front piece.
Fig. 10
The bottom edge of the jacket should be slanting slightly downward, and this slant is now marked. The front scye depth is measured from the inner shoulder point, beginning at 3½ inches (the distance from the inner shoulder point to the centre back), and the scye depth is adjusted according to this measurement.

Fig. 11
The cut of the pocket position is marked at half the distance between the scye depth and the bottom, and one inch downward. A classic straight pocket should be parallel to the bottom hemline.
The chest-dart is chalk marked along the grain line, pointing towards the inner shoulder point and ending just below the scye depth line. The dart is shaped according to the body type for which the jacket is cut. A high chest and narrow waist yields a larger dart, and a more corpulent figure yields a smaller dart.

The seam between the front and side panels is marked and starts at the bottom of the scye, slanting slightly forward down to the waist and following the grain downward. The seam is shaped somewhat between the scye and the waist.

The back piece is placed next to the front pattern, and the chest width is measured from centre back to centre front; seams should be counted and indicated. The distance should be equivalent to the body measurements plus an additional 7”. For example, 44” + 7” = 51”. This distance is for the whole jacket, so the number is divided in half, thus 25½”. The centre front line is marked at this distance.

The waist is measured similarly except that in its case, only an additional 4” are needed. For example, 38” + 4” = 42”. This distance is for the whole jacket, so this number is also divided in half, thus 21”. If needed, the pattern is adjusted, typically at the side seams.
Fig. 14
The front line is shaped and joined with the bottom line.

Fig. 15
The break line for the lapel is marked, starting 1⅛" inside the inner shoulder point. From this point, the desired position of the first button is measured, starting at 3½" above the inner shoulder point (the distance from the inner shoulder point to the centre back), and the break line is marked between these points. For a client with a high chest, a dart could be inserted crossing the break line, as shown in the picture. The lapel is now shaped as desired.
1. MOTIVE PART I, STUDIO PRACTICES

Fig. 16
The side seam of the front piece is adjusted below the pocket to create a straight line when the dart is closed.

Fig. 17
Final pattern pieces for the front and side, with horizontal and vertical guidelines marked in red.

Fig. 18 [right]
Suit made at Bauer Tailors, with tailoring matrix guidelines marked in red.
1.2 Reflection – Straight lines and perfect fit

The aim of the construction method presented here is to draft a pattern for a jacket that is perfectly fitted and tailored for a specific client. Ideally, a jacket drafted based on a system such as this should fit the client perfectly at the first fitting, but typically, adjustments to the patterns are made during the production and fittings of the jacket.

The horizontal and vertical measurements constituting the foundation for this pattern drafting process are taken from the client in an upright, static position, in the same manner as advocated in the majority of the construction systems described in pattern cutting literature (cf. Aldrich 1980/2004; Doyle 2005; MacDonald 2010; Öberg et al. 1985/1999). It could be argued that the tailored suit jacket is generally a garment type that supports such an upright position and that, with its shaped chest and constructed sleeve settings, it prevents certain movements while supporting others (cf. Hollander 1994:106).

For such an iconic and widespread garment type as the suit jacket – with a historical development stretching across several centuries, both with respect to the form of the garment and the technicalities of various constructions (cf. Hollander 1994:106) – it is difficult to say whether the construction method generates the form and function or whether a desired expression and function have raised demand for a certain type of method. However, it is clear that the correlation between working method and the artefact created is strong in the construction of a tailored suit jacket.
1.3 Cutting at Vivienne Westwood

Setup:
Joining the pattern cutting team to develop the Autumn/Winter 2011–12
Vivienne Westwood Gold Label collection.

Location: Westwood Studios, 9–11 Elcho Street, London

Duration: 4 months, November 2010–March 2011

The pattern cutting and sampling studio of British fashion icon Vivienne Westwood
is located in a rebuilt former film studio in Battersea, London. I had the opportunity
to join the team of pattern cutters in realising and developing the creative ideas of
Vivienne and her husband, Andreas Kronthaler, for the Autumn/Winter 2011–12
Gold Label collection. Apart from me, the team consisted of two in-house pattern
cutters, one freelance pattern cutter, and a senior pattern cutter, Iris, who lived in
Germany but joined the team for a number of weeks each season.

What follows is a selection from my diary notes, written at the close of each workday.
Monday, November 8th, 2010

I spend my first day in the Westwood studio alternating between looking through look books of the last ten collections and making some experiments with rectangular pieces of fabric on a half-scale dress-stand. The other pattern cutters and I are awaiting instructions from Vivienne and Andreas of where to begin work on the new collection; in the meantime, we play around with rectangular shapes, as Vivienne has long favoured this cutting principle. Most of my attempts go straight into the trash bin upon a second look; one or two of them may have some potential, but I see the whole day as a warm-up session.

After lunch, Iris shows up with photos of some haute couture gowns from the fifties. Iris used to work full-time for Vivienne, designing and cutting patterns, but nowadays, she only comes in for two or three weeks per collection as a senior cutter, and she is the cutter who develops most of the new styles. I was later told “they parachute her in from Germany every now and then to give a boost of creativity to the team.” The first step towards finding direction for the new collection turns out to be in recreating the dresses in the photos in toile fabric, as close to the original as possible.

Iris begins working with a photo of a fifties Balenciaga evening dress. After studying the photograph for a while, she starts drawing lines on large pieces of calico and pins the pieces together as a first tryout. She alternates between draping on a tailor’s dummy, drawing lines on the fabric at the cutting table, and looking at the dress while wearing it, herself, in front of the mirror in the corner of the room. It is a physical act where she works just as much with her own body as on the artificial body of the dress-stand: taking a step back to inspect the garment from a different angle, adjusting the volume, back in front of the mirror, another adjustment, and so on. Pattern paper is not used at this stage; everything is made straight on and out of the toile fabric. Later on, the dress will be taken apart, and the shapes of the different pieces will be transferred onto paper templates for further work on the details of the dress. By the end of the day, she has a rough toile ready, and Andreas comes by to have a look, making some further adjustments.

Another photo of Marlene Dietrich wearing a fifties dress goes to Jenny for her to recreate the dress, with emphasis on the corset construction. The dress has a soft draping over the chest in a lightweight fabric, but Jenny is asked to use jersey fabric instead. She begins by working from a corset base that was used in an earlier collection; she drapes the jersey on top of the corset, which is fixed to a dress-stand. I am a bit surprised by the classical look of the images that will to be the starting point of this collection. At first glance, the haute couture style of the fifties is far from the style of the previous collections that I have been studying today. I soon find out that what interested Vivienne and Iris in these dresses was not so much the style of the fifties as...
much as the dresses’ formal values. For example, the volume created a certain sleeve or line that was very straight in a place where one would typically have expected it to be slightly curved. The design concept turns out to be the creation in itself. The shapes of the prototype garments in relation to the body of the fitting model develop into new shapes and looks, and the different methods of cutting and draping that are applied at various stages in the process allow for different sorts of expressions.

I am told that I will work on a jacket from last season – a short boxy one made of rectangular pieces – and that I am to make a new version of it, though, this time, in the style of a school blazer. The sample of the jacket is in the Conduit street showroom and will be sent to the studio later in the day. It arrives at 6:10 p.m., but Sandra, who knows where the pattern is, has already left for the day, so I decide to have a go at it tomorrow morning.

Tuesday, November 9th, 2010
At the fitting in the evening, we try on the new toile that I made during the day from the boxy jacket. Andreas says that it looks more like a pea coat than a blazer.

– Let’s make it a pea coat instead.

It is decided that I will make a new prototype that is even longer and with the kind of diagonal welt pockets that a traditional pea coat would have; the school blazer idea is dismissed just as quickly as it was introduced. As the prototype reminded us of a pea coat when we looked at it, the course was immediately changed towards what we were now seeing.

Wednesday, November 10th, 2010
For today’s fitting, I help Iris, who, for the moment, has taken the position as fitting model so as to get into the new toile of the pea coat and button it correctly. She puts her hands into the welt pockets and turns around so that we can see the coat from all angles. After a few moments of silence, Vivienne is the first to open her mouth:

– I could say something, but I am waiting for someone else to start.

I understand that this someone is probably me. Just as this strikes me, Vivienne looks at me:

– What do you think about it, Rickard? You must have an opinion on this.

I respond that I think the welts are in a good position and make for a nice silhouette when the pocketed hands pull the fabric of the jacket forward. Before I manage to finish my sentence, Vivienne stops me:

– Those welts are way too small compared to everything else on this coat. We definitely need bigger welts. Can we pin on a larger one to see what size we need?
I go for a piece of fabric and press it into the shape of a larger welt, which is pinned onto the coat. We have another look at it with Iris walking back and forth in the room; we adjust the size once again, and finally, everyone agrees that we have found the ideal position and size for the welt pocket on this jacket. Then, we proceed to the belt at the back of the jacket, and I am again asked for my opinion. As I am not entirely accustomed to the rituals, I feel unsure of what to say about it, but I understand that I am asked to state the reasons behind my work, so I explain that right now, the belt has the same length as the back piece but that I was considering making it even longer because the back part of the jacket drapes as result of the jacket’s square construction; perhaps a longer belt would exaggerate that drape. I detach the belt at one end and pin it back on the coat to somehow visualise my thoughts. Vivienne’s opinion about this is clear:

– To make that belt longer would be very selfish and unconscious, I would say.

Vivienne instead pins the belt shorter, and we have another look at it. Now she seems more content, but she immediately shifts focus to the buttons that attach the belt:

– Is that the best way to do it? Should the belt go into the side seam instead?

To determine this, I am asked to unbutton the belt and pin it in such a way as to make it look like it goes into the seam. When inspecting the result, however, everyone immediately agrees that the button fastening was the better approach.

– You see, Rickard, the reason I talk like this is that we have to see all the possible solutions. It’s a matter of elimination. We have to try out all possibilities.

The discussion involves both verbal communication and physical communication – i.e., moving things around – and both aspects seem equally important. The discussion deals with the garments at a formal level. It is about lengths, proportions, silhouettes, and how the body moves in the garments. Representational aspects seem to be of less importance at this stage. The decisions’ logic is evident in what we visually see in front of us and how the garments interact with the body inside them. This is also clear from Iris’s comments, made while looking at some of the other garments fitted:

– I like the idea of the circle in the front.

– What I am interested in with this top is that it is straight across the bust. I find that very interesting.

It is the straightness of that specific line that makes the Marlene Dietrich top interesting to Iris, and that line will turn out to be the focus of further development.

Friday, November 26th, 2010
The fitting scheduled for yesterday was suddenly postponed until 3 p.m. today instead. The atmosphere in the cutting rooms gradually becomes tenser, and both
Jenny and Barbara seem to withdraw – the way lecturers might when preparing to give a speech. Lucca drops by my table and tells me that Vivienne wants to make a coat out of the Balenciaga dress that Iris made the first version of and for which I have been making a pattern. Though Vivienne is very keen on this idea, Andreas does not think that it will work out. Lucca tells me that the fitting scheduled for the afternoon will revolve around this coat and that maybe I should have a second look at it to see if I can come up with any new ideas.

While I have lunch at the cutting table, Vivienne and Lucca turn up, and I am asked if I can show Vivienne the toile of the Balenciaga dress. Vivienne tells me that Andreas does not think that this dress will work out as a coat since it is held together with a strap across the back; he thinks that it would not look right in a heavy coat fabric. Vivienne is relieved when I show her that the strap is not gathering that much, and she brings the dress upstairs to try it on herself.

Jenny takes the measurements of Maria, our fitting model, while I spread out the pattern pieces of the Balenciaga dress on my cutting table before the fitting starts so as to refresh my memory of what the pattern had been like. Andreas is nowhere to be seen; only Vivienne turns up, and she takes a look at the measurements that Jenny has taken down:

– So, she is neither long-waisted, nor short-waisted; she corresponds just perfectly to the measurements of a size 10, then.

We try on the three different versions of the dress. The one that Iris originally made, the one with more volume in the sleeves and with a higher collar, and the jacket version with long sleeves that I made after Iris left.

– I still don’t know whether I like it or not. We have to put on the dress from before, one more time, because I do not remember what it was like.

It turns out that the fitting of this style is primarily concerned with whether or not the wearer will be able to move her arm enough in the wide, but very low-cut, sleeves. The sleeves already open at the waist and are gathered with a piece of elastic tape just above the elbow. The elasticity is needed for the wearer to be able to move in these low-cut sleeves. Vivienne asks Maria whether or not she finds the sleeve acceptable. Maria knows even less than I do about how to answer Vivienne. She says that she would personally like to be able to raise her arms enough to adjust her hair, adding that she also thinks that many women wouldn’t mind this if they really loved the dress.

– That is the wrong answer; you cannot speak for anyone but yourself, Vivienne responds.

Vivienne likes both the dresses, but she is not sure about the long sleeve dress that I made and asks me to make a coat version with a knitted underarm part of the sleeve that we will have a look at during the next fitting.
The next garment is a box-shaped trench coat in heavy calico, which I made from a dress pattern that was used the previous season.

– What I have done with this garment is to add a lining at the yoke and sleeves and then put in buttons and buttonholes to transform it from a dress into a trench coat.

Vivienne approves the trench coat rather quickly; the fitting model walks back and forth in the room and puts her hands in the pockets, and Vivienne nods.

– It looks good from the front; it looks nice from the back. Can you please turn your side against us, Maria? Yes, it looks good from the side as well.

Her attention then turns to a wrinkle extending from the shoulder downward. Though the dress version had the same wrinkle, Iris did not mind it and, thus, neither did Vivienne. Now, the question is whether it works on the trench coat or not. I cut the shoulder seam open from the neck, across the shoulder gusset and halfway to the sleeve, and the wrinkle disappears. At first, this seems to solve the problem, except that it appears that by cutting this seam open, the tension that held the box-shaped shoulder in place was released, causing the shoulder to collapse backward and the box shape to become less distinct. In the end, we decide that the trench coat is good as it is and that we should proceed and make a sample in woollen fabric. I hand the toile over to one of the machinists to close the cut I made in the coat, in case we need to see it again later.

Vivienne asks to see the pea coat again and, inexperienced as I am, I point out that at the last fitting, we thought that the positions of the pockets were fine as they were.

– I don’t care what we said at the last fitting. What do we think of it today?

What is approved one day may be reconsidered the next because the collection as a whole is developing in many directions, and the proportions or the position of a pocket do not relate only to the jacket and the body wearing it, but also to the choice of fabric and colours as well as to all of the other garments in the collection.

The rectangular-cut skirt that Iris made, for which I later made the paper pattern, is tried on in a new toile version with hems and proper finishing. It is approved, and the only change to be made is that the pockets should be added in the side seams. I cut an opening in the side seams just below the gathering at the waist; Maria puts her hands in the openings and walks back and forth in the room.

– Right, now we know that we shall have pockets. Is the pocket opening the right size as it is now?

– Yes, Vivienne. I think the pockets are the right size.

– I think so, too. Should we simply make it a stitched-in, loose pocket bag, then?

– Yes, I think so – a loose pocket bag attached to the waist seam. With all this fabric gathered in the waist, I think that is the only reasonable way to do it.
Monday, November 29th, 2010

I go back to the square skirt and add pockets, stitch in buttons so that one is also able to wear it as a dress, and add reinforcement triangles so as to strengthen the weak points at the ends of both side vents. Since the dress is now fully approved by Vivienne, I have a closer look at the inside finishing, and I struggle a bit with how to finish the seam allowance on the inside of the heavily gathered waistband. Jenny and I discuss it back and forth for a bit. It would probably obstruct the gathering to just bind the seam allowance as it is. One solution could be to add extra fabric to the waistband, then fold it over the seam allowance and stitch it in place.

– You can ask Sandra; she is very good at knowing what would work or not work in production, says Jenny.

Finally, we agree that the best thing to do, probably, is to add extra fabric to both the body of the skirt and to the waistband, five centimetres each, and then bind them together. Just as we agree, Sandra turns up and confirms that, from her perspective, it is a good idea. She points out that it may also be able to support the volume created by the gathering. I spend the following hour changing the pattern of the waistband. It is a process of: check, fold, look, draw a line, punch a hole, check again, ask, try, redo, and check yet again.

Friday, December 3rd, 2010

I spend the hours before lunch altering the coat pattern, and after lunch, I cut it – this time in heavy calico. When I am halfway through, Lucca drops by and tells me Vivienne wants to come and have a look at the coat in about an hour and a half. I am quite pleased to hear that because I need some kind of direction if I am to take it further.

Upon Vivienne’s arrival, it is immediately obvious that what I have done was not what she was hoping for.

– This sleeve does not look like the one on the dress. Can we see the dress first? What I like about the dress is the sleeves and the volume that they create. I don’t want you to just randomly insert gussets; you have to look closely at the dress and try to make the same thing for the coat. I would put the coat and the dress next to each other and see if I could figure out what to do. I am not a pattern cutter, and I keep saying that; I will try to help you, but sometimes, what I see as the solution is not the best way forward because my point of view is a different one. For example, the first time I made a jacket, I made the lining smaller because that seemed to make sense to me, Vivienne says.
I pin the original dress to the left side of the stand and the coat version to the right side and keep looking at them in order to try to figure out exactly what it is that causes the difference between them. Maybe if I insert the gusset further down the sleeve as opposed to where the sleeve meets the body – i.e., where I have it now – or maybe if I just cut away some fabric under the sleeve. I take a couple of pictures to remember what it looks like, do some quick sketches, and then leave the studio for the weekend.

**Monday, December 6th, 2010**
I put the dress up on one stand and the coat up on another, and I look at them. I pull the dummy sleeves outward and let them fall back to their natural positions, then look again. I take the gusset out from the right-hand sleeve of the coat and also decide to remove five centimetres of the sleeve’s width. Then, I stitch together the opening where the gusset was. Putting the coat back on the stand, I cut an opening for the gusset further down the sleeve, opposite of where Vivienne had suggested. Here, a cut is hidden under the folds of the fabric and will allow the same amount of movement as in my earlier tryout.

Vivienne drops by with a half-scale stand for Barbara, on which she has made a new version of the dress that Barbara has been working on. I manage to get her attention for a few minutes.

– Rickard, I really don’t have much time at the moment.

She soon points out that I have cut the gusset opposite of where she had suggested.

– Yes, Vivienne, but I don’t think putting in a gusset were you suggested will do the job here. By putting the gusset here, it will be hidden between the wrinkles of the fabric.

– I see, maybe this is the right place after all, but the gusset looks ugly, and these points here are not right.

– I know – this is just the first version, and I am now making a new version that fixes these problems.

– Is the outer seam shaped here? I want this line to be straight, and I do not like this gathering down here; it is not nice.

**Tuesday, December 7th, 2010**
Andreas is silent for a long time during the fitting before he says:

– This skirt is so normal. I bet if we go downstairs to the archive, we probably already have it there somewhere.
Thursday, January 27th, 2011

Iris is working on a new skirt, and I ask her what the design brief said:
- To make something that was based on rectangles, with a lot of volume at the bottom – and tight at the waist.

Friday, January 28th, 2011

- I quite like it when it comes to the bottom like that, higher.
- Yes, and also what the hem does to it; now it becomes even more extreme.
- Can you please walk for us, Jenny?
- I think the volume in the hem is quite alright. It still does, move.
  Iris looks at the skirt in silence.
- Can you walk again, Jenny?
- That’s what we had before.
  Iris pins the hem up another five centimetres and again asks Jenny to walk back and forth in the room.
- Not that bad, in a way, when it is standing out more in the hem like that. That is what the long dress does as well, not collapsing so much. But still bumping around…
  Jenny again walks back and forth in the cutting room.
- It certainly is much better now than it was before.
- It is nice that it gives room for the knees to move and that it is not bumping around that much anymore.
- And it is not creating all that volume in the hem anymore, which I quite like.
- It could be maybe a bit shorter here.
  Iris cuts off a couple of centimetres at the front of the skirt. She stands back to have a look and again asks Jenny to walk up and down the cutting room floor.
- That’s nice, actually.
- That’s very nice.
- Can you please walk again?
- I think it’s a bit better now. Let’s take it off for now.

The atmosphere in the studio is different from what it was in November. In November we were trying things out, now we are doing it for real. This time it is serious. We are running late, and as much of the pattern as possible must be sent to Italy immediately or else everything has to be sewn in-studio, and no one wants that. We are also working longer hours, and I notice that my diary entries are becoming briefer and less dense in character.
Tuesday, February 1st, 2011
– Why should we move that point lower? Because that’s where the elbow is! And that makes a good silhouette. It’s not because of anything with the pattern! I don’t like funny patterns. I only want to make clothes for people to feel sexy in. Normal clothes are so much harder to make. It is not about the pattern, it is all about the body and what the garment does with the body. We have to get this coat and dress done. It’s just a circle but some girls like it. Do you know why? Because their legs looks beautiful in it.

Thursday, February 3rd, 2011
– Making a lining like this is very hard; there is a lot to consider.
– Then you have to make it, Andreas – you are so good with such things.
– No, that will take me two hours; someone else has to do it.
I somehow know that that someone is me...

After a bit of pinning, checking, trying, and sewing, I have a lining that I consider both functional and appealing. I show it to Johannes, who is working at the table next to me.
– Sharp, he says.

Friday, February 4th, 2011
Parallel to her work on the Gold Label, Brigitte, the head of couture, works on the Red Carpet collection – a capsule collection of cocktail dresses intended to be more accessible than the cutting edge Gold Label. As with the other diffusion lines, the Red Carpet collection is built on old Gold Label styles, and Brigitte has just brought two massive, heavy taffeta dresses out from the archive – one lilac and one yellow – in order to see if they can be used as a foundation for developing new styles. The dresses were originally made for the 1997 Viva la Bagatelle collection and are both made out of a single piece of fabric, long enough to be draped several times around the body and attached to a corset that holds the dress together. They are hand-stitched and appear to have been draped in the actual fabric, directly onto the corset; hence, there are no patterns for them in the archives.

When Andreas sees the dresses hanging on the rail in Brigitte’s room, they suddenly go into the Gold Label process as opposed to that of the Red Carpet collection, and I am asked to recreate the lilac one in toile fabric by re-draping it exactly as it is, only this time, a pattern is supposed to be made for it so that it is reproducible. I begin at 3:30 p.m., and though I have my doubts at first as to whether or not this is even doable, it turns out to not be all that complex after all, as it is only a matter of following a
path that someone else has already laid down. At 8 p.m., I consider myself to have a
decent version of the dress draped on the stand.

Andreas comes by and takes a look at the new version of the Viva la Bagatelle
dress.

– So, you are trying that one now.
– Yes, what was the idea?
– There is no idea; there is never an idea. As you know.
There is no clear idea here, or, rather, the idea is an investigation – an investiga-
tion of shape, techniques, and expressions: this shape has potential – let’s use it. What
if we take another material? What if we were to add five metres of fabric? Etc.
– Lucca, do you know what the theme of the collection is yet?
– It’s a bit of everything. A mix of different periods – there are some ethnic prints,
and some... are a bit like a patchwork. I mean the theme is not patchwork, so don’t go
on to make patchwork scarves...

**Thursday, February 10th, 2011**

Since I am running out of work, Brigitte hands a sketch to me from Andreas of two
possible new versions of the cartwheel dress that Jenny has been making. He is ask-
ing for a version with a slimmer skirt than the original. I put together two different
dresses – one with a skirt based on the full fabric width and a circle placed in the
centre front, and one with twice the width and circular shapes in the sides.

**Monday, February 14th, 2011**

A misinterpretation of the sketch, re-cut.

Should be narrower at the bottom, but at least we have three dresses now.
I rip off another metre of calico and steam it.
And yet another one.
Fourth prototype now.
Tired.
Cuts out the pieces and then back to the machine again.
As it is now, this dress will never make it across the English Channel.

**Friday, February 18th, 2011**

Mika, a freelance pattern cutter, asks me if I also find it difficult to work with such vague
instructions. At the Westwood studio, no one tells you clearly what to do. Sketches exist,
but they are rare, and most of the time, they are made after the garment is finished – not
before. The patternmakers are shape designers and are supposed to develop things
further than instructed, independently coming up with new possible avenues; what is tricky here, of course, is to know which avenue is the one running parallel to Vivienne’s often unarticulated direction. Mika compares the environment with other studios that she’s worked in, where the cutters were given more detailed sketches and where the studio manager had a clearer role in managing the work. Johannes then points out that, typically, a precise understanding of what Vivienne wants gradually emerges while working with her, and he says that depending on who the patternmakers are, the styles that they develop have quite varied expressions.

Saturday, February 19th, 2011
Lucca asks me to re-drape the huge yellow taffeta dress that Barbara started to work on earlier. Barbara is overloaded with work, and Andreas liked what I did with the lilac taffeta dress.

Thursday, February 24th, 2011
One week left before the show. Right now, everything is a blur.
- Rickard, we have a new style in the collection. Do you remember the skirt that Iris made? The square one that was gathered at the waist. We are going to make a miniskirt out of it now. In fake leather.

Friday, February 25th, 2011
I make a miniskirt from the long square skirt. Lucca and I rip the length of the original toile. First, thirty-five centimetres, then another five, then two more, and then one last centimetre before we are both satisfied. Lucca goes upstairs with it to show Vivienne.

Trying to drape the gold dress but am constantly interrupted by questions because several of the styles I have been working on are now being made in the studio.

Lilac dress in tulle. The train becomes three metres longer.

Saturday, February 26th, 2011
- Do you understand this dress?
  - I think so.
  - I think so, too.

Sunday, February 27th, 2011
- Don’t cut anything for nothing.
  - What do you mean?
  - I don’t know.
Monday, February 28th, 2011
Exhausted. Struggling with completing the wrap dress.

I cut a train for the tulle Balenciaga coat; the pieces are so big that I have to work on the floor in the marketing office. That’s not a problem, though, as everyone working there already left for the day, and many hours ago.

Tuesday, March 1st, 2011
Two more days of working before we have to leave for Paris, and things are still being cut everywhere. I make the interlining for the wrap dress, cutting it directly in the skin-coloured paper taffeta.

Wednesday, March 2nd, 2011
Three different dresses that I have been working on are being stitched simultaneously by three different machinists in three different rooms. I alternate between the rooms to give the machinists instructions of how to put everything together. Eventually, I find myself behind a sewing machine, stitching the skirt part of Barbara’s last dress while the corset part is being assembled at the machine behind me.

Thursday, March 3rd, 2011
Over the past couple of days, people from the studio have left for the showroom in Paris at various times, each of them bringing a couple of the finished dresses. I am the last one to leave the studio, and a taxi takes me to King’s Cross station and the Eurostar train, with the wedding dress in a bag under one arm and three other dresses in another bag under the other.

Friday, March 4th, 2011 – Paris
Sitting on the floor backstage, I am levelling the different layers of tulle on the skirt part of the wedding dress. I cut, crawl two metres backward, put my head at floor level to check where to make the next cut, and then crawl back to the dress again. Barbara assists me by pointing out new places to make cuts and by holding the pieces straight so that I won’t accidentally make any messy cuts.

–When you are finished with the wedding dress, we need you to trim down the train on the black tulle dress as well, Brigitte tells me.

I end up cutting for the collection until the very last hour before the show.
1.4 Reflection –
Perfect points and interesting lines

The discussions during the fittings in the Vivienne Westwood studio were both verbal and physical – i.e., they included moving things around. Both ways of communication appeared equally important. They dealt with the artefacts at a formal level, asking questions regarding the garment’s physical qualities (in relation to the body that is being dressed), such as lengths, proportions, silhouettes, and how the body moved in or together with the garment.

At this point, representational and associative aspects played a less important part, though sometimes, decisions took an unexpected turn because a fitted prototype referred to something different than had been intended. For example, the school blazer became a pea coat, causing details that refer to a pea coat to be added. The formal aspects of the bodily expressions were the ones usually stretching out towards new domains, whereas the representational ones were a model to which to relate the work – i.e., they were aspects that helped one to form guidelines, either for following or revolting against.

This does not mean that the collections did not include narrative elements – rather the opposite, as stories of different kinds often fuelled and directed Vivienne’s interest – but when it came to creating and evaluating the actual prototypes, the expression of the body, itself, was in primary focus. Many of the designs were experimental to such an extent that any other approach would not have made sense, as it would have been difficult to find anything for them to refer to apart from the fabric, the body, and the shape that they created. As Vivienne explained, the approach was:

– We have to see all the possible solutions. It’s a process of elimination. We have to try out all possibilities.

The logic of the decisions was taken from what we visually saw in front of us and how the garments interacted with the body wearing them. This is clear in the comments that Iris made when she was looking at some of the garments fitted.

– I like the idea of the circle in the front.
– What I am interested in with this top is that it is straight across the bust. I find that very interesting.

Here, it was the straightness of that specific line that made that top interesting to Iris, and that line would then become the focus for further developments and experiments. What evoked that interest was precisely how the line affected the expression of the body, and this interest then led to a more technical investigation into how to construct such a straight line running across the bust, and it also led to trying out dif-
ferent shapes in combination with different materials, eventually returning to the line on the body and the new expressions that this investigation possibly resulted in.

At first, Vivienne's comment about me being “selfish and unconscious” when I suggested a longer belt puzzled me (Nov. 10th). What caused her to consider the suggestion of making a longer belt draping across the back a lazy act, and what makes an act of design a selfish one? I gradually understood that the decisions made during these fittings were somehow made from a logic based on a certain in-house aesthetics. This aesthetic logic related to the function of the dress, the balance of the composition, and Vivienne’s never-ending desire to challenge conventions.

A similar logic is described by Yamamoto (2010:112) as “finding the point of rapture” – the perfect point for a single button, or the perfect length and position of a belt. At every fitting of a garment in the Westwood studio, the garments were rigorously examined on the fitting model and every detail was questioned, with buttons moved back and forth and length decreased centimetre by centimetre – all so as to find the perfect point or length. In the words of Yamamoto, it was “an act of concentrated seeing; of focused looking that was the fuel for the creative work” (Yamamoto 2010:61).

Hence, a belt would not be added if there was no need for a belt. That need may have been a merely functional one, but it rarely was. The functions of expressiveness and utility were not distinguished, even though the utilisation aspects differed depending on what type of garments we worked with. For the pea coat, for example, the belt was added first as a reference detail even though once it was in place, according to this logic, there was no reason for it if it did not function as a belt, i.e., by pulling the garment together. The only reason, then, for increasing a belt’s length would be simply because I could, which would constitute a selfish or unconscious act.

As I understood this, it was easier for me to see design work as less of a personal matter and more about understanding and adopting this logic of creation. The work focused on visual lines and shapes as well as how these transformed the expression of the body. The fabric and the human form constituted the guide to discovering new expressions (Yamamoto 2010:67). The construction, or cutting, became a concept in itself, or as Andreas put it:

– There is no idea; there is never an idea. As you know.

The starting points were different from design to design. Sometimes, it was in-depth studies of a photograph of an old couture dress with a focus on a certain quality, such as the shape that a certain sleeve created, or a hemline highlighting the legs in a flattering way. Sometimes, the work started out from experiments with shapes such as rectangular pieces combined on the body in various ways to create new dresses. The
centre of attention, however, was always the body that we were dressing. Whatever
the starting point of a new design was, the first step was always to assemble a wear-
able prototype for it to be studied on a living body. Then, an evaluation could be made
of, say, how a certain neckline highlighted the collarbone or how the volume of the
skirt in movement contrasted against the legs. Iris, the senior cutter, approached this
pragmatically, by working just as much on her own body in front of the mirror as on
the dress-stand or on the cutting table. Thus, even if the work begins from a historical
pattern, a garment from the archive and its pattern, or experiments with geometrical
shapes, Andreas’s comments accurately described the working conditions:

– It is not about the pattern, it is all about the body and what the garments do with
the body.
1.5 Cutting at Geneviève Sevin-Doering

Setup:
Workshop focused on archive studies and practical cutting work.

Location: Association Cultures et Développements, 18 rue Neuve Sainte Catherine, Marseille
Duration: 2 weeks, December 2011

Since the 1970s, French costume designer Geneviève Sevin-Doering has systematically developed and refined a cutting method in which the garment is sculpted from a single piece of fabric on the body, which is termed ‘coupe en un seul morceau’. Her work is based on studies of pre-tailoring garment-making, i.e., how the garment was cut before the Middle Ages in Europe and in various ethnic costumes around the world, before the introduction of drafting systems, basic templates, and mannequins (Sevin-Doering 2004).

In December 2011, I visited her in the Marseille studio. Though she is now elderly and has been blind for several years, she explained and demonstrated her philosophy and working method for me over the course of two weeks. I was given free access to her garments and pattern archives and was invited to work alongside her and her daughter, Mireille Doering-Born, in the studio.
Famille DuCollant

histoires de famille...

le Grand-père

la Grand-mère

le Père

la Mère

le Fils

la Fille

le grand père Macbeth vit

dans un château haut au

sommet de la montagne.

Le père et la mère sont portés

gazonnés en terre pointue clans

la Côte-de-Beaume, tontoniques.

la fille porte une longue

tête marquée du sceau

du même anciel.

Le fils rêve encore

échapper au destin familial.

Jeu des 7 familles

d'après les plans de coupe de vêtements de Geneviève Sevin-Doering
Before meeting Geneviève, my only experience with her pattern work was through books (Debo 2003; Trebbi 2010) and her website (Sevin-Doering 2004). The concept of cutting garments from a single piece seemed like an interesting field for research and development as viewed from an interest of the relation between two- and three-dimensional shapes. From 2009 to 2011, while producing collections under an eponymous label, I elaborated on Geneviève’s patterns by working in a manner comparable to what is described in Section 2.5 as “designing with patterns”. By printing and enlarging the patterns, attempting to determine how they were supposed to come together, and further altering and elaborating on the shapes, new garments were developed for the collections. Attempts were also made to merge traditional pattern blocks into one-piece patterns that eliminated or shifted the positions of conventional seam placements on various garment types comparable to what has been done by North Face (Liszewski 2014), for example, as well as designers David Telfer (Telfer 2014) and Maria Hedmark (Hedmark 2012).

In being personally introduced to Geneviève’s work and ideas, a methodological and theoretical discrepancy in my attempts to work with the ‘coupe en un seul morceau’ principle presented itself. Geneviève’s garments also related more directly and naturally to the body than any of my own attempts did, and they also moved along with the wearer in a manner different to what I was used to. I had approached the concept of cutting garments from a single piece of fabric by beginning with the theoretical framework that I had learned in tailoring school – i.e., by elaborating with block patterns derived from the tailoring matrix, as in the work at Bauer Tailors. Here, the starting point was the fabric and the body. Block patterns or dress-stands marked with straight lines were nowhere in sight. The garments were sculptured on the person that they were intended for while that person moved around in the atelier. Moreover, according to Sevin-Doering (2007), if one begins with the actual body, there is no clear logic to split pieces at, say, the top of the shoulder or along the sides. Quite the opposite: the shoulders are one of the natural points where garments rest on the body and from where the garments are being pulled downward by gravity, or as Geneviève, herself, expressed it to me: You must work from the inside and outward, not from the outside inward. By this, Geneviève is suggesting that, rather than starting from pattern blocks or from fabric pieces that are shaped towards the body, one should start from the body, wrapping and/or draping it in fabric according to its shape and movements.

It was obvious that Geneviève’s work was based on a different approximation or theoretical understanding of the body than the one I had been presented with in tailor-
ing school. However, how this approximation differed from the traditional tailoring matrix was not comprehensible, as it was neither verbalised nor visualised, other than through the garments and the patterns bearing marks of another view on dressmaking.

1.7 Discussion – Working from the inside and outward

The guidelines used while drafting patterns in the tailoring workshop of Bauer Tailors directed the ways of drafting and were strongly connected with the garments being produced. Systematically, the work was very clear, but then it also aimed at a very specific result. This system of traditional tailoring was also understood in the Westwood studio; sometimes garments were designed based on this way of working, but simultaneously, often by questioning it and revolting against it in breaking its rules and conventions. The drafting system of the tailors works from the outside and in towards the body, as Geneviève noted, as it starts with a straight matrix and then removes unwanted space in the form of darts, shaped vertical seams, and shaped shoulder seams. In Geneviève’s garments, however, neither darts nor shoulder seams were anywhere to be found.

The time in the Westwood studio changed the basic conditions for the research. Previously, the main focus was on the patterns of the garments to be designed – on elaborations and experiments with two-dimensional shapes that resulted in certain expressions or functions when worn on a three-dimensional body. At the Westwood studio, both the starting point and the results were concerned with three-dimensionality. In numerous fittings, it was mentioned that it is “all about the body, not about the dress or the pattern. What we are interested in is what the dress does with the body”. The notion of considering the body as the centre of attention became even more apparent when meeting and working with Geneviève Sevin-Doering, for whom the pattern was highlighted not as a tool, but as a beautiful notation of the shape that is sculptured directly on the body of the person who is intending to wear the garment, i.e., to work from the body and outward instead of from the pattern towards the body.

The guidelines in the tailoring matrix that were used at Bauer Tailors and elaborated on or revolted against at the Westwood studio were completely rejected by Geneviève Sevin-Doering, who, instead, connects her ways of working to pre-tailoring methods of dressmaking. However, an alternative system or model of explanation was not presented or visualised, and when I asked how the more complicated garments and patterns had been created, they were merely explained as being “works of art”.
2. MOTIVE PART II, SYSTEMS OF GARMENT CONSTRUCTION
This part of the thesis draws from document research as a form of literature and research review (Scott 2006) in the sense of collecting, analysing, and interpreting previous academic research and various publications on the subject of pattern cutting. This analysis is performed so as to review the area of research and formulate motives behind and objectives for this research. Herein, historical paradigms of the construction of dress are identified, as are contemporary practices and research related to the paradigms. Placing emphasis on the interaction and relations between a moving body and garments may appear self-evident both in reflecting on and practically creating garments. However, most of the construction methods of pattern cutting presented in the educational literature merely deal with the shapes of patterns, how to alter them to achieve a certain familiar garment (cf. Aldrich 1980/2004; MacDonald 2010; Öberg 1999), or how various two-dimensional shapes can be turned into three-dimensional ones that can then be used to create garments (cf. Roberts 2008; Nakamichi 2005). Others clarify methods for draping garments on tailor’s dummies or turning these creations into reproducible patterns (cf. Amaden-Crawford 2012; Duburg 2008; Di Marco 2010; Mee 1987). This is essential knowledge for anyone who aims to take part in or understand pattern cutting for fashion design, but the story neither starts nor ends with the pattern; instead, it commences and concludes with the body that is being dressed.
Reconstruction of an Indian dhoti (cf. Broby-Johansen 1953:62), with directions of dressing extracted and marked with a line on silhouettes of a human body.
2.1 Wrap clothing

Ancient ways of dressing involved little cutting, if any. Wrap clothing such as the Indian sari and dhoti, the Roman toga, or the Arabic hajk were rectangular woven pieces of fabric that remained undefined in shape until being worn and were recreated each time while dressing (Figs. 26–28). Since, in creating these garments, the body is just as central as the rectangular piece of fabric, it would be awkward to illustrate these folding techniques without including a body to fold the fabric around. The craft or design work required in these types of garments is visible in the weaving, dyeing, and, possibly, in the embroidery of the fabric. However, the wearer, herself, eventually created the shape of the garment. As Burnham (1997) observes, the techniques used to fold and shape the fabric – as well as the location on the body on which it was placed – differed between cultures and ages as a result of the varying width of the fabric as well as which weaving technique was utilized. Nonetheless, in a variety of cultures, the wrapped garments did rest on and begin either from the shoulders or from the waist. In the recreations of three different wrapped garments (Figs. 26–28), the directions of the drapes around the body have been extracted and visualized as direction lines around the body, presenting a theoretical explanation of different ways of dressing.

These ancient ways of whole cloth wrap dressing are dependent on the physique of the body they are draped around, or as Broby-Johansen (1953:47) expresses: “without the body those garments lose their meaning and becomes just a piece of fabric.” The garment exists in symbiosis with the body, and there is no representation of a body in these garments if the body and garment are apart from each other. The folding techniques in which a rectangular piece of fabric is wrapped around the body do not include any actual cutting, in the sense of cutting into something, but they help to clarify the essence of what cutting for a human body should be about – the body – and they also tell us about basic principles of dress, such as how fabric naturally wraps around and flows from the body: this way of letting the fabric lead the way is, as Yamamoto (2010:96) explains, the foundation for modern draping techniques that were later developed within the haute couture.

If the garment (and the pattern) is nothing but the uncut fabric, an explanation of how a garment is assembled needs to also include its wearer’s body. Later in history, when the pattern could be communicated in its own right, it was possible for the body to be left out of the process of making and, as a result, it often is.
Fig. 27
Reconstruction of an Indian sari (cf. Broby-Johansen 1953:62), with directions of dressing extracted and marked with a line on silhouettes of a human body.
Fig. 28
Reconstruction of an Arabic hajj (cf. Broby-Johansen 1953:59), with directions of dressing extracted and marked with a line on silhouettes of a human body.
Analysis by Hamre (1978) based on studies by Tilke (1952) outlining formal connection between ancient whole cloth wrap dresses and rectangular cut garments.
2.2 Rectangular-cut garments

The next major paradigm of dress after ancient wraps and drapes is garments that are cut from rectangular pieces of fabric. The basic principles are the same around the world, for example, for a Japanese kimono, a European chemise, or an Arabic djellaba. The rectangular-cut fabric hangs from the shoulders, with an opening cut for the head, and has smaller rectangular pieces attached to its sides, forming the sleeves (Tilke 1990).

Pieces are rarely shaped, and when the fabric is cut, it is primarily done in straight lines. The use of darts to shape the garment after the body is rare; instead, gussets are sometimes inserted to create three-dimensionality in garments. The valuable hand-woven fabric is cut apart, though not cut into shapes that align to the shape of the body. In this manner, very little or no fabric is wasted in the making of the garments. The garments are generally not tightly fitted to the body, and the individual fit, if there is one, is usually achieved by the use of, say, belts that gather the fabric towards the body. The pieces that make up the garments are nonfigurative in relation to the body and, hence, need to dress the body in order to be defined. In itself, the rectangular piece of fabric of the sleeve may just as well be used to cover the leg (Tilke 1990; Burnham 1997; Broby-Johansen 1953; Hamre 1978).

Based on Tilke’s (1922) studies, Hamre (1978:13-15) clarifies the connections between full cloth wrap dressing and rectangular-cut garments by observing that, historically, wrap clothing, ponchos, and mantles developed into djellabas, tunics, and kaftans; thus, she brings to light different propositional positions of where to join the fabric with seams for creating such rectangular-cut garments. Hence, clothing wrapped around the body developed into djellabas, as the fabric was joined with seams at the shoulders, leaving an opening at the front; the poncho developed into a tunic with seams that connect the fabric along the sides of the body and that constitute a garment to be pulled over the head; and the mantle developed into a garment whose fabric hangs over the shoulders and is then cut open at the front and joined along the sides, similar to the cutting principles of a kimono (Fig. 29).

Historically, patterns were not used in the making of ancient full wrap clothing or rectangular-cut garments. The form of the garment was either communicated by the dressing itself (wraps) or was clear from looking at an existing or flatly depicted garment (rectangles). Without patterns, both the ancient wraps and the rectangular cuts are modelled on a living body, and lengths and widths are decided based on the width of the woven fabric in relation to the body of the intended wearer. For both of these types of garments, the fabric hangs from either the shoulders or the waist, acting
Fig. 30
Reconstruction of a rectangular cut garment (c.f. Tilke 1990:5) with directions of dressing extracted and marked a line upon the garment. Lines start at centre back of the neck and the fabric hangs forward and downward over the shoulder. (See design experiment 5.2 for further clarification).
as the bodily starting point while outlining the size and proportion of the drapes or the rectangular pieces. Based on the analysis by Hamre, viewing rectangular-cut garments in this way facilitates an understanding of just how the fabric hangs on the body in a similar way as has been made for the full cloth wrap dresses. Hence, it is possible to extract directions of how the fabric hangs upon the body in a similar way as has been made for the full cloth wrap dresses (Fig. 30). In this reconstruction, the garment is cut from one piece of fabric in a manner similar to the Bronze Age pattern in Fig. 31 and the 19th century cloak in Fig. 33, but as illustrated in Fig. 32, this construction principle is valid for many ancient rectangular-cut garments, regardless of the number of pieces constituting the garment.

In modern times, the principles of rectangular cutting have been further developed into everyday wear in parts of the world (cf. Tsui 2008), and principles derived from this paradigm have been adopted by many designers, for example, Romeo Gigli (Debo 2003:86), Vionnet (Kirke 1998), Kawakubo (Fukai et al. 2010), and Westwood (Wilcox 2005), among others. The use of geometrical shapes (rectangles

![Pattern of blouse found in Silesia from the Early Bronze period (Tilke 1990:plate 38).](image-url)
Fig. 32
Pattern of ancient Persian cloak flattened out, sleeves and back part is separate pieces stitched together with body piece. (Tilke 1990:plate 5).
and occasionally triangles) in this paradigm of cutting should be distinguished from contemporary geometrical approaches to cutting that combine geometrical shapes of various sorts to find new three-dimensional expressions. Historically, each piece of fabric relates to the body and folds around it, while contemporary adopters of geometrical exercises in pattern cutting, such as Nakamichi (2005), Roberts (2008), and Sato (2011), et al. construct shapes and apply them to the body in order to find new expressions. Because of the limitations of the fabric width, the first method works its way from the body outward by using rectangles, while the other contemporary experiments utilise various geometrical shapes and focus on the relationship between two-dimensional and three-dimensional shapes and the body.
Fig. 34
Pattern draft for tailored suit jacket. Extract from cutting school notebook of Börje Moberg, former owner and cutter at Bauer tailors, noted in the fifties.
Pattern making, as we know it, originated in the medieval period, when tailors began cutting pieces of fabric to be shaped for the anatomical contours of the body. Until then, most garments consisted either of long rectangular pieces of fabric, which were either wrapped around the body in various ways, or as rectangular pieces assembled with a minimum number of cuts in the fabric. The tailoring method of cutting garments – i.e., starting from flat, shaped pieces – has been developed in Europe over the last 500 years (Waugh 1964:34-35). Tailoring and fit, as we know them today, developed gradually. The tape measure was introduced in the beginning of the 19th century (Hollander 1994:106; Waugh 1964:130), and with it, various drafting systems were developed, as were theories of how to reproduce known styles to fit different body types. In 1863, parallel to the shift towards mass-production, German mathematician Dr. H. Wampen published Mathematical Instructions in Constructing Models for Draping the Human Figure, which outlined a scientific system for drafting and introduced principles for grading. Beginning with studies of proportions of the Greek statues, Wampen – in collaboration with his tailor – developed his influential system of general human proportions of height and breadth (vertical and horizontal measurements) to be taken into consideration when drafting patterns (Waugh 1964:131). Western tailoring has had a huge impact on dressmaking worldwide, and the near-universally dominant flat-pattern cutting methods taught today are derived from it. The pattern of a tailored sleeve depicts the shape of an arm, and a front body piece depicts the shape of a chest.

Rather than working solely with the fabric and the body, the focus of the cutter shifted towards the pattern. Consequently, the introduction of the pattern established a form of notation which allowed ways of cutting to be documented (see Fig. 34), in turn making it possible for knowledge to be shared and spread in trade journals, etc. Craftsmen learned to envision the body while shaping the patterns with which they were working, and “a sound knowledge of the human form” became a requirement for the experienced cutter (Hulme 1945:23). Hence, it became possible to work with an abstraction of the body – a template – and by altering the pattern, new variations of garments could be created. This allowed for new possibilities and refinements in cutting, but also introduced an aspect of alienation to the work – a risk that the awareness of the body became lost in the act of cutting, since there was less need for the body to be physically present.
2.3.1 Drafting systems

Drafting a flat pattern in the absence of the body of the intended wearer demands high accuracy in terms of drafting methods. There exist numerous mathematical systems based on vertical and horizontal measurements of the body that assist in drafting a foundational pattern that may then be transformed into any kind of garment. These measurements are generally taken from a person who is standing still, in an upright position, as Simoes (2012) notes and examines; consequently, the spatially moving body is abstracted into a series of fixed numbers, and from these, a diagram of guidelines is drawn on a flat surface (see Fig. 35), and pattern pieces are drafted within this tailoring matrix (see Fig. 36). It is a process for repeating specific styles or yielding a block pattern, as accurately as possible, in relation to the body measured –
simply “a ‘join the dots’ form of drawing” (Campbell 2010:352). The order of working follows that order of taking measurements; for example, the centre back neck is a common starting point for both measuring the body and drafting patterns, which is logical, as it is the initial point of balance for garments resting on the shoulders. Measurements are typically taken of chest width, waist width, seat width, shoulder width, length of the front and back, and the width and length of the arms.

Some systems generate a basic block that adheres to the shape of the body – i.e., a representation of the body – which is then altered into specific styles (cf. Aldrich 1976/2004; 1980/1997; MacDonald 2010; Öberg et al. 1999), while other systems are designed for the drafting of patterns of pre-defined garments (cf. Doyle 2005; Friendship 2008). The general character of these systems is not experimental, though they embody the developed understanding of everyday work in the cutting room.
They are a mathematical extraction of a spatial knowledge that is systematized so that it is reproducible and can be shared.

Drafting systems that incorporate vertical and horizontal lines, connected at right angles in this manner, imply a certain quantitative approximation of the body (see Fig. 37), which has little to do with how the body interacts with the fabric, but which is easy to communicate with precision, facilitates reproduction of patterns and styles, and is thus widely spread because of its practical applications. This grid of straight lines applied to the body may thus be understood as the theoretical framework for the construction of the vast majority of contemporary garments (cf. Simoes 2012:14). The same type of matrix is often applied on the dress-stand to be used as a foundation.
while draping (see Fig. 38), and these applied lines on the dress-stands insinuate that contemporary draping as described by Mee (1987), and Duburg’s (2008) is based on the same theory for understanding the body as the one used in flat construction. Thus, despite the fact that working in two dimensions on the table or in three dimensions on the dress-stand is often considered to be two different methods for garment construction, the methods are arguably based on the same theoretical framework or paradigm (see Section 2.4 below).

Numerous comparative studies within the paradigm of the tailoring matrix have been carried out. These studies variously address fit issues related to different methods of drafting and/or body proportions. An applied focus on efficient and rational
production or possible developments of CAD is a common denominator in this area of research. With the aim of “eliminating time and expense of multiple fittings”, in a case study, McKinney et al. (2012) compared published pattern making specifications against trouser patterns custom-fitted for seven female participants. McKinney observes how “theory can ground the practice and lead to a better understanding of body-pattern relationships”, and the study aims to develop the theoretical understanding of the body and fitting issues within available theories of flat pattern cutting, i.e., the tailoring matrix. Gill et al. (2009) conducted a comparative study between five different drafting methods to determine and compare the level of ease incorporated in the various construction methods of basic front, back, and sleeve blocks. They concluded that the various methods resulted in a slightly different amount of ease and visualised this difference in diagrams and tables. Similarly, utilising Gerber CAD software, Tama et al. (2014) constructed a basic shirt by utilising four different drafting methods, fitting them on virtual mannequins of the same size, but with different body types. The fit was evaluated by examining tensions and pressures digitally, and it was noted that the result varied between different body types and different drafting systems.

It is clear that when measuring the body and drafting a basic pattern to represent the body according to the measurements taken, a predisposed template for the notion of fit is created. This seems to fuel a perception that a well-fitted garment is one that accords to the shape of the wearer’s body, creating a minimal number of creases while nonetheless allowing the body to move about comfortably. This understanding of fit is arguably one-dimensional and debatable, as it places little emphasis on the living body and its expressional and biomechanical qualities and demands. In addition to look upon fit and volume from such a quantitative measurable point of view and hence determine varying amounts of suggested ease for different types of garments etc. it is preferable, in a design situation, to consider how a certain volume or size of a garment interacts with the moving body that is wearing it; how the garment changes, depending on fabrics or material being used; and how the garment covers some parts while revealing and accentuating others. Simply put, how the garment transforms the expression of the body.

However, the prevalent quantitative approximation of the body – i.e., the tailoring matrix and the manner of cutting from block patterns based on the body’s static upright position – is disputed, and several improvements of it have been suggested. Wang (2011) and Simoes (2012) both present alternative ways of constructing foundational patterns based on different studies of bodies in motion: Wang, by altering tight-fitted blocks after studies of runners in motion, and Simoes, by tracing distorted forms of tight-fitted costumes with plastic qualities that are worn by six different
women. Both methods are intended to better support the biomechanical functions of the body, and though they question the prevalent approximation of the body, they are both still developments within the this theory of garment construction.

Furthermore, the developments in pattern construction through three-dimen-
sional body scanning build on, and stay within, the theoretical framework of the tailoring matrix. For example, research may be focused on changes in body measurements for various active body positions, comparing a standing posture, a 120° knee-bending posture, and a one-pace stepping posture (Synyoon 2011); the role of quantitative data on the intra- and inter-observer serve as landmarks for correcting errors in measurements for garment constructions (Kouchi 2011) or the precision and definition of the waist in relation to the current ISO waist definition because of the waist’s significance for several garment construction technologies (Veitch 2012).

2.3.2 Block pattern manipulation

The block pattern tradition encapsulates the shape of the body and transforms it into basic pattern blocks. Hence, the body is abstracted – taken apart and turned into flat, graspable parts such as the top front, top back, the sleeve, etc. These parts are then joined to create a layer that shapes to the body like a second skin, and this layer is constructed with varying volume or ease, depending on whether the cutter is aiming for a tightly or loosely fitted garment.

Methods of altering basic block patterns into various garment types have been explained and clarified in various ways (cf. Aldrich 1976/2004; Aldrich 1980/1997; Kershaw 2013; MacDonald 2010; Öberg & Ersman 1999; et al.). Such instructions can be useful in developing variations of already existing designs and in understanding and altering patterns of various garments.

If we consider fashion design as an act of further developing new bodily expressions – i.e., inventing new types of garments – the techniques and methods for altering flat patterns may be a productive, practical way of developing shapes and expressions. As Nakamichi (2005; 2007) and Sato (2011) illustrate, it can even be used as a method of finding and developing radically new shapes. However, it is questionable, from two points of view, to propose this as the principal working method for the construction of garments.

The first one regards the physical or biomechanical functions of the human body. As Burnham (1997) discusses, the body is a moving variable which constantly shifts its physical appearance. It is a changeable, varying, and by all means inconstant
variable – quite apart from what Aldrich claims in arguing for the excellence of the working method:

“Pattern cutting by this method is a means of achieving a shape around the body so that, although the body and therefore the body blocks remain constant, there is no limit to the ideas that can be followed through into workable designs” (Aldrich 1976/2004:4).

In short, since the alterations and transformations of the block patterns are removed from the living body on an abstract level, the result may be that of rigid, static creations that are not made for a living, moving body, but for a static one.

The second point of view that questions block pattern manipulation as a cutting method arguably has to do with its tendency to cause users to repeatedly attempt to reinvent the wheel. In the current stage of fashion industry, with wide access to numerous types of well-cut garments, it is notable that, while constructing classic garment types, the emphasis in education and industry is still focused on altering basic block patterns. Reverse engineering, or knock-offs – i.e., taking the pattern of an already existing garment – is, if being equipped with a tracing wheel, paper, and pencil, a simple task for most garments. There is no need to unpick the garment, and in merely a couple of hours, a pattern is created that can be used to make further adjustments or for new prototyping.

Copying earlier masters or contemporary competitors is an excellent way to learn and find one’s own artistic voice (cf. Yamamoto 2011). Such works may become the foundation for development, deconstruction, and reconstruction. The ability to distinguish the potential of new developments from an existing piece of work – whether it is historical, one’s own work, or someone else’s creation – is arguably a key skill for a fashion designer. Using block pattern transformation to recreate historical or contemporary designs may be seen as an easy and efficient way of working, but potentially also a methodologically discrepant one. If the copying process is not performed well, but, rather, filtered through, say, basic block patterns, the actual essence of a garment – i.e., how the garment interacts with and changes the expression of the body – might be lost, transferring details rather than shapes. The work of the designer would then be comparable to that of the stylist (i.e., moving known parameters around), instead of focusing on possible developments of shape and bodily expression.
2.4 Draping

Until recently, few works on the practical applications of the art of draping had been published, leaving the craft to become a skill passed on from master to apprentice, as with tailoring. However, as there is growing interest in this working method, a number of titles are now available on the subject. Mee (1987), Jaffe (2005/2012), Joseph-Armstrong (2008/2010), and Amaden-Crawford (2012) all illustrate the working process with drawings. Some of these illustrations are clearer than others, but generally, it is difficult to understand the significance of the soft fabric that dresses the body, and the consequences, for example, of pulling it too tight or of letting out too much are difficult to follow. Duburg et al. (2008) and Di Marco (2010) illustrate the process with photos, which makes it easier to grasp and actually see what happens with the fabric when it is folded, gathered, or put on the bias. It is common with these publications, however, for there to be no photos of any fittings of the created garments on a living body: they all hold on to the static dress-stand for displaying their creations.

The clearest description available of the work process of traditional draping or ‘moulage’ (French for ‘moulding’) is arguably the one by Duburg et al. (2008). By showing the process systematically, in clear and instructive photos, it provides a technical and hands-on illustration of how to proceed in order to create various types of garments on the dress-stand.

In order for the fabric to stay in position and not fall down while working, the fabric is pinned to the dress-stand, and the pins attaching the garment to the dress-stand are gradually removed as the garment comes together and stays in position by itself. When making symmetrical garments, one works only on one side of the dress-stand, and when that side is completed, the toile is taken apart, duplicated, and pinned or stitched together again as a whole garment. In traditional draping, the method for making, say, a blouse or a jacket normally begins from the front of the dress-stand – traditionally on the right-hand side for women’s wear and on the left-hand side for men’s wear, depending on which side overlaps when a garment is buttoned at the front. The piece or pieces of fabric are gradually shaped by pinning darts, pleats, etc. and working from the front towards the centre back of the dress-stand; gradually, new pieces are attached, and the shoulder seams are joined once the centre back is reached. This step is then followed by shaping a collar and adding sleeves.

Though moulage is a well-used working method that has been used in haute couture for more than a hundred years, it has, as Yamamoto observes, methodological connections to ancient wrapping techniques: “People associate draping with
haute couture, but in truth the concept has implications that extend much further. It originates with the practice of wrapping the body in cloth, as was done in ancient Greece and Rome. The very foundations of draping can be found in the way they wrapped fabric around the body such that it flowed naturally” (Yamamoto, 2010:96). As a method, draping shares foundations with the ancient techniques of wrapping, as it uses the fabric directly to create shapes around the body. Contemporary draping methods as an alternative for two-dimensional/flat garment construction, however, are distinctively different from ancient wrapping techniques in several ways.

One obvious difference is that, in most cases, the living body has been replaced by a static dress-stand. The second apparent difference is that the fabric is normally cut into pieces, which are pinned on the dress-stand. However, neither of these two conditions should be considered general conditions, and the principal difference is instead in the theoretical frameworks.

The contemporary method, as described by Duburg et al. (2008) is based on the same theoretical framework for understanding the body as the drafting systems for flat construction are, whereas ancient drapes are not. While introducing the general principles of draping in most literature, a dress-stand, for example, is decorated with tapes that mark a circle around the neck and one circle around each armhole. The centre front and the centre back of the stand are also marked with tape. Furthermore, lines are attached horizontally along the seat, the waist, and the chest, and with a line going across from the centre front to the armhole. These lines are the ones where the body is normally measured when drafting a flat pattern based on measurements of a body. There are also lines simulating a shoulder seam from the neck out to the armhole and lines marking the sides of the stand as a side seam. These lines are frequently traced and marked on the fabric pieces for reference purposes before the toile is taken apart.

Additional methodological phenomena that are in line with this common theoretical framework that is shared by flat pattern-cutting and draping on the dress-stand include the approach of starting out from a flat surface (paper or fabric pinned to the stand) and working from the outside in towards the shaped body while gradually removing space by inserting darts or seams. Arguably, the working direction is from the outside in and then upward to shape the shoulder seams (or darts and seams for garments resting on the waist) in order for the garment to not fall off of the body. Thus, for both working methods, the aspect of gravity enters the process relatively late – in draping, while the pins attaching the fabric to the stand are removed, and in flat construction, while the garment is fitted after being assembled.

This theoretical connection between the two diverse methods may be challenged
by, for example, pointing out that the lines are often not marked on dress-stands prior to draping, and without these lines, the dress-stand is merely an abstraction of a body, and no specific theoretical framework is utilised. However, it is also the case that the guidelines from the tailoring matrix are not marked on block patterns that are used as the foundation for flat constructions, despite the fact that the blocks do relate to these construction lines.

Notably, modelling on the dress-stand allows for breaking the rules of the outlined theoretical framework more easily than while constructing garments flat, and what is described here primarily relates to the construction of garment types that may also be constructed flatly, to varying extents. Many designers elaborate on their designs with diverse draping techniques that mix influences from ancient approaches to draping with geometrical shapes, and therefore, they create garments and patterns that – if being analysed from a making perspective – are precisely that: founded in a conglomeration of various theoretical frameworks. The construction and posture of dress-stands, however, are tightly connected to the theoretical framework of the tailoring matrix, and garments constructed on them are therefore related to and affected by it, intentionally or otherwise (cf. Simoes 2012).

Draping (moulage) partly reintroduces the body into the practice of garment construction. However, it involves working primarily on a fixed dress-stand, and it uses the same theoretical framework for understanding the body that has been defined by tailors who are developing drafting systems based on measurements of the body (i.e., the tailoring matrix); thus, it arguably has the tendency to lead to rigidity, just as cutting from block patterns does. Furthermore, the absence of arms, head, and lower body is quite evident in many garments that are designed on dress-stands (cf. Thornquist 2012).

In the preface to Draping, it is stated that “a mastery of the basic principle of pattern drawing and workmanship is necessary before commencing with draping” (Duburg 2008:5); similarly, Mee and Purdy (1987:1) argue that “working on the flat in two dimensions is a far simpler concept to master, and once mastered will give the students the insight which allows them to visualize the same pattern in three dimensions.” This statement is debatable, since the reverse may also be true. Due to the fact that the same theoretical framework is the basis for both methodologies, learning draping may be a natural way of understanding the basic principles behind what a pattern is and why pattern pieces are drawn the way they usually are. While working on a mannequin or, possibly, directly on a moving body, the rules taught in pattern cutting classes begin to make sense, and many are unnecessary, since with three-dimensional modelling – for example, how wide a dart needs to be, or the amount of ease to put into a shoulder seam – will come naturally.
2.5 Creative pattern cutting

In attempting to highlight the activity of pattern cutting as not merely a technical, but also a creative, activity, with a central role in the process of fashion design (cf. Almond 2013; Rissanen 2013; Narielwalla 2013), the term ‘Creative Pattern Cutting’ has been appropriated by several cutters, designers, and researchers.

For example, Rissanen (2013) examines and discusses this relation between fashion design and pattern cutting from the perspective of an industrial fashion system, with emphasis on sustainability, by applying zero-waste cutting principles that call “for fashion design to consider pattern cutting as an integral part of the fashion design process.” Furthermore, in a part-historical, part-artistically-driven thesis, Narielwalla (2013) discusses the patterns' historical and inspirational meanings. Narielwalla argues that patterns are “undervalued and neglected, and remain a hidden craft” and continues “that patterns are unique abstracted drawings of the human form, carrying with them not only the outline of the garment but also impressions of the body.” However, instead of contributing to the field of pattern cutting by developing ways to reveal this “hidden craft”, he makes artwork collages of abandoned pattern blocks, treating them merely as inspirational objects. The notion of the pattern as a work of art is also put forward by Simeos (2013) as she discusses their body portrayal aspects while clarifying the motive of her further developments of a new type of basic pattern blocks.

Over the past ten years, alternative and more creative ways of working with block patterns have been publicised in various forms. The methodological approach of a number of these contemporary pattern cutters may be described as designing with patterns (cf. Roberts 2008:14) instead of creating a pattern for an already defined or sketched design. Two categories can be defined within this movement: one emulates draping through block manipulations (cf. Nakamichi 2005; 2007; Sato 2011), and the other experiments with pattern pieces or other shapes to come up with new, more or less unexpected shapes (cf. Roberts 2008; Rissanen 2013; McQuillan 2011; Ohrn-McDaniel 2013).

The first category – creating shapes and expressions that would normally be associated with draping – includes the Pattern Magic series by Nakamichi (2005; 2007) and Transformational Reconstruction by Sato (2011). Both Nakamichi and Sato compare their cutting practice to solving a puzzle, which clarifies their view on cutting as a practice in which the core is the pattern itself: by manipulating the puzzle pieces, one can achieve another kind of image. Nakamichi states that she is often inspired by fashion of the past and as she tries to recreate it, she often ends up creating new
designs (2005:61). Such creation is achieved via manipulation of basic blocks. By doing so, both Nakamichi and Sato explain a way of achieving a draped expression through block manipulations. This formulates methods easily accessible to anyone familiar with the principles of block manipulation. It may, however, lead to a methodological discrepancy, the consequence of which is that, instead of creating draped expressions that form to the shape and movement of the body, one instead ends up with unwearable creations made for a static body. A method bearing some similarity to that of Nakamichi and Sato is one presented by Preben Hartman (1985) called ‘Anatomisk tilksæring’ (‘Anatomical cutting’). Just as Sato does, Hartman drapes his patterns in paper and also utilises sticky tape to assemble the prototypes. In contrast to Sato, however, Hartman does not begin with some basic block but instead drapes the paper on live bodies; hence, his method becomes quite a useful methodological investigation in the border area between draping with fabric and flat construction.

The second category includes Julian Roberts’s (2008) ‘Subtraction Cutting’ method and the contemporary ‘zero-waste cutting’ movement promoted by Timo Rissanen (2013), Holly McQuillan (2011), and others. Roberts’s work can be compared with action painting or gestural abstraction, where the artist is painting spontaneously, smashing the paint towards the canvas instead of applying it carefully. In action painting, the physical work, itself, is often considered an essential aspect of the finished work, just as the pattern is to Roberts. On the other hand, the zero-waste cutters use the limitation of not wasting any fabric as a means of forcing themselves to change the shape of their block patterns (or other shapes) into new, unknown paths.

The name ‘Subtraction Cutting’ is derived from a principle in which pieces are cut away from a tube of fabric, and the holes are then stitched together in various manners, shaping the fabric. Here, the pattern pieces represent what is cut away instead of what is to be stitched together. However, Roberts presents Subtraction Cutting more as a general approach to cutting and design, stating that “Subtraction cutting is DESIGNING WITH PATTERNS, rather than creating patterns for designs” (2008:14). He uses his body for measurements when dealing with his patterns and takes a big step away from numbers, rules, and measurements, claiming that space and balance are what cutting is really about. He allows for mistakes as possible starting points for future successes, in contrast with a trade that traditionally searches for perfection in drafting and fit. Prior to being published by Roberts, techniques similar to the ones he describes have been used by practicing fashion designers, but they have seldom been explained.

Roberts (2008) mentions that the pattern has been his main interest and that his designs have often been dominated by his interest in the pattern itself. While
explaining his method, the body is depicted as arrows that illustrate the way it passes through a garment or the pattern (see Fig. 39). This can be considered contrastive to the directions derived from the wrap clothing, where the lines illustrate the direction of fabric that drapes around the body (Fig. 26–28). Methodologically, it is clear that the cutting activity begins with the pattern. Nonetheless, Roberts observes that in the fashion industry, the activity of pattern cutting is often considered beneath the activity of design, hierarchically; one possible reason that the cutters are often seen as being below the designers may be that, from the cutter’s perspective, the pattern and
its possibilities are given priority over the body, itself, and its relationship to the garments. However, if the cutter is also a trained body watcher – i.e., someone who works with the body and its expressions when creating garments – he or she may manage to achieve a higher status in the fashion hierarchy.

Timo Rissanen (2013) is also focused on the pattern and its possibilities and, during an attempt to find ways of making fashion more sustainable, argues for a shift towards a zero-waste cutting practice in which the material that is normally cut away in production may instead be used for extra seam allowances, larger hems, and reinforcement pieces, allowing the garments to go through alterations in the future and providing them with a longer lifespan. Both ancient wrapping techniques and rectangular cutting may also be viewed as zero waste cutting methods, and connections to these paradigms are clear in the work of such zero-waste cutters as Telfer (2014) and Carrico (2013). The dominant part of the contemporary zero-waste movement, however, seems to use block patterns as the tools for achieving zero-waste, and this combination of traditions outlines a new design method where block patterns are transformed into new shapes in order to fit onto the chosen fabric. Consequently, the garments become shaped in a manner that one otherwise would not have expected (McQuillan 2010). As McQuillan (Gwilt et al. 2011) describes, “zero-waste design is design practice that embraces uncertainty” because, while moving lines around on the layout plan, the outcome in three-dimensional space may be difficult to predict.

A common denominator between these cutters is that they emphasize the pattern, itself, as a tool for creation. By experimentation and transformation of patterns, either through block patterns or other shapes, they find new shapes and ways of designing for the body. As Roberts (2008) notes, one problem that may arise is that the garments may end up as walking patterns that have little to do with the body wearing it.

A similar problem is also highlighted in a statement made by Lucy Orta (2010:7) in describing the participating artists and designers in the British Craft Councils exhibition, Block party. The exhibition showed contemporary craft that was inspired by the art of the tailor; Orta described the participants: “They are advocates of the craft and masters of the art of block manipulation: they are explorers who wish to experiment and invent new ways to assemble pattern shapes, not to create garments but to manipulate shape to realise new forms.” Orta suggests that the participants are dealing first and foremost with the pattern and that they are not creators of garments, but of new pattern shapes.
2. MOTIVE PART II, SYSTEMS OF GARMENT CONSTRUCTION

Fig. 40
Reconstruction of an Indian Sari (c.f. Broby-Johansen 1953:62) with directions of dressing extracted and marked a line upon silhouettes of a human body.

Fig. 41
Reconstruction of a rectangular cut garment (c.f. Tilke 1990:5) with directions of how the fabric hangs on the body extracted and marked a line upon the garment. Lines start at centre back of the neck and the fabric hangs forward and downward over the shoulder.
2.6 Discussion – Approximations of the body

As clothing is made for living bodies, problems of inactivity and rigidness – as may occur when exhibiting fashion in museum contexts as a result of bodies being replaced by mannequins (Debo 2003:9) – is also a problem present in the design studio. Broby-Johansen (1953:2) points out that to thoroughly know anything about clothing, we must first discover what the clothes conceal – the body – and then observe them in use. This is clear for the paradigm of ancient drapes, as only the rectangular piece constituting, for example, a sari is not enough to understand the sari: the body cannot be left out. However, the body is just as essential for understanding any kind of garment: the garment in itself is not enough, and neither are the garment and its pattern. Without the body, the garment can neither be entirely understood, nor fulfilled, or as Yamamoto notes: “Clothing is, ultimately, made to be worn. It is complete only at the instant it is donned by a living human being” (2010:68). Dress historian Dorothy Burnham further notes, “The body with its need for movement is a variable constant in the development of clothing” (1997:2). As valid as this point is from a historical perspective for developments in dress, it is equally essential for the creation of dress and for future developments in the field of pattern cutting.

For practical reasons, fashion designers do not typically work directly on a human body while draping or constructing a garment. Within the different pattern cutting paradigms and methods, different theoretical approximations of the body can be identified – theories that do not represent the body accurately, yet close enough to be useful for cutting and draping. These approximated theories aid in the construction and design process and are also used to make predictions of the result easier.

For ancient wraps, the body was present during the creation of the garment, as it was wrapped on the actual wearer. However, directions regarding how the fabric was draped around the body may be extracted and viewed as models of explanation or theoretical frameworks for these garment types (Fig. 40). Similar to ancient drapes, historical garments made within the paradigm of rectangular-cut fabrics – resting on the shoulders or on the waist – were also not cut from patterns, and, as shown earlier, it is possible to extract directions or guidelines from these garment types by observing their relation to the body in the same manner as for ancient drapes (Fig. 41).

For drafting and flat construction, the tailoring matrix is the theoretical approximation used predominantly, along with the basic block patterns derived from it (Fig. 42). This paradigm has come to define the construction of modern garments, with its shoulder and side seams together with developments of grading principles, and the framework is arguably also strongly interconnected with the contemporary notion of
fit, which is a rather different concept to that of form in relation to the dressed body. For draping on the dress-stand, the tailoring matrix arguably also constitutes the theoretical framework (Fig. 43) that shares both methodological directions of working (from the outside and inward; Fig. 44) and the horizontal and vertical guidelines for measuring and marking.

The methods of draping and flat construction that are based on the paradigm of the tailoring matrix work principally from the outside towards the body, as they begin with a straight matrix or a straight piece of fabric pinned onto the dress-stand. From that flat surface surplus fabric is gradually removed by inserting darts and by shaping seams, which adjusts the shape of the fabric towards the body. In contrast to construction methods based on the tailoring matrix, ancient whole cloth wrap dressing clearly works from the body outward, as it drapes the fabric around the body without cutting into it. This is arguably also the case for historical rectangular dressing being noticeable in (i) the usage of gussets to create shape, thus adding as opposed to removing fabric, as with the darts in the tailoring matrix and (ii) the directions of hang-and-balance that may be extracted from these garments in a manner resembling those of ancient drapes.

In contemporary academic research, several researchers are preoccupied with propagating that pattern cutting is a creative activity either in its textual arguments or by showcasing examples of various ways of designing with patterns. Furthermore, most academic research attempting to develop the field of pattern cutting is still approaching the construction of garments from the outside in, either by engaging in comparative studies regarding usage of the tailoring matrix, or by questioning the prevailing paradigm, but generally not going further than suggesting refinements within this theoretical framework.

The mathematical systems developed during the 19th century in attempts to turn pattern cutting into a scientific practice have certainly had a huge impact on the development of the field. Theories of construction based on horizontal and vertical measurements of the body and the methods of drafting patterns based on mathematical instructions are successful and operational ways of representing the static body. The practice of drafting from a tailoring matrix of straight lines in combination with given measurements makes it relatively easy to communicate the procedures of drafting in literature, utilising scaled sketches and verbal explanations.

As Almond (2010:16) notes, understanding the fundamentals of cutting is an essential part of designing garments, both from a creative and commercial point of view. Working with patterns requires “a sound knowledge of the human form” (Hulme 1945:23) and an ability to envision the body while shaping the pattern pieces.
Fig. 42
The tailoring matrix and the basic block patterns constitutes the prevalent approximation of the body used for drafting and flat pattern cutting.

Fig. 43
The dress-stand together with the tailoring matrix, often applied to the stand constitutes the prevalent approximation of the body used draping.
However, Fischer (2008:25) notes that, in educational settings, “pattern cutting can at first seem difficult and intimidating but with a basic understanding of the rules to be followed – and broken! – the aspiring designer will soon learn interesting, challenging and creative approaches to pattern cutting.” May this difficulty of understanding and applying pattern cutting rules relate to the foundations of the prevalent theoretical framework? Does the tailoring matrix promote such abilities as envisioning the body while shaping pattern pieces? It can be assumed that the tailoring matrix is a valid way of representing a static body correctly, but whether or not this theoretical framework is a preferable way of describing and understanding the interaction between soft fabric and the living body is questionable.
Fig. 44
Rectangular shape (paper or fabric) placed upon dress-stand to illustrate the direction of work from the outside towards the body. Grey areas indicate space removed by shaping seams around the body or dress-stand.
3. DEVELOPMENT OF A THEORY OF THE BODY
When constructing garments for a body, the question of how to view the pattern becomes crucial. Should it be considered a representation of the body (Aldrich 2004)? As a tool or the starting point for designing (Roberts 2008)? As a catalyst that lays between fabric and garment (Debo 2003)? Or should it be considered a notation of a shape? Arguably, pattern making ought to first and foremost concern the body, then the dress, and then the pattern, or as stated by Andreas Kronthaler in the Westwood studio: “It is not about the pattern, it is all about the body and what the garment does with the body” (p.38). As the static post-constructed approximation of the body as the block patterns are, the usage of them as the foundation for pattern cutting tends to move pattern cutters to a position working from the pattern and towards the body – from the outside inward – rather than from the inside and out, i.e. starting from the core of dressmaking, the living body, while creating dress.

Looking at the above systems of pattern cutting in Chapter 2, it is clear that the dynamics of the body are easily neglected while working within the tailoring matrix paradigm, just as they are when the pattern is viewed as a tool for designing. To move from this static approach towards one that focuses on the body, there is a need to develop a new, more dynamic theory of the body as a base for pattern cutting. Such a model may be based on how the moving body interacts with fabric while being dressed in a manner similar to ancient ways of dressing. This calls for a new approximation of the body that is derived from qualitative measurements of the moving body instead of quantitative measurements of a static body, in order to allow for previously unconsidered aesthetic values, both functional and expressional. As part of the process, we need to better understand the concrete differences between the various construction systems so as to find the principal variables with which to build a more dynamic system.

Arguably, flat pattern cutting is not automatically a simpler concept to master than modelling garments in toile on the dress-stand. Manipulating blocks may be a safe and efficient way of working, since the method begins from a shape that has already been evaluated in relation to a body; the aspect of balance is predetermined, and the notion of fit is somewhat predisposed. However, the patterns of standard garments are out there – available as an open source code for anyone equipped with a tracing wheel and some basic technical skills – so there is no need to reinvent the wheel. If the aim is to explore and develop new shapes, functions, or garment types, it is often less abstract to go into three-dimensional experimentation from the start (cf. Sevin-Doering 2007; Kirke 1998; Yamamoto 2010). This is also a hands-on way of learning how and why pattern pieces are commonly shaped as they are when taking the toiles apart. As such, the pattern turns out to be a notation of the form created, and the focus can be placed on how the garment interacts with the body instead of what the pattern looks like.
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To develop a new theory based on the notions put forward by Westwood and Sevin-Doering, I will therefore follow a concrete experimental research approach, draping with fabric on live models. First for the development of an alternative theory of the body (intended for garment construction), and secondly for the development of a derivative construction method that is exemplified in a number of prototypes that are based on this alternative theory of the body.

3.1. Design research and design of experiments: developing axioms

In recent years, there has been an increased focus on design programmes and programmatic research for propositional knowledge for change in and through experimental methods of practice-based research that are based in the (art/design) material, itself (cf. Binder et al. 2006; Brandt at al. 2007; Koskinen et al. 2010). However, while the emphasis on experimental research with the goal of exploring expressional and aesthetic qualities within the material, itself, may be strong, the definition of ‘experimentation’ as a method in design research remains both vague and quite different from the definition of the experiment in the sciences. As Steffen (2013) observes, a liberal interpretation would involve a metaphorical use of the term in the arts, whereas a strict understanding discloses a biased use of the term, not to say that it misuses and abuses the term for academic prestige among the sciences, as Steffen further argues. Where experiments in the sciences may commonly be characterised by systematic methods for the testing of hypotheses and validation of theoretical claims based on strict principles, experiments in the arts commonly lack these attributes and refer more vaguely to the uncertainty involved in a physical development process, or focus on how resulting artefacts can lead to new meanings and perspectives through the agency or associations evoked (cf. Biggs et al. 2010). Thus, experimentation in design research seems arguably more closely related to methodological aspects of ‘scientific invention’ (cf. Pointcare 2010; Farmelo 2009) than the epistemological quality of scientific experimentation. Moreover, even though experiments in art and design research are performed to support causal relations between variables, experiments have more frequently been used to gain an insight into issues of phenomenological character (Koskinen et al. 2010).

Instead of expanding on the relatively vague methodological approaches that build on the open-minded nature of the designerly-thinking designer or the mystical
intuitive process of the artist, I will instead conduct research via a more strict use of experimental methodology that is drawn from its definition and character in the sciences, specifically by looking at one of the roots for modern scientific experimentation found in Francis Bacon’s experimental method.

Bacon claimed that many medieval research methods were based on poor reasoning and a biased mindset, leading him to demand a more rigorous scientific method. The mind, he claimed, is too eager to see patterns and too willing to make generalisations which are not necessarily correct. To Bacon, scientific discovery should instead be based on a method that rids itself of such unconscious prejudices, which he grouped together into the four “Idols of the Mind”.

“Idols of the Tribe” is the tendency to perceive more order in phenomena than actually exists, due to people following their preconceptions; “Idols of the Cave” are weaknesses in reasoning because of personality, desires, and likes. “Idols of the Marketplace” refers to misunderstandings of concepts due to differing meanings in different disciplines, while “Idols of the Theatre” is the instinct to follow academic dogma rather than asking questions about the world (Bacon 2001).

For art (design) research, the first of these Idols may, for example, involve making overly broad categorisations about universal user behaviours as a result of ethnographic research. Similarly, the “Idols of the Cave” may mean that the above categorisation of behaviours is the result of the artist’s particular ideological or political convictions. The third of the Idols may involve differences in meanings between concepts such as experiment and theory in, for example, the natural sciences and fine art practice that will lead to different results because one is striving for new methods and definitions, while the other is striving for insights and interpretation. Then, for the “Idols of the Theatre”, an uncritical subscriber to any academic discourse that states something along the lines of ‘I’m a social constructionist, therefore the following is…’ imposes a certain phantom image onto the world instead of asking questions about the world.

Based on the “Idols of the Mind”, Bacon concluded that truth could be better realised through inductive reasoning by gradually making generalisations based on data accumulated from the world through experimentation, which he saw as a much more subtle form of knowledge than the sense itself:

[…] the sense itself, even when assisted by exquisite instruments—such experiments, I mean, as are skilfully and artificially devised for the express purpose of determining the point in question. […] I contrive that the office of the sense shall be only to judge of the experiment, and that the experiment itself shall judge of the thing.
[Experiments] possess this wonderful property and nature that they never deceive or fail you, for being used to discover the natural cause of some object, whatever be the result, they equally satisfy your aim by deciding the question. (Bacon 1858: 26)

The aim of the method, Bacon continues, is the investigation of forms:

[…] which are … eternal and immutable, constitute Metaphysics; the investigation of efficient causes, of matter, of hidden processes and of hidden microstructures – all of which concern the common and ordinary course of nature, not its eternal and fundamental laws. (Bacon 1952:140).

From a modern-day perspective, this definition of experimentation still seems quite reasonable, at least when considering one of the more strict definitions of ‘experiment’ as defined, for example, by Merriam-Webster (2014): “an operation or procedure carried out under controlled conditions in order to discover an unknown effect or law, to test or establish a hypothesis, or to illustrate a known law.”

Following Bacon, then, the method itself works by gradually eliminating alternative hypotheses, by moving inward in a matrix analysis which is based on procedures of constructing tables. These assist in isolating and investigating the form, nature, or cause of a phenomenon that includes a method of presence (essence), a method of divergence and nearby absence, and a method of degrees (comparison).

In the first table:

We must first present to the understanding all the known instances which agree in the same nature, although the subject matter be considerably diversified. And this collection must be made as a mere history, and without any premature reflection, or too great degree of refinement. (Bacon 1952:140).

In the second table:

We must next present to the understanding instances which do not admit of the given nature, for form (as we have observed) ought no less to be absent where the given nature is absent, than to be present where it is present. If, however, we were to examine every instance, our labour would be infinite.

Negatives, therefore, must be classed under the affirmatives, and the want of the given nature must be inquired into more particularly in objects which have a very close con-
nexio with those others in which it is present and manifest. And this we are wont to
term a table of deviation or of absence in proximity. (Bacon 1952:141)

In the third table:

[…] we must exhibit to the understanding the instances in which that nature, which
is the object of our inquiries, is present in a greater or less degree, either by comparing
its increase and decrease in the same object, or its degree in different objects: for
since the form of a thing is its very essence, and the thing only differs from its form as
the apparent from the actual object, or the exterior from the interior, or that which
is considered with relation to man from that which is considered with relation to the
universe. (Bacon 1952:145)

As Horton (1973) explains, the third table contains proper inductions with the
intention of discovering form, and in cases where the form of a thing is its essence –
not in a Platonic sense of transcendence, but as related to nature –, as nature cannot
be considered a form – which does not decrease and increase with the given nature.

3.1.1 (i) Converging causes (list of presence)

According to Bacon’s method, this means first listing all “known instances that agree in
having this nature” – i.e., garments with construction methods (competing theories)
that are based on interaction between the living body and the fabric – and, from them,
identifying possible causes (key biomechanical points and directions) that result in a
different structural relationship with the body than traditional metric pattern construc-
tion methods do. To illustrate Bacon’s point, this list will consist of the following cases
based on the moving body in interaction with fabric, among other cases:

Wrap garment
Rectangular-cut garment
Geneviève Sevin-Doering-cut garment
(see Fig. 45)
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3.1.2 (ii) Diverging causes (list of nearby absence)

Second, there is a need to create another list of cases in which the phenomenon does not occur, that is, cases in which the structure of the garments does not create an interaction between the living body and the fabric, but nonetheless where such interaction is not completely absent. For example, these may be:

- Drafting in bespoke tailoring, with structural lines abstracted
- Draping, with structural lines abstracted
- Basic pattern blocks, with structural lines abstracted
  (see Fig. 46)

3.1.3 (iii) Degrees of presence (lists of comparison)

The third step is to rank the items of the two above lists according to the degrees to which the phenomenon occurs. With regard to the degree of interactive garment structure, the ranking for list one will thus be:

1) Sevin-Doering-cut garment
2) Rectangular-uit garment
3) Wrap garment (see Fig. 47)

For the second list, it will be:
1) Draping
2) Bespoke tailoring
3) Metric pattern (see Fig. 47)

For Bacon, the purpose of these three tables – the third consisting of the ranked contents of the first two – is to present instances to the intellect to which proper induction may be employed (Bacon 1952: 149). This involves deducing the factors that correspond to the effect in (i) and (ii), as well as determining which factors change in accordance with the way the phenomenon is ranked in (iii). For the first list, this would be:
(i) Converging causes in comparison:

1. Sevin-Doering-cut garment
   • The fabric hangs from the shoulders and then wraps around the body.
   • Shaped cuts are made in the fabric towards a large number of points, spread across the body.
   • Tight-fitting garment offering great freedom of movement.

2. Rectangular-cut garment
   • The fabric hangs from the shoulders and then wraps around the body.
   • Straight cuts are made in the fabric directed towards the armpits.
   • Loose-fitting garment with great freedom of movement.

3. Dhoti (crotch, groin, back waist, and hip points)
   • The fabric hangs from the back of the waist, wraps around the hip and crotch.
   • No cuts in the fabric.
   • Not a fitted garment, with great freedom of movement for the body.

For the second list, this would be:
(ii) Diverging causes in comparison:

1. Draping
   • Refers to the horizontal width and vertical length of the body by marking on the mannequin.
   • Loose-fitting garment constructed for a certain static pose in mind.
   • Uses fabric and a static 3D representation of the body (the mannequin) as medium.

2. Bespoke tailoring
   • Based on the horizontal width and vertical length of the body in combination with adjustments for certain body types.
   • Regular-fitting garment constructed with a certain static pose in mind.
   • Uses flat paper as a medium.

3. Construction of basic blocks
   • Based on the horizontal width and vertical length of the body.
   • Tight-fitting garment constructed with a certain static pose in mind.
   • Uses flat paper as a medium. (see Fig. 47)
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Fig. 45
(i) Converging causes (list of presence)

From top to bottom:
- Wrap garment, reconstruction of a sari with direction of wrapping indicated on silhouette of the body (cf. Broby-Johansen 1953).
- Rectangular-cut garment with direction of wrapping indicated on silhouette of the body (cf. Tilke 1990).
- Geneviève Sevin-Doering-cut garment and pattern with direction of wrapping indicated (cf. Debo 2013:81, 84-85).

Fig. 46
(ii) Diverging causes (list of nearby absence)

From top to bottom:
- Drafting of jacket in bespoke tailoring, with horizontal straight structural lines (cf. Doyle 2005).
- Dress-stand for draping, with structural lines marked in red (cf. Duburg et al. 2008).
- Basic pattern blocks, with structural lines marked in red (cf. Aldrich 2004).
Fig. 47
(iii) Degrees of presence (lists of comparisons)

From top to bottom:
(i) Converging causes in comparison
1. Geneviève Sevin-Doering-cut garment
2. Rectangular-cut garment
3. Dhoti (crotch, groin, back waist, and hip points)

For the second list, this would be:
(ii) Diverging causes in comparison
1. Draping
2. Bespoke tailoring
3. Construction of basic blocks
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Fig. 48
Three-dimensional sketches for the First Vintage on miniature wooden dolls.
Fig. 49
Three-dimensional sketches for the First Vintage on half-scale (top row) and full-scale (bottom row) dress-stands.
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Fig. 50
Photo studio during photo- and draping session.
Fig. 51
Draping on model in photo studio during photo- and draping session.
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3.2 A dynamic theory of the body

What we find here is that, instead of taking the construction methods of modern dress – with its standard block patterns drawn from the tailoring matrix or its dress-stands used within draping as reference points for shape creation, as in the second list – the first approach presents us with questions directly related to the body. How does fabric react to the body? Where does it drape? How does it fall? What happens to the fabric when the body moves?

Considering the biomechanical functions of the body and the way that the fabric interacted with the living body in ancient ways of dressing, both full cloth wrap dressing and rectangular-cut garments, combined with reverse engineering and the design recovery of Geneviève Sevin-Doering’s work have presented an alternative relationship between the body and dress. As Chikofsky (1990) explains, reverse engineering is a process of analysing a system to create representations of the system at a higher level of abstraction, so as to bring about new development. Thus, design recovery may be understood as a subset to reverse engineering in which recovery means: reproducing all of the information that is required for a person to fully understand what a system (or a design programme) does, how it does it, why it does it, and so forth – as explained by Biggerstaff (1989). By quoting principal parts of Sevin-Doering’s work, various representative types of dress were recreated on live bodies by using the same working method that she had instructed me in. In this manner, a hypothesis for a kinetic or biomechanical theory for garment construction took form, the ‘First Vintage’ (see below). This hypothesis was then developed and refined through concrete experimentation while the human kinetic construction method (illustrated in Chapter 5) was developed and defined.

The directions suggest the places on the body where the fabric ‘wants’ to fall and where it may be draped so as to neither fall off the body nor restrain its movements. These lines are not suggestions for where to place seams, nor are they guides for where to measure the body, but, rather, proposals for how the fabric may be draped around the body (see Fig. 48 and 49). The way in which the fabric falls and the places where it ‘breaks’ or folds also highlights certain points towards which the cuts in a piece of fabric are suggested to be directed in order to construct garments that move along with the body and create shapes that relate to the body. As distinct from conventional draping, in this case, the ‘break-lines’ are not just ‘beautiful’ lines that exist because of how a fabric hangs when it is draped based on the traditional grid. Instead, these marginalised, ‘beautiful’ break-lines are, in themselves, part of the fundamental structure – grid – of a more dynamic approximation of the body.
Fig. 52
The First Vintage – a rough conclusion of the causes, visualised as lines and points of a more interactive approximation of the body – induced from the lists of cases.

This is a system of qualitative measurements – i.e., one that studies how fabric drapes on a living body – that are created to explain and achieve what cannot be accessed through quantitative measurements, i.e., numeric measurements that can easily be compared and used for various calculations; therefore, it is a radically different approximation of the body for garment construction. Thus, it is also a theoretical foundation that emphasizes the expression and biomechanical functions of the body rather than the pattern. It proposes an alternative way of understanding the relationship between the body and the fabric in order to allow for not previously seen aesthetic developments in dress, both functional and expressional.
The principal difference between the prevalent theory of the tailoring matrix and this human kinetic construction theory is that the latter is derived directly from how the fabric interacts with the living body instead of being derived from measurements of a static body. As such, this biomechanical construction theory proposes an alternative model for garment construction.

The above is what makes up the ‘form nature’, a dynamic theory of the body for an interactive garment construction method that is based on the listed cases. Such a rough conclusion as that in Fig. 52 is based on the first analyses of the three lists and is what Bacon terms a ‘First Vintage’. It is the first analyses and judgment of the underlying cause of the phenomenon, the form. However, it is not the final conclusion, but rather, a judged hypothesis or a rough first theory. These lines and points are what Bacon refers to as axioms, derived from the first methods of induction – “abstracted from particulars in the proper way” and which “often herald the discovery of new particulars and point them out, thereby returning the sciences to their active status” (Bacon 1952:108). Described as such, axioms, for Bacon, seem to be roughly equivalent to what, today, we would call hypotheses or tentative statements, with the purpose of suggesting experiments or observations that will either ‘support’ or ‘correct’ them (Horton 1973), and where every contradictory instance (case) destroys “an hypothesis as to the form” (cf. Bacon 1952:149). However, Bacon’s axioms, and hypotheses as their modern-day translation, are based on experimentation and clearly distinct from hypotheses determined by argument in the form of assumptions or ill-defined notions.

3.3 Analyses of axioms by experimentation

In order to arrive at the Conclusive Form of the theory, a second phase is needed; this involves a process of exclusion and refinement, where the aim is to reduce “the empirical character of experience, so that the analysis converges with an anatomy of things” (Klein 2012:97). Bacon explains this in terms of the fact that “not only each table is sufficient for the rejection of any nature, but even each single instance contained in them” (Bacon 1952:2:18). That is, any conjecture of the type along the lines of ‘Nature N belongs to form F’ is knocked out by a single contrary instance. Hence, a theory of nature – in this case, a theory of the body for developing methods of garment construction – is only approached by gradual degrees, as Bacon suggests. For Bacon, this again involves drawing up tables of presence and of absence in which the central element of the method is, again, the procedure of exclusion for the purpose of determining the
relationship between the two natures of form and matter: formal determination of real causes (theory) based on material determination (cf. Klein 2012).

However, to reduce and refine the necessary points and lines to the Conclusive Form by rejection, one cannot rely on visual analyses such as the ones in the presentation of the cases above. For Bacon, this is to say that the problems of information that is gained through the senses and that owes to the “Idols of the Mind” must be corrected by the use of experiments (cf. Bacon 1952). A visual analysis alone is only able to affirm or reject points according to the already assumed form structure that is based on particular garment types and construction systems, rather than the form structure that is their cause.

In other words, for Bacon, making is knowing, and knowing is, in the same way, making. This is based on Bacon’s rejection of the anticipation of nature in favour of an interpretation of nature that, again, starts by collecting cases in the lists – tables – above, and then investigates these systematically in a taxonomy. So far, however, it is only the order of causes that has been established, and not the proposed conclusive form. To discover the form of the given nature – the material determination of the biomechanical structure of the body – we need, therefore, to set up a series of material experiments in order to be able to reject unnecessary points and lines in the form structure. But what would such a series of experiments look like? What samples and variables should be explored in relation to one another?

Bearing in mind that the aim of the research is to develop an alternative theory of the body for garment construction based on a how the living body interacts with fabric, locating the Conclusive Form through gradual rejection, refinement, or classification of points and lines is to carry out experiments by working in two directions: (i) from cases to formal determination of material cause (from garment to theory); (ii) from formal determination of material cause to cases (from theory to garment).

The constant in these experiments is a live body with the centre back of the waist and the centre back of the neck used as starting points, based on the First Vintage hypotheses as derived from analyses of the lists of converging and diverging causes. A rectangular piece of woven fabric that is manipulated by cutting into the fabric in different lengths, directions, and shapes is used as an independent variable. The dependent variable is thus defined as the fabric’s relation to the body as influenced by the different length, directions, and shapes of the cuts made into it. The experiment begins with cuts into the rectangular piece of fabric that is placed over the shoulder or wrapped around the waist. These cuts are directed by the drape of the fabric in relation to the body (see Figs. 53 and 54) and by the biomechanical functions of the
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Fig. 53
Study of break points on a piece of fabric draped over the shoulders.

Fig. 54
Study of shape and possible points on the body.
Fig. 55
Anatomical drawing of the human muscles.

Fig. 56
Study of bodily movement directions and their axes (cf. Hulme 1944:47).
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body – gravity, balance, and movement (see Figs. 55 and 56) – and the act of cutting becomes a search for new bodily expressions.

The parameters of gravity, balance, and movement are commonly taken into consideration during the fitting of a garment or a toile: ‘how does it fall? Is the balance good? Can we see it from the side? Can you please give us a walk?’ If the pattern is drawn from ready-made blocks, one has to rely on the balance of the blocks that one is altering and on mentally visualising the body within the pattern pieces. Gravity and the moving body are present only through the experience of recognising well-known pattern shapes and what they may or may not do in interaction with a body. While draping on a dress-stand, gravity is a present axiom, but the fabric pieces, however, are often pinned in position on the dress-stand, partly abolishing the parameters of gravity and balance. The movement and, to a degree, the balance are also neglected while working with the rigid artificial body of the dress-stand.

If, instead, one works on a living body of an individual who is modelling the garments out of a single piece of fabric, the gravity, balance, and movement are present throughout the process. For practical reasons, it may sometimes be difficult to always work and shape garments on a living person, and in those situations, the dress-stand is a useful complementary tool. What is important when modelling on the dress-stand is to constantly shift between modelling on the stand and on a living body during the work process.

Figs. 58–65 show the outcome from four sets of experiments. In each set, the same type of garment has been constructed in two versions: (i) from cases to formal determination of material cause (from garment to theory), and (ii) from formal determination of material cause to cases (from theory to garment).

The first version, (i), means to start out from the notion of a specific garment in attempts to utilise the First Vintage hypothesis. A number of such experiments were carried out (cf. Lindqvist 2013). After visualising the theory from different perspectives (observing the directions and points on the body, on the garment, and on the pattern) and comparing the visualisations from the various garments to one another, a number of discrepancies were evident. These discrepancies called for a first revision of the theory. The arm and leg directions were altered, and a number of points were rejected as being part of the Conclusive Form. For example, the three garments for the upper part of the body (chemise, shirt, and tailored jacket) have a different shape around the sleeves, and hence, the shoulder points are not the same for all garments, which may cause them to be rejected.

Second, when the first rejection and revision of points and lines in the First Vintage had taken place, the same set of experiments was carried out in the opposite
direction, (ii) from formal determination of material cause to cases, i.e. beginning from the revised theory and attempting to reconstruct the garments in a manner more congruent with the revised theory. This was done to further develop the theory and in aiming to visualise the theory with a higher level of precision. During the execution of these experiments (and other experiments presented in Chapter 5), continuous refinements were made in the positioning and definition of lines and points. Thus, when analysing both (i) from cases to formal determination of material cause and (ii) from formal determination of material cause to cases, the resulting points and lines that remain the same as those found in the experiments that move from theory to garment form the ‘Conclusive Form’ or revised theory that is illustrated in Fig. 67. Points rejected during comparison of the various experiments may, however, still be valuable reference points during garment construction. As they are connected to specific shapes, garments, or body types, and not part of the Conclusive Form, they will be denoted as derived points. This applies, for example, to the points in Figs. 53 and 54, as in the different experiments, they are considered to depend on the shape of the sleeves and shoulders to varying degrees (see Figs. 58–65). The diverse definitions of the points and the reason for the different directions are presented in more detail in Chapter 4.

These four sets of experiments are examples from the experimental work that was conducted to develop the kinetic garment construction theory. They have been selected from a larger number of experiments to illustrate the methodological analysis of the experimental development of the theory from the first hypothesis of the First Vintage to the revised theory. They illustrate refinements to the actual theory as well as developments in how notations of the theoretical findings were made (i.e., how lines and points were marked in a plausible manner). The methods employed in the experiments are explained in detail in Chapter 5.

After the experimental analyses, the fundamental direction of lines and position of points were compared with an anatomical drawing of the human muscles. In the comparison, it was clear that the directions and points corresponded, to a large extent, to the muscle lines and muscle holds. After this non-scientific comparison, some minor adjustments to the exact positions of the lines were made in order for the directions to be even more congruent with the muscle directions, and these small adjustments also functioned well on the patterns. The importance of these similarities still remains to be determined.
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Fig. 57
Outline of the Baconian method. To the left, described generally, and to the right, illustrated with images from the development of the kinetic garment construction theory.
AIM

To develop a more dynamic theory of the body for pattern cutting

The Conclusive Form, or revised theory.

Rejected parts of the First Vintage, the derived points.

Experiments moving in two directions:
(i) from cases to formal determination of material cause (from garment to theory)
(ii) from formal determination of material cause to cases (from theory to garment).
Experiment attempting to utilise the First Vintage hypothesis in the form of a chemise. This experiment moves from cases to formal determination of material cause (from garment type to theory). Here, the First Vintage hypothesis is adapted to the notion of a chemise.
Fig. 59
Experiment based on the revised theory; chemise. This experiment moves from formal Experiment based on the revised theory, in the form of another chemise. This experiment moves from formal determination of material cause to cases (from theory to garment types). As compared to the First Vintage hypothesis in Fig. 58, the direction for the arms has been adjusted, and points have been added at the back of the armpit. The garment has been reconstructed so that the sleeve address only the foundational armpit points, and hence the rejected shoulder point is absent here (cf. Fig. 58). See also Section 5.2.4 for a more detailed description.
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Fig. 60
Experiment attempting to utilise the first vintage hypothesis; shirt. This experiment moves from cases to formal determination of material cause (from garment type to theory). Here, the First Vintage hypothesis is adapted to the notion of a 'classic' fitted shirt. Note the dotted lines at the sleeves and side seams connecting the grid of directions where it is intersected by the seams.
Fig. 61
Experiment based on the revised theory, in the form of another shirt. This experiment moves from formal determination of material cause to cases (from theory to garment types). As compared to the First Vintage hypothesis in Fig. 60, the direction for the arms was adjusted, and points were added at the back of the armpit. The two rejected points at the shoulder are marked in yellow, as they are not part of the Conclusive Form but are related to as derived points. The pattern was unchanged, but due to the adjustment of the arm direction, the grid is now more clearly displayed flat on the pattern. Here, the dotted lines do not connect the interfered direction, but instead indicate where on the pattern the part of the grid that continues outside of the pattern will eventually be when the garment is assembled. See also Section 5.2.10 for a more detailed description.
Fig. 62
Experiment attempting to utilise the First Vintage hypothesis in the form of a tailored jacket. This experiment moves from cases to formal determination of material cause (from garment type to theory). Here, the First Vintage hypothesis is adapted to the notion of a tailored jacket. Note the dotted lines at the sleeve setting, elbows, and side seams that connect the grid of directions where it is intersected by seams.

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Fig. 63
Experiment based on the revised theory, in the form of another tailored jacket. This experiment moves from formal determination of material cause to cases (from theory to garment types). Compared to the First Vintage hypothesis in Fig. 52, the direction for the arms was adjusted, and points were added at the back of the armpit. The three rejected points at the shoulder are marked in yellow on the pattern, and the rejected points at the elbows are marked in lilac, as they are not part of the Conclusive Form but are related to as derived points. The garment has been changed at the elbow so as to make the grid of directions more clearly displayed when flat on the pattern. Here, the line that is dotted does not connect the interfered direction, but, rather, indicates where on the pattern the part of the grid that continues outside of the pattern will eventually be when the garment is assembled.
See also Section 5.2.8 for a more detailed description.
Fig. 64
Experiment attempting to utilise the First Vintage hypothesis in the form of trousers. This experiment moves from cases to formal determination of material cause (from garment type to theory). Here, the First Vintage hypothesis is adapted to the notion of a pair of trousers. Note the dotted lines across the legs that connect the grid of directions where it is intersected by a seam.
Fig. 65
Experiment based on the revised theory, in the form of another pair of trousers. This experiment moves from formal determination of material cause to cases (from theory to garment types). As compared to the First Vintage hypothesis in Fig. 64, the direction for the legs has been adjusted, and points have been added at the back and front of the crotch, similar to the ones at the armpit. The points at the seat have been rejected as being of the same nature as the rejected shoulder points in Fig. 61 and 63. On the pattern, these points are marked in yellow, as they are not part of the Conclusive Form but are related to as derived points (see Fig. 99). The garment has been reconstructed in order for the legs to correspond to the adjustment of the leg direction; due to these two actions, the grid is more clearly displayed when flat on the pattern. (See also Section 5.2.9 for a more detailed description.)
3. DEVELOPMENT OF A THEORY FOR THE BODY

Fig. 66
The First Vintage – a rough conclusion of the causes, visualised as lines and points of a more interactive approximation of the body – induced from the lists of cases.
Fig. 67
The Conclusive Form – the revised theory, visualised as lines and points of a more interactive approximation of the body – refined and developed by experiments.

Fig. 68
The rejected, contrary instances; the derived points not being part of the Conclusive Form.
4. A HUMAN KINETIC THEORY FOR GARMENT CONSTRUCTION
In this chapter, the revised theory – a human kinetic theory for garment construction – is outlined. The chapter is primarily a graphical presentation that begins with a visual comparisons between the tailoring matrix and this kinetic garment construction theory. The theory is outlined step by step, and the characteristics of the various direction lines and points are clarified. It is worth noting that this should not be considered a closed theory attempting to authoritatively explain the nature of the body but, rather, as a theoretical model of suggesting a way of approximating the body while constructing garments. As such, the model is not presented as complete; it is continuously open to refinement.

**FUNDAMENTAL (STRUCTURAL) POINTS AND DIRECTIONS**

- Starting points, centre back of neck and waist
- Anatomical break points, front and back of armpits and crotch
- Gravity direction
- Gravity direction on rear side of body
- Balance and movement direction for torso and legs
- Balance and movement direction at rear side of body
- Balance and movement direction for arms
- Balance and movement direction for arms at rear side of body

**DERIVED (FORM) POINTS**

- Kinetic form points at front and back of knee and elbow
- Material form points

Fig. 69
Chart of fundamental (structural) points and directions, with derived (form) points.
Fig. 70
Lines from the tailoring matrix applied to the human body, illustrating the theoretical framework for construction of the vast majority of contemporary garments.
Fig. 71
Fundamental directions and points for the kinetic garment construction theory, visualised on the human body. The blue points indicate starting points, and green points indicate fundamental (structural) points.
Fig. 72
Horizontal and vertical guidelines based on measurements of the torso as drafted in a flat tailoring matrix.
Fig. 73
Flat visualisation of directions and fundamental points for the upper part of the body from the kinetic garment construction theory, based on experiments with living bodies in interaction with fabric.
Fig. 74
Horizontal and vertical guidelines based on measurements of the torso as drafted in a flat tailoring matrix with basic body blocks for women drafted within the matrix.
Fig. 75
An example of a garment pattern for torso and arms, with directions and points from the kinetic garment construction theory.
4. A HUMAN KINETIC THEORY FOR GARMENT CONSTRUCTION

Fig. 76
The fundamental directions and fundamental points of the kinetic garment construction theory, displayed on a silhouette of the body, as viewed from the front.
Fig. 77
The fundamental directions and fundamental points of the kinetic garment construction theory, displayed on a silhouette of the body, as viewed angularly from behind (left) and back (right).
The fundamental directions and fundamental points of the kinetic garment construction theory, displayed on an anatomical sketch of the body, as viewed from the front. To a large extent, the directions and points correspond to the muscle lines and muscle holds.
Fig. 79
Scheme of possible movement of arms and legs. Points at the centre of the rotation of the arms and legs inside the shoulders and hips are marked in green.
The origins of ‘kinetic’ are from the Greek word kinein, meaning ‘movement’ or ‘to move’ (Merriam-Webster 2014b). Human kinetics, or kinesiology, is the application of biomechanics in studies of human motion characteristics. From the perspective of kinetics, in considering the relationship between a piece of fabric being draped over the body, the fabric is affected by linear (translational) and angular (rotational) kinetics. Translation is caused by the net force that impacts the fabric (gravity pulling it downward), and rotation is the consequence of the net torque (the rotational and twisting movement of the body around a number of biomechanical points) (cf. Özkaya et al. 2012:89, 109).

The blue fundamental (structural) points (see Fig. 84) are the starting points for the translational net force that affects the fabric – i.e., the point from where the
direction of the fabric starts (while being affected by gravity) when it is either hanging from the shoulder or from the waist. As starting points, these points will direct the first cuts in the fabric with the aim of letting the fabric hang undisturbed from the shoulders or from the waist.

The green fundamental (structural) points (see Fig. 84) at the front and back of the armpit and crotch are the fabric’s centre points of rotation while following the movement or the arms or legs. Theoretically, these points relate to the ball and socket joints that are located at the centre of the rotation of the arms and legs, inside the shoulder or hip (see Fig. 80). However, since the fabric is located outside of the moving body and will eventually form a three-dimensional garment around the body, the points practically relate to the anatomical break points at the front and back of the

Fig. 81
The biomechanical centre points of the various rotations and twisting movements of the body that cause the fabric to ‘swing’ around the body in a direction of a ‘simple harmonic motion’.
Fig. 82
Notation of a simple harmonic motion.

Fig. 83
Notation of a damped oscillation.
armpit or the crotch. These points suggest where to cut or split the fabric in order to construct sleeves and legs of garments that are intended for the moving body.

The fundamental directions on the body outlined in this chapter may also be associated to notions of kinetics. The blue lines that begin at the centre back of the neck and continue with a direction straight downward over the chest (see Fig. 85) as well as the blue line that moves straight downward from the centre back of the waist (see Fig. 89) are affected by linear kinetics and represent the fabric in a neutral or equilibrium position, i.e., one being pulled downward by gravity. The red directions rotating around the torso (see Fig. 86) and the legs (see Figs. 88 and 89) are thus affected by angular kinetics, i.e., the movement of the torso and the legs around a number of biomechanical points (see Figs. 80 and 81). In the same manner, the arm’s movement affects the orange direction, rotating around the arms (see Fig. 87). As the body moves, the fabric ‘swings’ back and forth around the body, creating a direction comparable to – a ‘simple harmonic motion’ (see Fig. 82), or perhaps more precisely, a ‘damped oscillation’, as it swings less, the lower on the body it is (see Fig. 83).

The fundamental direction lines and fundamental points coincide, meaning that the lines either start or pass through the points (see Fig. 76). As previously explained in Chapter 3, the lines are not suggestions for where to place seams, nor are they guides for where to measure the body, but, rather, proposals for how the fabric may be draped around the body in order not to fall off of the body or restrain the movements of the body. The directions and points outlined in this chapter are recommendations for basic construction guidelines that are derived from the studies and experiments outlined in Chapter 3.

The specific direction of the rotations depends on the starting points being located at the centre back, from where the fabric swings downward, around the body. The rotational direction is also a consequence of the biomechanical movements of the arms and legs; i.e., they move forward as opposed to backward. These suggested directions are primary proposals that are based on the experiments and studies executed. However, the fabric may also be wrapped the other way around the arms or legs for specific applications; for example, to meet the demand for a seam to end in a slit at a certain point (see Sections 5.2.9 and 5.2.11), and a piece of fabric may obviously be draped over the shoulder or around the waist in the other direction, starting at the front and turning backward, in which case the rotational directions would also be reversed.

The points indicate positions on the body towards which it is suggested that cuts into a piece of fabric are directed in order to construct garments for the living body and to create shapes that relate to the body. Points that appear off the fundamental
lines are not fundamental elements of the theory and are denoted as derived (form) points (see Figs. 97 and 99). These points relate to the form of the body and to the desired form of the garment.

The lilac points at the front and back of the elbow are based on the rotational kinetics of the elbow, i.e., the centre of rotation when the arm is bending at the elbow. The same applies to the lilac points at the back and front of the knee (see Fig. 97). These points visualises as break points on the fabric at the back of the elbow and front of the knee or as creases at the front of the elbow and the back of the knee while the forearm or the shin is bending (see Fig. 96). Though these points correspond to biomechanical movements (as do the green ones), here they are classified as derived points that are not a fundamental element of the theory. These points at the elbows and knees direct the cuts if cutting a bent sleeve or leg. As the elbow and knee joints are hinge joints that allow movements in one plane only – in comparison to the ball and socket joints of the shoulders and hips, which are capable of circumduction – the demands for dynamics in the construction are less. From a functional point of view, the possible bending of a sleeve or leg is primarily contingent on the angle of extension of the limb and hence the amount of fabric in the bend of the arm or leg.

The yellow points (see Fig. 99) are derived from the translation motion of the fabric – i.e., the break points that appear due to the drape that is caused by gravity (see Fig. 98) – and may vary in appearance and utilisation, depending on various body shapes, fabric qualities, positioning of grain line, etc. Whether or not they are taken in consideration while constructing garments depends on whether or not the garment is supposed to shape to the body at these specific positions. By either cutting through such a point or leaving it uncut, one can eliminate a break point or keep it. For example, atop the shoulder, three break points appear; if one leaves all three and only cuts past the fundamental armpit points, one obtains a sleeve shape that is similar to that of a square-cut chemise, while if one places a cut going through all three of these break points, one may create a sleeve shape that is similar to that of a tailored jacket.

Garments hang on and touch the body at the blue fundamental points and at the yellow derived points and thus they appear in same position on the body and on the garment or pattern; hence, when these points are addressed, cuts often pass through the actual points. On the other hand, as the fundamental green points and the derived lilac points are fixed on the body, they shift position on the garment or pattern in relation to the body, depending on the shape and fit of the garment; i.e., the cuts in the fabric are still made towards these points on the body, but the cuts do not necessarily extend all the way to the bodily points.
The direction lines and fundamental points are intended to be valid for all body types and both sexes, while a greater number of yellow derived points might be added on a more curved body; which typically involves adding additional derived points at the bust and hips. Hence, the number of yellow derived points is the only principal difference between a male and female body within the theory. As mentioned, the point’s purpose is to assist while directing cuts into the fabric; the cuts may (but mustn’t, necessarily) pass through the points, depending on shapes, widths, scye depths, crotch depths, etc.
4. A HUMAN KINETIC THEORY FOR GARMENT CONSTRUCTION

Fig. 84
The fundamental [structural] points. The blue ones are the starting points at the centre back of the neck and at the centre back of the waist. The green ones are the ‘bodily break points’ at the back and front of the armpit and crotch. The points indicate positions on the body towards which it is suggested that cuts into a piece of fabric are directed in order to construct garments for the living body.
Fig. 85
The blue direction lines from the centre back of the neck over the shoulders and down over the chest mark the first fundamental direction. This starting point at the centre back neck directs the first cuts into the fabric with the aim of letting the fabric hang undisturbed from the shoulders. Gravity pulls downward, giving the line a direction that starts at the centre back of the neck, going forward and downward.
Fig. 86
The second fundamental direction, marked in red, addresses the balance of a garment that rests on the shoulders. The lines indicate a direction for the fabric to be draped around the torso so as to allow full movement and also to stay in place while the body moves. The lines start at the centre back of the neck (upper blue point) and move forward and down over the shoulder, then turn under the armpit, where they pass the front green armpit point and connect to themselves at the centre back of the waist (lower blue point). This direction may be associated with so-called halter-neck garments, but it is valid for any garment that rests on the shoulders (jacket, shirt, dress sweater, etc.).
The third fundamental direction, the one for the arms, is marked in orange and starts at the centre back of the neck (blue point), goes towards and past the green back armpit point, and then twists around the arms, as illustrated. The direction of the twist is the result of (1) the biomechanical properties of the arms – i.e., they move forward rather than backward (see Fig. 80) – and, (2) the fact that the twist acts as a counterpoise to the balance direction for the torso.
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Fig. 88
The red fundamental balance direction from the torso crosses itself at the centre back and continues downwards around the body pass the front crotch point, from where it goes in between the legs and twists downwards.
Fig. 89
Primarily, garments hang either from the shoulders or from the waist or hips. Like the directions on the upper part of the body, the fundamental directions on the lower part also begin at the centre back and move downward. The blue direction moves straight downward at the back and connects to the fundamental green back crotch point. The red direction, wraps around the body and passes the centre front crotch point, from where it moves in between the legs and twists downward, as illustrated.
4. A HUMAN KINETIC THEORY FOR GARMENT CONSTRUCTION

Fig. 90
The three fundamental directions and the fundamental points for the upper part of the body, displayed together; displayed on the silhouette of a body (left) and removed from the body (right).
Fig. 91
The three fundamental directions and the fundamental points for the upper part of the body, displayed as flattened out – as a possible construction grid. The orange directions (top-most) correspond to the arms, the red directions to the balance and the torso, and the blue (bottom) directions to the hang of the fabric over the shoulders.
Fig. 92
The fundamental directions and the fundamental points for the lower part of the body; displayed on the silhouette of a body (left) and removed from the body (right).
Fig. 93
The fundamental directions and fundamental points for the lower part of the body, displayed as flattened out – as a possible construction grid. The blue direction [centre] moving downwards from the centre back and the red directions [to the sides, bent] twist first around the hips and then around each leg.
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Fig. 94
The fundamental directions and fundamental points for the whole body; displayed on the silhouette of a body (left) and removed from the body (right).
Fig. 95
The fundamental directions and the fundamental points for the whole body, displayed as flattened out – as a possible construction grid. The orange directions (top-most) relate to the arms and the red directions (bottom, left and right) to the balance – first around the torso, then around the legs – and the blue directions (left-most, right-most, and centre) to the hang of the fabric over the shoulders and from the waist.
Fig. 96
Circles in red indicate the break points on the fabric of a garment that occurs when the elbow or knee is bending.
Fig. 97
Derived points in lilac. These points at the back and front of the elbows and knees relate to the rotational kinetics of the elbow and knee. On the fabric, they become visualised as creases at the front and as break points at the back of the elbow and knee while the forearm or shin is bending. These points serve as indications of where to direct cuts if constructing bent sleeves or legs.
Fig. 98
Circles in red indicate the break points – on the draped fabric that is hanging from the shoulder or the waist – from which the yellow points are derived.

4. A HUMAN KINETIC THEORY FOR GARMENT CONSTRUCTION
Fig. 99
Derived [form] points in yellow. On this female body, they are apparent on the hips, the seat, the busts, the shoulder blades, and at three positions on the shoulder. The number and positions of this kind of points may vary depending on gender, body type, posture, fabric qualities, grain line direction, etc. Whether or not they should be taken into consideration during the garment construction process depends on whether or not the garment is supposed to shape to the body at these specific positions. Note that, in theory, there could be many more of these points, as bodies have various shapes. However, in a practical sense, most of those points would have no use. This is a visualisation of points that are commonly considered within garment construction.
5. EXPLORATION OF THEORY THROUGH DEVELOPMENT OF GARMENT CONSTRUCTION METHODOLOGY
Every designer has his or her own actions and handwriting, and two designers working with the same brief are not likely to arrive at the same result even if they are taught the same working methods, at least when it comes to the relationship between function and expression. However, new working methods do allow for new expressions and functionalities.

The origin of the kinetic garment construction method outlined in this chapter is the one-piece draping method termed ‘coupe en un seul morceau’ that was established during the 1970s and 1980s by Geneviève Sevin-Doering and which has been utilised by her and a small number of apprentices since then. However, as mentioned in Section 1.6, Geneviève has not attempted to link her working method to a defined construction theory or to derive and communicate a clear, accessible methodology from her experiments and creations.

By defining the kinetic garment construction theory outlined in Chapter 4, it was also possible to further develop Geneviève’s methodology and to turn this development into a communicable visual methodology of garment construction. The method radically differs from manipulating block patterns but is somewhat similar to draping, using the same principles of pinning, cutting, and marking as described by Duburg et al. (2008). However, the method outlined here is, in contrast with traditional draping, based on the theory outlined in Chapter 4. Thus, it is also a method that primarily emphasises the expression and movement of the body and the garment, working from the body outwards and secondly the patterns’ shape, as it originates from the human kinetic garment construction theory and not from the mathematical post-construction of the tailoring matrix.

The experiments support and correct the functions of the proposed kinetic garment construction theory. Both individually and collaboratively, each example demonstrates that the theory works in practice; it is possible to apply the theory to garment making. The following examples show garment prototypes modelled from a single piece of fabric, though the number of pattern pieces that the garments is composed of is of less importance. The one-piece principle is merely a means to an end and may be compared to a beautiful proof in mathematics, or the shortest equation that can explain an experiment. The proof could be written differently, in various possible ways, but doing so would make the principle less clear.
5. EXPLORATION OF THEORY THROUGH DEVELOPMENT OF GARMENT CONSTRUCTION METHODOLOGY

**FUNDAMENTAL (STRUCTURAL) POINTS AND DIRECTIONS**
- Starting points, centre back of neck and waist
- Anatomical break points, front and back of armpits and crotch
- Gravity direction
- Balance and movement direction for torso and legs
- Balance and movement direction for arms

**DERIVED (FORM) POINTS**
- Kinetic form points at front and back of knee and elbow
- Material form points

**MARKS ON PATTERNS**
- Current cut addressed in photos and texts
- Grain line

Fig. 100
Chart of fundamental (structural) points and directions, derived (form) points and cuts, and marks on patterns.
5.1 Foundational cuts – fundamentals for repeating experiments

The initial steps or cuts of each experiment – the cuts directed towards the fundamental (blue and green) points of the kinetic garment theory – are termed ‘foundational cuts’. As these cuts, in various shapes, are part of all of the experiments, they are outlined as the basics for repeating the experiments in this first paragraph.

These initial cuts transform a piece of fabric that hangs on a living person, either from the shoulders or from the waist, into a shaped garment. Aimed towards the fundamental points, they are directed by the drape of the fabric (gravity) in relation to the biomechanical functions of the body. The parameters of gravity, balance, and movement are commonly taken into consideration during the fitting of a garment or toile. Here, however, it is entirely present throughout the garment’s construction (or shape design).

The foundational cuts presented here can be viewed in comparison with the foundational acts in flat construction or traditional draping that relate to the paradigm of the tailoring matrix, which is arguably darts, side seams, and shoulder seams.

In the step-by-step visualisations the garment are presented as toiles, and each photo shows a new cut made into the fabric; the new cut is marked in green on the accompanying pattern visualised flat, next to the photo. The points that the cuts are directed towards are visualised on the toiles, on the patterns, and on black silhouettes of bodies, and the direction that the fabric wraps around the body is marked with blue, red, or orange arrows.
5.1.1 Shoulders and arms

Fig. 101
On the black, top-level silhouettes, fundamental points for the upper part of the body are marked. The blue one is the starting point at the centre back of the neck, and the green ones are the bodily break points at the front and back of the armpit.

The size of the piece of fabric may vary, depending on the size of the body for which the garment is intended and the size of the garment, itself. Generally, however, if constructing a piece with long sleeves, the piece should be slightly wider than the arm span, and the length depends on the length of the garment – generally 1.5-2 times the final length is needed, depending on the construction.
The first foundational cut is directed towards the fundamental blue starting point at the centre back of the neck. The cut makes it possible to place the piece of fabric over the shoulder to begin modelling the garment. This cut is the green straight vertical line in the centre of the pattern. At the end, it is cut in a T-shape, as wide as the neck.

In this example, and in most of the experiments, the opening created by this cut is turned towards the centre front of the body; this does not have to be the case, as the opening can be turned in any direction, pinned together, and the modelling may then commence. However, when it is turned towards the centre front, the fabric stays in position because the natural posture of the body leans slightly forward. The length of the cut into the fabric may vary. Generally, if sleeves need to be constructed, the uncut fabric at the back will extend downward to about the waist.

The fabric is cut along the neck and smoothed out over the shoulders.
Fig. 103
After pinning the fabric together at the centre front, draped as desired over the shoulders and chest, the centre front is shaped as illustrated. The angle of this centre front cut may differ depending on posture, demand for range of movement – i.e., when lifting the arms high, the shoulders need extra space as well – and/or the desired amount of drape from the shoulders.
The foundational cuts marked in green on the pattern are directed towards the fundamental green points at the front and back of the armpits. The cuts towards these points enable directions for draping of the fabric in two planes – around the torso and around the arms – and create the foundation for the scye and sleeve settings. These cuts may have different lengths, directions, and shapes, and they may begin from different places at the edge of the fabric (as will be clear in the experiments to follow), but they are always directed towards these green points. Even though the green points are fixed on the body, they may shift position on the garment or pattern in relation to the body, depending on the shape and fit of the garment; i.e., the cuts into the fabric still aim towards these points on the body, but the cuts do not necessarily extend all the way to the bodily points. As the points are not fixed on the fabric in relation to the body, and as the fabric sometimes shifts position in relation to the body while being split and rearranged, it is suggested that the cuts start from the edge of the fabric and continue inward towards the points, as the cuts then can be made gradually in search of the desired final point. However, it can be helpful to mark estimated points and cuts on the toile with pins or a marker before cutting.

Generally, the cuts start from a position at the edge, leaving as much fabric as possible from which to model more parts. That is, in this example, the fabric will be wrapped from the front under the arms towards the centre back; the cut first aims for an estimated point at the centre back when the fabric is wrapped around the body, then turns forward under the armpit towards the front green points. The cut towards the back armpit points splits the fabric at centre back, then continues towards the back green points, leaving as much fabric as possible for later shaping of sleeves.
5.1.2 Waist and legs

Fig. 105
On the black, top-level silhouettes, fundamental points for the lower part of the body are illustrated. The blue one is the starting point at the centre back of the waist, and the green ones are the bodily break points at the front and back of the crotch.

The size of the piece of fabric may vary depending on the size of the body for which the garment is intended and the size of the garment, itself. Generally, however, if constructing an item with legs in this manner, the piece should be twice as wide as the hips and just as long as from waist to floor.
Fig. 106
The fabric is wrapped around the waist, beginning at the centre back and continuing to the centre front of the body, where it is pinned together from waist down to seat level. The first foundational cut is the short, straight, green one that is directed towards the fundamental blue starting point at the centre back of the waist, which is made to let the fabric hang without creases from the waist. This cut's depth depends on the shape of the hips: the more shaped the hips are, the deeper the cut. The curved, green cut follows the waistline horizontally from the centre back towards the centre front of the waist. Based on the depth of the first straight cut, the shape of the curved line will be different, depending on the shape of the model's hips. The shape of the curved line is also determined by the desired tightness around the hips. As the curved cut is made, creases around the hips will disappear because the fabric now hangs smoothly from the waist. Normally, the pins at the front need to be readjusted after the cut is made, as the fabric shifts position.
These cuts are made towards the fundamental point at the front of the crotch, starting at the waist and continuing downward along the pinned centre front.

Fig. 107

5. EXPLORATION OF THEORY THROUGH DEVELOPMENT OF GARMENT CONSTRUCTION METHODOLOGY
Fig. 108
This foundational cut is made towards the fundamental point at the back of the crotch, splitting the piece of fabric into two possible legs. Depending on desired crotch depth, this cut may continue all the way to the point or stop at the desired crotch depth.
5.2 Design experiments

The experiments in this section exemplify possible results while applying the kinetic theory of the body to garment construction. The experiments include men’s wear, women’s wear, and unisex garments. They stretch from rectangular-cut garments – with references to ancient dresses and basic ones, such as a piece of fabric hanging over the shoulder – to contemporary sportswear, tailoring, and garments as art installations. Some experiments, such as the rectangular-cut garments, are mainly performed to clarify the method, while others, such as the hard-shell jacket, investigate the potential of the theory to a specific application, and others still, such as the raincoat, have been made in commercial settings and put into industrial production.

Only the construction and patterns of the main parts of the garments are visualised in the experiments. The construction of pockets, collars, facings, etc. are mentioned only when relevant in relation to the construction of the shape.

What is not shown in the images, which explains how the experiments are conducted, is that every time a cut has been made into the fabric, the toile is taken off, and the cut is replicated to the other side so that both sides are symmetrical (see Fig. 109). It is also important to consider the seam allowance while cutting into the fabric and while making cuts towards, or passing by, various points.

The size of the piece of fabric may vary depending on the size of the body for which the garment is intended and the size of the garment, itself. Generally, however, if constructing an item with long sleeves, the piece should be slightly wider than the arm span, and the length depends on the length of the garment – generally 1.5–2 times the final length is needed, depending on the construction. The explanation of the experiments describes the direction from which the cuts have been made and why they have been made in that particular manner. If repeating the experiments, however, it may be difficult to make the cuts in the desired position on the first attempt – i.e., one may cut away fabric that is needed for further modelling. If that happens, or if the piece of fabric is too small from the beginning, it is suggested that an additional piece of fabric be stitched onto the main one, using the same grain direction.

The experiments are presented with photos of the results and with text describing how they develop, support, and demonstrate the theory from various perspectives. The majority of the experiments also contain a step-by-step description of how they were conducted, but such a description has been omitted for some so as to not be too repetitive, for example, in such cases when the experiments are made according to the same principles already described in other experiments.
Fig. 109
Every time a cut into the fabric has been made, the fabric is taken off of the model and folded flat along the centre back, on the floor. The cut is then replicated on the lower layer to achieve symmetry. Here, a cut for the arm is being replicated. Along the fold line, the cut for the neck is visible, along with the foundational cut at the centre front.
5.2.1 Flat rectangle – torso and arms

The flat rectangle experiment is principally constructed in the same manner as is the Bronze Age blouse from Section 2.2 (see Fig. 110).

A rectangular piece of fabric with a T-shaped cut for the head hangs from the shoulders. Apart from the T-shaped opening, the only cuts are two straight, horizontal cuts directed towards the fundamental green armpit points. The garment is two-dimensional in that it is completely flat with no shaping or depth in the construction. This experiment visualises and connects kinetic garment constructions to ancient rectangular garment construction, showing how gravity affects the fabric and how balance is achieved in the garment when the fabric at the front of the body is connected to the fabric at the back.

This experiment is connected only to the fundamental points and directions on the upper part of the body, as it involves a rectangular piece draped over the shoulders that is not shaped to the body’s silhouette.

Fig. 110
Pattern of blouse found in Silesia, from the early Bronze Age (Tilke, 1990: § 38), marked with directions and points from the kinetic theory.
Fig. 111
Toile of the flat rectangle experiment. The fabric drapes loosely over the shoulders.
5. EXPLORATION OF THEORY THROUGH DEVELOPMENT OF GARMENT CONSTRUCTION METHODOLOGY

Fig. 112
A T-shaped cut – large enough for the head to pass through – is made into the fabric prior to placing the fabric over the shoulders. It is positioned with as much fabric at the back of the T as the desired width of the sleeve (see top-left). The fabric rests from the shoulders and is pulled forward and downward by gravity, as indicated by the blue direction lines.
Fig. 113
Straight cuts at a 90° angle to the fabric edge are made from both sides directed towards the green front armpit points. The cuts are made at the same vertical position as the edge of the fabric at the back and as deep as a quarter of the fabric width, making the two cuts, together, as wide as the uncut part in the middle.
As indicated by the red direction lines, the fabric below the cuts is pulled backward under the arms, pinned together at the centre back, and joined with the top-back part. Then, the sleeves are closed beneath the arms. If the cuts are made at exactly the same vertical position as the edge of the fabric at the back and as deep as a quarter of the fabric width, the garment should end up well-balanced.
Fig. 115
The blue gravity direction, the red balance direction around the torso, and the orange direction for the arms, displayed on human silhouettes and on the garment’s pattern.
5.2.2 Rectangle – torso and arms

As in Section 5.2.1, this is also a rectangular piece of fabric with a T-shaped cut for the head, which hangs from the shoulders. However, in this case, the fabric at the back extends down to the waist; i.e., the T is placed further from the back edge. This placement is made so that enough fabric will pull forward under the arms to create a gusset-like three-dimensionality while still utilising merely straight cuts in 90° angles. This experiment links kinetic garment construction to ancient rectangular garment construction that added gussets to the rectangular pieces as a way of creating three-dimensionality.

This experiment connects only to the fundamental points and directions on the upper part of the body, as it involves a rectangular piece draped over the shoulder that is not shaped to the body’s silhouette.
Fig. 116
Toile of the rectangle experiment. The fabric from the back of the sleeve is pulled forward under the arm, creating a three-dimensionality.
A T-shaped cut – large enough for the head to pass through – is made into the fabric prior to placing the fabric over the shoulders. It is positioned so that the fabric at the back extends down to the waist (see top-left). The fabric rests from the shoulders and is pulled forward and downward by gravity, as indicated by the blue direction lines.
Fig. 118
Straight cuts are made in a 90° angle to the fabric edge from both sides directed towards the green front armpit points. Compared to the cuts in Section 5.2.1, this cut is in a higher position and ends closer to the body.
Fig. 119
Commencing at the back of the body, two straight, vertical cuts are directed upwards, towards the fundamental green armpit points. The fabric in between the cuts is cut away. The cuts end at the same vertical position as the horizontal cuts at the front. If the cuts end at exactly the same vertical position, the garment should be well-balanced upon completion.

The fabric at the front, below the cuts, is pulled backward under the arms – as indicated by the red direction lines – pinned together at the centre back, and joined to the top-back part. Care is taken to not pull the fabric too tight backward; the front green armpit points should remain at the front of the armpit and not be pulled in under the arm. Any excess fabric at the centre back is trimmed away.

Finally, the fabric that is hanging down at the back of the sleeves in the top image is pulled forward beneath the arms and pinned together (bottom-right) – first from the back, under the arm, and then outward, along the sleeve. Again, any excess fabric is trimmed away.
Fig. 120
The blue gravity direction, the red balance direction around the torso, and the orange direction for the arms, displayed on human silhouettes and on the garment's pattern.
5.2.3 Shaped shoulders

In contrast to the previous rectangular-cut experiments, this basic experiment illustrates how a piece of fabric is placed over the shoulders and shaped to the body's silhouette. Due to the fact that the posture of the body leans slightly forward, the fabric stays in position. The direction of the grain gradually shifts from straight-horizontal at the back to a bias at the centre front.
Fig. 121
Experiment illustrating how a piece of fabric hangs in an unrestrained manner over the shoulder.
A straight cut into the middle of the fabric, and then, from the end of that cut, a T-shaped cut as wide as the width of the neck is made prior to placing the fabric over the shoulders.

Fig. 122

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The front edge is trimmed vertically when the fabric drapes in an unrestrained manner over the shoulder. The angle of this cut is determined by the shape and angle of the shoulders, but it also depends on whether the fabric is draped tightly and smoothly over the shoulders (as in this example), or whether a more generous width has been applied. If the latter is the case, this cut would angle more downward.
5.2.4 Shaped shoulders – torso and arms

This experiment combines draping the fabric according to the shape of the shoulders, as in Section 5.2.3, and the way of constructing three-dimensionality, as outlined in Section 5.2.2. It is constructed closer to the body than the rectangular experiments, and the scye and sleeve seams are shaped accordingly, still allowing full movement for the arms.

Even though the fabric is shaped after the shoulders, this experiment, like the previous experiments, only connects to the fundamental points and directions on the upper part of the body. This results in a generous drape at the front and back of the sleeves.

The direction of the grain shifts gradually, from straight-horizontal at the back to a bias at the centre front. Due to the anisotropic qualities of non-stretch woven fabric – i.e., fabric that is generally non-elastic along the grain and stretchy to different degrees on the bias – it is possible on most male bodies and many female bodies to drape the fabric in this manner without creases appearing at the chest or bust.
Fig. 124
Toile of the shaped shoulder experiment. The shoulders and scye are shaped according to the body, and the seams of the sleeves twist backward.
Fig. 125
The first cuts are essentially the same as the ones in Section 5.2.3. However, the fabric is pinned together at the centre front and then trimmed after the pins. The fabric piece is as wide as the arm span and extends down to the waist in the back and down to the knees in the front.
These cuts are directed towards the fundamental green points at the front of the armpits. The cuts towards the points enable directions for draping of the fabric in two planes – around the torso and around the arms – and create the foundation for the scye and sleeve settings.

The cut starts from a position at the edge, leaving as much fabric as possible from which to model more parts. That is, as the fabric in this example will be wrapped from the front under the arms towards the centre back, the cut first aims for an estimated point at the centre back when the fabric is wrapped around the body, then turns forward under the armpit, towards the front green points. This cut is first made roughly, making it possible to position the fabric under the arms, and is then refined, defining the exact position of the green point and the balance as described in Fig. 127.

As the shoulders are shaped and the fabric is draped smoothly over the chest, the cut ends at the bodily fundamental front armpit point. The positioning of this cut towards the point is crucial for the movement of the arms in the construction.

The cut is made on one side of the body, then the toile is taken off, and the cut is replicated on the other side.
For later shaping of the sleeves, a vertical cut is made at the centre back, towards the back neck point. New cuts in a T-shape form at the top of this cut and are directed towards the back armpit points, leaving as much fabric as possible. The fabric from the front is pulled backward under the arms and is pinned together at the centre back and attached to the back part, as illustrated above. The surplus fabric at the centre back is trimmed away. When being attached to the top-back part, the positioning of the lower part defines the balance of the torso part of the garment. The cut made in Fig. 126 may need to be refined to balance the garment; i.e., the body part hangs vertically downward.
The top part of the sleeve seam is trimmed in position, as indicated on the pattern. The fabric at the back of the arm is pulled forward and preliminarily pinned in position along the scye while checking the ability to move the arm freely.
Before cutting away the fabric from the sleeve part, the sleeve is inspected along the scye – both in movement and in a relaxed position, from all angles – checking that the creases drape freely and in an unrestrained manner. After any refinements, the fabric is trimmed along the scye, attached, and is trimmed along the sleeve, as illustrated above.
Fig. 130
The blue gravity direction, the red balance direction around the torso, and the orange direction for the arms, displayed on human silhouettes and on the pattern of the shaped shoulders, torso, and arms experiment.
5.2.5 Rectangle – waist and legs

This experiment outlines the directions and fundamental points for the lower part of the body. As a rectangular piece of fabric that is wrapped around the hips is held in position by a strap constructed from only straight cuts, it connects only to the fundamental points and directions on the lower part of the body.
Fig. 131
Toile of rectangular-shaped trousers, held together at the waist by a strap.
The piece of fabric used is the same length as from the waist to the floor and twice as wide as the
distance from the centre back point, via the front crotch point, to the back crotch point. The fabric is
wrapped loosely around the hips in a straight-horizontal position. Then, the fabric is pinned together in
a straight line in a 90° angle to the fabric edge at the centre-front, at least down to the front crotch point
or to a point creating the desired crotch depth, and cut along the pinned line, as illustrated above.
A strap that holds the fabric in position is tied around the waist, and then the fabric in front of the centre-front cut is removed with a straight-horizontal cut towards the end of that first cut.

The fabric is split into two legs by a straight vertical cut at the centre-back towards the back crotch point, ending at the same vertical position as the front cut except for the seam allowance.
Finally, the fabric at the front is pulled backward in between the legs and attached to the cut at the back, and any excess fabric is trimmed away. Here, the fabric is pulled to such an extent that the fabric hangs in an unrestrained manner. If the cut at the front and back ends at the same vertical position, the trousers will be balanced in an upright position.
Fig. 135
The blue gravity direction and the red balance direction around the waist and legs, displayed on human silhouettes and on the pattern of the rectangle – waist and legs experiment.
5.2.6 Shaped waist and legs – trousers

This experiment introduces derived points at the back of the seat. By addressing these points, the trousers are shaped over the seat and the hips.

The direction of the grain is straight only at the top part of the centre back, keeping the trousers in position. A lining with the grain straight at the front prevents the waistline from stretching. Everywhere else but at the top-centre back, the grain is on the bias to various degrees, which gives the fabric different characteristics compared to conventional trousers cut on a straight grain; for example, it adds stretch qualities at the inside of the legs and below the seat at the back.

For the experimental designer, these trousers might not appear to offer a necessarily different expression than a pair of traditional trousers. However, for the men’s tailor, they exemplify a radically different take on cutting trousers that allows for not previously seen expressional values and enhanced functions.

Fig. 136 [right]
Front view of cotton trousers. The waistband is integrated in the trousers, and the waist is lined with a fused, no-stretch facing. The tank top is not part of the thesis.

Fig. 137 [overleaf]
Back view of cotton trousers. The trousers are cut with some hang at the back. The tank top is not part of the thesis.
Fig. 138
The piece of fabric used is the same length as from the waist to the floor and is twice the distance as around the waist.

The fabric is wrapped tightly around the waist and hips, starting at the centre-back and continuing forward to the centre-front of the body, where it is pinned together from the waist down to seat level. The first foundational cut is the short, straight, green one that is directed towards the fundamental blue starting point at the centre-back of the waist to let the fabric hang without creases from the waist. This cut’s depth depends on the shape of the hips; the more the hips are shaped, the deeper the cut. The curved green cut follows the waistline horizontally from the centre-back of the waist towards the centre-front. As an effect of the depth of the first straight cut, the shape of the curved line will be different, depending on the shape of the model’s hips. The shape of the curved line is also affected by the desired tightness around the hips. As the curved cut is made, creases around the hips will disappear because the fabric now hangs smoothly from the waist. Normally, the pins at the front should be readjusted after the cut is made, as the fabric shifts position.
This cut is directed towards the front crotch point and then outward in an estimated crotch curve. The depth of this cut depends on the desired crotch depth and the shape of the curve on desired garment shape and function in relation to body type. It is suggested that the curve be first cut higher than expected, then gradually trimmed into the final shape while the balance is defined, as it is connected to the back part of the trousers (see Fig. 141).
This cut is directed towards the fundamental point at the back of the crotch, splitting the piece of fabric into two possible legs. This cut may continue all the way to the point, pass through it, or stop at the desired lower point if a lower crotch is preferred. Hence, the Y-shaped cut at the end may just as well have the shape of a T or any other angle. The Y-cuts aim towards the yellow points at the back of the seat that are derived from the creases that appear on most bodies while wrapping a piece of fabric smoothly around the waist, as shown. By addressing these points, it is possible to eliminate or alter the creases and shape the garment according to the shape of the seat. On a more curved body, additional creases at the side of the hips may occur (see Fig 99), in which case the cut may continue towards such a point or points.
The crotch-shaped fabric at the front is pulled backward between the legs towards the point of the V-shaped cut at the centre-back. The pull's tightness defines the width of the legs around the thighs. When connecting the shaped crotch curve from the front to the back, the balance in the trousers is defined. This balance may be defined by standing in an upright position or with the legs bent to various degrees if additional ease of movement is desired. While defining the balance, the crotch curve is pinned to the V-shaped point at the back, and the drape of the leg is inspected from all angles. To define this balance, the crotch curve may need to be refined several times by pulling it forward again and re-cutting the curve.

When the balance has been defined for the crotch, the fabric is pulled towards the yellow derived point, pinned in position and trimmed accordingly, further defining the balance and shape of the seat. Finally, the leg is pinned together, following the red direction line, as indicated.
The toile is taken off of the body, and the cuts are replicated on the other side. The direction of the grain is straight only at the top part of the centre-back, keeping the trousers in position. In order to prevent the waistline from stretching, the use of either a waistband on the straight grain or a facing split at least once at the centre-back and with the grain straight at the front is suggested.

Everywhere else except for at the top-centre back, the grain is on the bias to various degrees, which is especially beneficial below the seat and on the inside of the legs, as it results in stretch qualities that allow for enhanced movability.

The blue gravity direction and the red balance direction around the waist and legs, along with two derived yellow points at the back of the seat, displayed on human silhouettes and on the pattern of the shaped waist and legs – trousers experiment.
5.2.7 Hard shell jacket

In order to investigate the potential for the proposed model for sports and functional wear, this hard-shell jacket was designed and prototyped in Gore-Tex Pro three-layer fabric. All seams and pockets are taped to make the jacket waterproof and, thus, most seams are kept straight to facilitate the taping. The absence of seams – at, for example, the shoulders – means fewer areas of potential leakage.

Modelling the jacket on a living body that moves while the draping occurs allows for enhanced precision in optimal positioning of the cuts and defining the amount of ease needed for various movements. It is clear that such advantages – in combination with the fact that the grain direction varies across the garment, which gives the non-stretch fabric stretch qualities – make kinetic garment construction suitable for the construction of garments that demand unrestrained movements. Due to the precision in the cuts and the utilisation of the stretch qualities of the fabric on the bias, the amount of fabric bulk under the arms (in relation to the possible movement of the arms) is quite small. In combination with an unrestrained drape from the shoulder in a relaxed position, this effect creates a most functional sleeve. The absence of seams in the shoulder area and the fabric draping on various degrees of bias over the shoulders and the arms create a light sensation over the shoulders and around the neck. At the elbows, the sleeves are shaped with cuts directed towards the lilac-derived points (see Fig. 97). The turning points for the seams are divided into two steps, which address the positions of the points at the back and front of the elbow as it is either in a relaxed or in a raised position; moreover, this division facilitates assembling as the turns become less sharp.

The stitched-in zipper at the centre-front prevents the front edge, which is on the bias, from stretching. There are zippers at the front both for pockets and for ventilation.

Apart from the immediate qualities of the jacket, another interesting aspect is its fabric consumption. Including all parts of the jacket – such as pockets, facings, hems, etc. – the consumption is 190 cm on a fabric width of 142 cm (see Fig. 144). This is in comparison to the consumption of 206 cm for an Arc'teryx Alpha jacket in the same size. The consumption of the Arc'teryx jacket was defined by reverse engineering of the pattern and generating a test layout of the same fabric width. Hence, it is clear that constructing according to the kinetic garment construction method does not, by default, result in higher fabric consumption.

Fig. 143 [right]
Front view of the hard shell jacket on a model in a relaxed position. The jacket is fully taped and finished with waterproof zippers. The surplus army long johns is not part of the thesis.
Fig. 144  
Layout of all pieces of the jacket pattern with fabric consumption and width noted.

Fig. 145  [right] Side view of the shell jacket with arm raised displaying range of movement.

Fig. 146  [overleaf left] Side view of the shell jacket with arm in relaxed position displaying the additional fabric in the bent sleeve.

Fig. 147  [overleaf right] Front view of the shell jacket with hood raised.

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The first cuts are essentially the same as the ones in Section 5.2.3, and the neckline is just a bit wider. The fabric piece is slightly wider than the arm span and extends down to the seat in the back and down to the knees in the front.
Fig. 149
These cuts are similar to the ones in Section 5.2.4 (Figs. 126 and 127). The T-shaped cut at the back addresses the two fundamental back armpit points and splits the fabric into two potential sleeves.

The cuts towards the fundamental front armpit points aim first towards an estimated centre-back point and then turn towards the back armpit point in a cut that will be attached to the top-back part. Finally, the cut moves underneath the scye, passing the front green point and ending at the foremost yellow derived point on the shoulder, which eliminates the crease that begins from here (see Fig. 98). This cut is made on one side of the body and is then replicated on the other side. The cut around the scye is straight at the back to facilitate taping of the seams.

The fabric from the front is pulled backward, pinned together at the centre-back, and attached to the top part of the back; the balance is defined at the cut towards the front green point and is then refined.
Fig. 150
The back seam is trimmed, and the shape of the hem is defined.
In a manner similar to that in Figs. 128 and 129, the fabric hanging from the back of the arm is pulled forward and preliminarily pinned in position along the scye while checking the ability to move the arm freely. Before cutting away the fabric from the sleeve part along the scye, the sleeve is inspected both in movement and in a relaxed position from all angles, checking that the creases drape freely and in an unconstrained manner. After any refinements, the fabric is trimmed along the scye, attached, and trimmed along the sleeve, as illustrated above. The slightly convex shape of the green seam line on the pattern, at the sleeve head close to the back armpit point, allows the arm to be raised higher.
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Fig. 152
At the top-left, a straight cut from the yellow point at the shoulder towards the elbow is illustrated. The cut bends two times around the bent elbow and ends at the lilac point at the front of the elbow. With the arm in the desired bent position, the fabric hanging in front of the arm is draped and pinned along the first cut and around the arm, then trimmed down. The fabric should drape without creases at the desired bend angle. For such an angle of the bending in this experiment, this line becomes almost straight. For a less bent sleeve, as in Section 5.2.8, the line will instead be concave.
The last part of the sleeve is shaped and pinned in position around the arm, which is still in a bent position. Before trimming the excess fabric away, the drape is checked from all angles in a relaxed and bent position.

The blue gravity direction, the red balance direction around the torso, and the orange direction for the arms – together with one derived yellow point at each shoulder and the lilac derived points at the elbows – displayed on human silhouettes and on the pattern of the hard-shell jacket experiment.
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5.2.8 Tailored jacket

The tailored jacket is made in two versions. The first is fully lined wool jacket constructed with a floating chest canvas. The marks on the pattern for the wool jacket refer to the First Vintage hypothesis (see Fig. 154). The second jacket is made to be congruent with the revised theory and has the same general form but is unlined and made out of cotton. The seam at the end of the sleeve follows the direction outlined (cf. Figs. 62 and 63).

The choice of making a tailored jacket, as a traditional garment tightly connected to the prevalent paradigm of garment construction, was made from an epistemological point of view, highlighting subtle but important differences in the garment. Though the resulting expression may not be all that different in the eyes of an experimental designer, it represents a radically different take on classic men’s wear to a men’s tailor. Functionally, it is worth noticing that in comparison to a traditional tailored jacket, it is possible to lift the arm to a much higher degree with this sleeve construction and utilisation of grain direction, which is comparable to a built-in gusset for extra movement being placed on the bias.

The front of the jacket is on the bias, allowing it to shape to the chest without any darts, which are otherwise commonly used in tailored jackets. The facing, however, is cut on the straight grain, holding the fold line together and preventing the front edge from stretching.
Fig. 154
Pattern of constructed tailored jacket marked with directions and points from the First Vintage [top]. Pattern of unlined tailored jacket marked with directions and points from the kinetic garment construction theory [bottom].

Fig. 155  [overleaf left] Front view of fully lined constructed tailored jacket in wool. The jacket and trousers have been painted with black paint on top of the grey fabric.

Fig. 156  [overleaf right] Back view of fully lined constructed tailored jacket in wool. The jacket and trousers have been painted with black paint on top of the grey fabric.

Fig. 157  [p.226] Front view of unlined tailored jacket in cotton.

Fig. 158  [p.227] Back view of unlined tailored unconstructed jacket in cotton.
The first cuts are essentially the same as the ones in Section 5.2.3, except that they have a larger overlap at the centre front for the buttons and buttonholes. The fabric piece is slightly wider than the arm span and extends down below the seat at the back and down to the thighs at the front.
Fig. 160
A lapel is roughly shaped and folded in position.

In contrast to the earlier experiments in which the fabric at the front has been pulled backward to the centre back, here the first cut directed towards the fundamental front armpit point begins below the back armpit point at the edge of the fabric at the seat. From the seat underneath the back part of the scye, the cut continues slightly forward, towards the front armpit point. The cut passes through the front armpit point and all three derived points at the shoulder and ends slightly above the back armpit point. The cut is replicated on the other side of the toile and the front, and all the uncut fabric now hangs from the back.
Fig. 161
The fabric at the back is pinned to the first cut, as illustrated above, defining the balance of the torso, after which the fabric is cut apart along the pins. Since the side seam is leaning diagonally backward and downward, it is possible to shape the waist rather tightly, but under the arm, where the fabric folds outward, it is recommended to not pull the fabric too tightly and let the fabric crease a bit, as this will leave room for movement.

The exact vertical position at which the pieces are pinned together at the front armpit point is crucial for the ability to later lift the arm freely. As is visible in the top-left image, the fold beneath the arm should lean downward and forward, creating a gusset-like effect when the arm is lifted upward and forward.
Fig. 162
The fabric hanging under the arm is pulled forward under the arm and upward in front of it, and a sleeve head is pinned in position and trimmed. The ability to move the arm freely is controlled, and the position of the cut towards the front and back armpit points is adjusted if needed.
The sleeve is pinned together down to the lilac point at the back of the elbow. The bottom hemline is shaped as desired.
With the sleeve in a desired bent position, a cut is made on the inside of the sleeve from the back of the elbow towards the lilac point at the front of the elbow, as illustrated. The result is that any creases that appear when the arm is bending will be straightened out.
Fig. 165
The fabric hanging loosely from the back of the elbow is pulled forward along the cut between the two lilac points, and the sleeve is shaped and pinned in position.

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Finally, the last part of the sleeve is pinned together from the front elbow point towards the sleeve opening.

The blue gravity direction, the red balance direction around the torso, and the orange direction for the arms – together with three derived yellow points at each shoulder – displayed on human silhouettes and on the pattern of the jacket experiment. The dotted red line shows the position of the balance line when the jacket has been assembled.
5.2.9 Trousers with bent legs

The top part of the trousers is the same as the trousers in Section 5.2.6 apart from the construction of the legs. This experiment was first carried out in order to investigate the possibility of creating a leg that is shaped at the knees in the same manner as for the arms in experiment Sections 5.2.7 and 5.2.8. The trousers address the yellow derived points at the seat which shape the trousers around the hips and the lilac derived points at the knees in order to create the shaped legs.

The result of the first prototype was successful in the manner of shaping the leg in the desired manner as outlined in Figs. 170 –174. The direction that the fabric was wrapped while constructing the bend at the knee differed however from what was outlined and suggested in Chapter 4 because of a desire to construct a pair of trousers without any seams at the outside of the legs. Hence, if marking the direction outlined in Fig. 89, the direction ‘leaves’ the pattern (see Figs. 172 – 174).

To further explore this incongruence between theory and method, two additional prototypes were made with the same bending of the leg but addressing the lilac points with cuts from diverse directions and hence wrapping the fabric around the knee in different manners. Fig. 175 shows a toile made as suggested by the direction outlined in Chapter 4 with a cut for creating the shape at the outside of the leg and Fig. 176 shows a toile where the fabric is wrapped all around the legs. If a direction is extracted from how the fabric is draped in Fig. 176, we are presented with an alternative direction that makes an additional turn around the leg. The bending of the knee in the toile with the seam twisting around the knee (Fig. 176) is made in the same manner as the bending at the elbows in the sleeves in Sections 5.2.7 and 5.2.8.

This experiment presents us with three versions of the same shape but with different positioning of seams and different grain directions on the legs. It also suggests an alternative turn for the leg direction in Fig. 176. This allows for possibilities of further comparative studies of diverse versions of the experiments in order to further develop and refine the theory.
The first steps, shaping the waist, are identical to the experiment in Section 5.2.6; cuts are made towards the fundamental points and to shape the crotch.
Fig. 171
From the yellow point at the back of the seat, a seam is modelled towards the front lilac point on the front of the knee.
Fig. 172
A cut is made from the front of the knee backward against the lilac point at the back of the knee, with the leg in a slightly bent position. As a result, the creases that appear when the leg is bending will be straightened out.
Fig. 173
The fabric from the front of the knee is pulled backward along the cut between the two lilac points, and the leg is shaped and pinned in position.
Fig. 174
Toile of the trousers with bent legs, with cuts towards the lilac points at front and back of knee at the inside of the legs, creating a pattern where the direction outlined in Chapter 4 "leaves" the pattern.
Fig. 175
Alternative toile of trousers with bent legs, with cuts towards the lilac points at front and back of knee at the outside of the legs, creating a pattern where the direction outlined in Chapter 4 corresponds to the pattern.

Fig. 176
Alternative toile of trousers with bent legs, with cuts towards the lilac points in a manner twisting the fabric around the leg and creating an alternative direction that makes an additional turn around the leg.
5.2.10 Shirt

Apart from the fundamental blue and green points, the shirt addresses the two most forward of the yellow derived points on the shoulder, creating a 'classic shirt sleeve'. The large-scale checks on the fabric clearly display how the grain direction varies over the garment. A placket on the straight grain at the front opening prevents the edge on the bias cut front from stretching.

Fig. 177 [right] Checked shirt in loosely woven cotton fabric. A placket on the straight grain at the front opening prevents the edge on the bias cut front from being stretched out. Trousers are from Section 5.2.9.

Fig. 178 [overleaf left] Back view of checked shirt in loosely woven cotton fabric.
Fig. 179 [overleaf right] Detail of back sleeve drape on checked shirt in loosely woven cotton fabric.
The first cuts shaping the front and neck are made in the same manner as in the experiment in Section 5.2.3. The fabric is split by vertical cuts towards the back armpit point and then forward in a curved scye line, passing through the front fundamental armpit point and the two most forward yellow points, which are derived from the very creases at the shoulder that they effectively eliminate. The cut is then replicated on the other side of the garment.

The front part is pinned together with the back, defining the balance and width around the chest and waist.
Fig. 182
The back part is split by one vertical cut along each line of pins that attach the front to the back.

Fig. 183 [bottom right]
The fabric hanging from the back of the arm is pulled forward and preliminarily pinned in position along the scye, while checking the ability to move the arm freely. Before cutting away the fabric from the sleeve part along the scye, the sleeve is inspected both in movement and in a relaxed position from all angles, checking that the creases drapes freely and in an unconstrained manner. After any refinements, the fabric is trimmed along the scye, attached, and trimmed along the sleeve, as illustrated.
Fig. 184
The blue gravity direction, the red balance direction around the torso, and the orange direction for the arms – together with two derived yellow points at each shoulder displayed on human silhouettes and on the pattern of the shirt experiment.
The dotted red line shows the position of the balance line when the shirt has been assembled.
5.2.11 Dress

In this experiment, the fabric is draped from the front of the body and joined at the centre-back in contrast to the previous experiments, in which it was draped from the centre-back neck and joined at the front. The sleeves are constructed in the same manner as the sleeve of the tailored jacket in Section 5.2.8 but are wrapped in the opposite direction around the arm.

The two main purposes of the experiment were (i) to explore the possibility of constructing tightly fitted woven garments for curved (women’s) bodies, utilising the kinetic garment construction method, in which the wearer is still able to move her arms freely, and (ii) to construct a garment in which the fabric is draped backward instead of forward, and the sleeve is wrapped around the arm in the opposite direction as from the earlier experiments.

The orange direction lines turn backward, as visualised on the pattern, instead of forward, as in the earlier experiments. However, the blue and red directions are marked in the same manner, starting from the centre-back, as this is primarily the direction in which gravity is pulling the fabric.

The dress addresses all three of the yellow derived points on the shoulder, creating a ‘blouse sleeve’ – but with a better ease of movement than many such sleeves – as well as the yellow points at the bust and seat with gusset-like cuts shaping a tightly fitted body.

This experiment illustrates that, as with any outlined method or theory, it is sometimes possible to divert from suggested guidelines; moreover, it clarifies that the outlined directions for the kinetic theory for construction are guidelines for understanding the body in interaction with fabric rather than strictly definitive rules.

Fig. 185
Tightly fitted woven wool/linen dress. The checked fabric clearly shows how the grain line varies over the garment.
Fig. 186
The blue gravity direction, the red balance direction around the torso, and the orange direction for the arms – together with derived yellow points at the bust, seat, and at three positions on each shoulder – displayed on the pattern of the dress experiment. The orange direction at the arms is pointing backward instead of forward, as on the earlier experiments, as the fabric is wrapped around the arm in the opposite direction as compared to those experiments.
Fig. 187
The orange direction at the arms wraps around the arm in the opposite direction as compared to what is suggested in Chapter 4 and how it is done in the earlier experiments. This alternative direction is illustrated here both on silhouettes of a body and on the dress.
5.2.12 Sweater

This unisex orange sweater in slightly elastic three-dimensional spacer mesh was modelled in a similar manner to that used to create the garment in the experiment in Section 5.2.4. However, the seam joining the sweater at the front is not vertical at the centre-front.

Apart from the fundamental blue and green points, the sweater addresses the most forward of the yellow derived points on the shoulder. The positions of the seams are clearly displayed by the contrasting flatlock seams.

Fig. 188
The blue gravity direction, the red balance direction around the torso, and the orange direction for the arms – together with one derived yellow point at each shoulder – displayed on the pattern of the orange sweater experiment.

Fig. 189 [right]
Side view of unisex orange sweater in slightly elastic 3D spacer mesh. The surplus army long johns are not part of the thesis.

Fig. 190 [overleaf left] Front view of unisex orange sweater in slightly elastic 3D spacer mesh on a model. The tights are not part of the thesis.

Fig. 191 [overleaf right] Back view of orange sweater in slightly elastic 3D spacer mesh on a model.
5.2.13 Electric sweater

This unisex black sweater in transparent mosquito net is, apart from the straight vertical seam in the front shape, identical to the one in Section 5.2.12. Before assembly, EL-wires were attached, illustrating the fundamental directions for the arms and torso. The experiment illustrates the possibilities of mounting wearable electronics, spread out over a garment on a one-piece pattern before assembly.

Fig. 192
The blue gravity direction, the red balance direction around the torso, and the orange direction for the arms – together with one derived yellow point at each shoulder – displayed on the pattern of the electric sweater experiment; also illustrating the placement of the EL-wires.

Fig. 193 [right]
The electric sweater on a model in a dark room.
5.2.14 Elastic shaped full body – Body stocking

This experiment encapsulates all the directions outlined in Chapter 4. Due to the elastic material, the body stocking addresses only the fundamental points. The black silhouettes throughout the thesis wear a black body stocking cut from the same pattern as the striped one presented here.

The seam lines run parallel to the outlined directions, and the stripes highlight the subtle but important variations in grain direction as the fabric is wrapped around the body.

Fig. 194 [right]
Front view of striped full body stocking.
5. EXPLORATION OF THEORY THROUGH DEVELOPMENT OF GARMENT CONSTRUCTION METHODOLOGY

Fig. 195
Pattern of full body stocking marked with directions and points together with fundamental directions and points on the black full body stocking.

Fig. 196 [right]
Back view of striped full body stocking.
5.2.15 Jumpsuit

This experiment encapsulates all the directions outlined in Chapter 4 and yellow derived points at the shoulders and seat, together with lilac points at knees and elbows for bent legs and arms.

The jumpsuit is made in two versions, highlighting different aspects of the construction. The block-striped jumpsuit in jersey viscose emphasises the direction of the fabric through the stripes and presents us with drapes of various form as the fabric hangs from the body. The grey jumpsuit with orange flat lock seams in a 3 mm-thick 3D spacer mesh exemplifies exaggerated forms, due to the stiff material, while still relating to the shape and movement of the body.

The order of working starts for the top part of the body as is outlined for the yellow hard-shell jacket in Section 5.2.7 and then continues as for the bent knee trousers in Section 5.2.9 for the bottom part.

Fig. 197 [right]
Side view of block-striped jumpsuit in jersey viscose.
5. EXPLORATION OF THEORY THROUGH DEVELOPMENT OF GARMENT CONSTRUCTION METHODOLOGY

Fig. 198
Pattern of jumpsuit marked with directions and points marked along with the directions and points on a black silhouette of the body.

Fig. 199 (right)
Front view of block-striped jumpsuit in jersey viscose

Fig. 200  [overleaf left] Back view of grey jumpsuit with orange flat lock seams in a in 3-mm thick 3D spacer mesh.

Fig. 201  [overleaf right] Side view of grey jumpsuit with orange flat lock seams in a in 3-mm thick 3D spacer mesh.
5.2.16 Raincoat

The blue-coated raincoat was designed for the Gothenburg-based denim company Nudie Jeans Summer 2015 Collection and was modelled in a similar manner as that utilised in the experiment in Section 5.2.4.

The pattern was split into smaller pieces (see Fig 203) for two reasons. First, it was necessary for fitting them on the 110 cm-wide fabric that was utilised for the coat’s production.

Second, a company such as Nudie Jeans primarily work with stereotypical garment models as, for example, five-pocket jeans, t-shirts, parkas, etc., and the added seams thus served a purpose as reference points to classic cuts such as a raglan sleeve and the seam placements at the back on classic denim jackets.

This example shows that the one-piece principle is merely a means to an end and that the pattern may eventually be in any number of pieces. Since the pieces are cut with the grain at a vertical angle, some qualities that appear in earlier experiments do not appear in the raincoat. However, in the case of Nudie Jeans, neither the expression of a bias-cut front nor the functions of unrestrained mobility of the arms are required.
The pattern of the raincoat with the blue gravity direction, the red balance direction around the torso, and the orange direction for the arms, along with one derived yellow point at each shoulder. At the top, the pattern is shown as one piece and, at the bottom, split into smaller pieces.

Fig. 203

5. EXPLORATION OF THEORY THROUGH DEVELOPMENT OF GARMENT CONSTRUCTION METHODOLOGY
The blue gravity direction, the red balance direction around the torso, and the orange direction for the arms – together with one derived yellow point at each shoulder – displayed on the raincoat.
5.2.17 Vitruvian sphere T-shirt

The Vitruvian sphere T-shirt begins from a t-shirt version of the sweater in Section 5.2.13, incorporated in a sphere that is constructed by lightweight tent poles and a mosquito net surrounding the movements of the body, as illustrated in Figs. 206 and 208. It was made for a performance at the IFFTI conference at Polimoda in Florence, in May 2015. The wearable sphere defines a notion of a sphere that encapsulates the physical movements of the arms and legs in the same manner as the circle surrounding the Vitruvian Man by Leonardo da Vinci (see Fig. 207). This paraphrase was made so that the work aligned with the conference’s theme, which related to the history of the region of Florence. As an example, the experiment highlights the generality of the theory, showing it may also work as foundation for garments, geared towards installation and performance purposes.

Fig. 205 [right]
The Vitruvian Sphere T-shirt.
5. EXPLORATION OF THEORY THROUGH DEVELOPMENT OF GARMENT CONSTRUCTION METHODOLOGY

Fig. 206
Sketch for the Vitruvian Sphere T-shirt. Scheme of possible movement of arms and legs surrounded by a circle in the same manner as on the Vitruvian Man to the right.

Fig. 207 [right]
The Vitruvian Man by Leonardo Da Vinci.
5. EXPLORATION OF THEORY THROUGH DEVELOPMENT OF GARMENT CONSTRUCTION METHODOLOGY

Fig. 209
Sketch for the Vitruvian sphere T-shirt in profile. Scheme of possible movement of arms and legs surrounded by a circle in the same manner as on the Vitruvian man.
Fig. 210
The pattern of the Vitruvian Sphere T-shirt with the blue gravity direction, the red balance direction around the torso, and the orange direction for the arms, along with one derived yellow point at each the shoulder.
6. DISCUSSION, EVALUATION OF THEORY
6.1. Theory – method – expression

The human kinetic construction theory builds on an alternative qualitative and biomechanical approximation of the body in contrast to the traditional quantitative theory, which is based on the horizontal and vertical measurement grid. The actual living body is the point of departure for the theory’s development and its applied construction method, which is an essential difference as compared to theories that are derived from outside measurements of an upright body.

The development of the kinetic garment construction method, as outlined and exemplified in Chapter 5, explores the application of this alternative theory. The method proposes diverse expressions and enhanced functions for garments in relation to the body through various examples. The kinetic garment construction method is not a method of draping in the traditional sense, even though procedures of pinning and marking from conventional draping are utilised. Instead, it proposes a working order from the body outward as opposed to methods derived from the tailoring matrix, which work from the fabric, or the pattern, inward towards the body.

In itself, the theory is not more creative than previous theories of the body for construction. It does not by default produce more flexible garments, nor does the utilisation of the theory function as any guarantee of avoiding the construction of ‘rigid’ garments. Like the tailoring matrix, it is a theory for understanding the body, and such an understanding and methods connected to it are beneficial while constructing garments, but naturally, it do not replace skills, hard work, trial and error, etc. However, as the human kinetic construction theory is derived from studies of living bodies in interaction with fabric, it is arguably a superior foundation for constructing flexible garments, and as an alternative to the tailoring matrix, it may fuel further creative works and unexplored paths of development and research.

The general grain directions and seam lines in contemporary fashion are connected to various archetypal garments, and large parts of the fashion design industry today refer to and elaborate on these archetypes. This fundamental difference in the positioning of seams and utilisation of grain direction within the kinetic garment construction method – beginning from the structure of the body and the material qualities of the fabric – presents an alternative from an expressional perspective and, though not necessarily noticeable as sweeping gestures, proposes change on a subtle but fundamental level; this becomes clear when comparing the striped body stocking made from pattern blocks derived from the prevalent tailoring matrix and the striped body stocking based on the kinetic garment construction theory in Section 5.2.14 (see Figs. 210 and 211).
6. DISCUSSION, EVALUATION OF THEORY

Fig. 210
Body stocking made from pattern blocks derived from the tailoring matrix.
Fig. 211
Body stocking based on the kinetic garment construction theory [see Section 5.2.14]
6.2 Rotations – directions – functions – expressions

The experiments in Chapter 5 serve various purposes. The rectangular ones and the ones introducing shoulder and waist shapes (Sections 5.2.1-5.2.6) connect the theoretical framework to the methodology and define general principles, such as gravity, directions, movements, and the reason why cuts are made in a certain manner. The hard-shell jacket in Section 5.2.7 explores functional enhancements that are the results of precision in cuts and grain utilisation and thus proposes an applied usage of the method. The experiment further imply that the fabric consumption can be kept at the same level or possibly reduced with this alternative working method. Applied usage is also explored in the rain coat in Section 5.2.16, demonstrating how a one-piece pattern may be split up in an industrial production.

The experiment of the tailored jacket in Section 5.2.8 – presenting a general shape comparable to an archetypal one from the prevalent theoretical framework – illustrates subtle but significant differences between the kinetic garment construction and traditional tailoring; apart from the unfamiliar positions of the seams, one difference is that the front is on the bias, draping softly over the chest without any darts shaping it, and another is the freedom of movement of the arms, which is rarely found in tailoring. The application of EL-wires to the sweater in Section 5.2.13, suggests a possible area of usage for the one-piece constructions on an otherwise familiar shape.

The jumpsuit in Section 5.2.15 incorporates the directions for the whole body in one garment, and while the experiments mentioned above relate to familiar archetypes and shapes, the jumpsuit, with its exaggerated shapes, may be the experiment that most clearly demonstrates expressional possibilities. The sphere surrounding the Vitruvian sphere T-shirt in Section 5.2.17 (also a most exaggerated shape) could arguably have been based on the tailoring matrix; however, it is debatable whether or not the idea would have come up.

As with the tailored jacket, the dress in Section 5.2.11 and the bent knee trousers in Section 5.2.8 may also be considered as examples that create similar shapes but with diverse expressional and functional qualities. However, they also exemplify alternative directions for wrapping the fabric around the body, as compared to what is outlined and argued for in Chapter 4. Should these alternative directions be viewed as a sound breakage of set up guidelines and a way of applying certain demands of expressional or functional nature, or are these alternative directions an adoption of preconceptions of how garments should be and merely a remnant from the theory of the tailoring matrix? The three versions of the same bent knee trousers with three
different directions and, hence, three different utilisations of the anisotropic qualities of the fabric, need further studies. This may be a path for future research in order to further develop and refine the theory.

6.3 Additional experiments – diversity in expressions

In addition to the experiments in Chapter 5, which were performed primarily to develop the methodology and explore and define the theory, additional work related to this thesis has been done during the time frame of this research project. Parts of three such projects are shown here, adding diversity to the exploration of the theory. The three projects have been carried out independently from each other and refer to kinetic garment construction in slightly different ways. These projects are included with the intention of bringing additional visual diversity to the discussion of how this theory might change garment construction practice.

In 2011, a number of garments that combined one-piece patterns with print design and an alternative assembling method was constructed in collaboration with Andreas Eklöf. The cutting patterns were printed on the fabrics, and the fabric was then stitched together without cutting away the excess fabric – i.e., all the fabric outside the patterns – leaving all of the fabric on the garment. Even though the project commenced before the kinetic construction theory was outlined the project exemplifies an additional expressional perspective and an extension of the method.

Jesper Danielsson at the Swedish School of Textiles in Borås, Sweden and Annabelle Fitzgerald at Massey University in Wellington, New Zealand constructed large parts of their BA graduate collection based on the earlier presentation of kinetic garment construction (Lindqvist 2013). Some examples of their work, along with patterns are presented here as a complement to the experiments in Chapter 5. Danielsson (2013) applied kinetic garment construction to function wear and performed several experiments of specific movements being connected to various physical activities.

From Fitzgerald's (2014) collection, two knitted garments are presented that were constructed by utilising the kinetic garment construction method. They demonstrate the construction method clearly, as the directions are visualised through the rib of the kint that varies in direction over the body. Along with the knits, a lightweight skirt and a pair of trousers show applications of the principles outlined in Section 5.2.6. The fluid, lightweight fabric used in the skirt adds another material aspect to the design examples, and the knitwear illustrates the expressional potential for the utilisation of
directions and principles from the theory to knitwear design.

Both Danielsson’s and Fitzgerald’s work exemplify applied design that is based on the previously outlined theoretical and methodological framework (Lindqvist 2013). Their work shows that it was possible to apply the principles of kinetic garment construction to fashion design independently utilising these previously outlined instructions (cf. Lindqvist 2013). Hopefully, the extended and more precise description in this thesis will provide a framework that allows practitioners to further apply and develop kinetic garment construction.

Fig. 212
The pattern of the dress is printed four times on the fabric: in four different colours and in four different positions. The only cuts made are for the opening of the sleeves, and then the dress is stitched together along the blue seam line.

Fig. 213 [right]
Multi-printed jersey viscose dress.
The pattern of the dress is printed four times on the fabric: in the same colour but in four different positions. However, only one set of lines is used in the assembling of the garment. The only cuts made are for the opening of the sleeves, and then the dress is stitched together along the designated seam line.

Printed pattern dress in silk georgette.
6. DISCUSSION, EVALUATION OF THEORY

Fig. 216
Front and back view of the ‘Apron wool trousers’ with white printed seam lines, along with the pattern of the trousers printed in white on black wool fabric. The only cuts made are for the crotch and waist, and then the trousers are stitched together along the printed lines. The fabric above the waistline is pulled forward and buttoned to the waist as an apron.

Fig. 217 [right]
Side view of ‘Apron wool trousers’ with seam lines printed in white.
6. DISCUSSION, EVALUATION OF THEORY

Fig. 218
Side and back view of ‘Rib knit top’ and ‘Pleat pant’ by Annabelle Fitzgerald [top left and right] together with the patterns with directions and points marked. Patterns of ‘Rib knit top’ (lower left) and ‘Pleat pant’ (lower right).

Fig. 219 [right]
Detail of ‘Pleat pant’ by Annabelle Fitzgerald.
Fig. 220
Pattern of 'Morph knit dress', with directions marked. The red balance direction lines begin at the back, pass under the arms, and meet at the front.

Fig. 221 [right]
Front view of 'Morph knit dress' by Annabelle Fitzgerald.

Fig. 222 [far right]
Back view of 'Morph knit dress' by Annabelle Fitzgerald.
Fig. 223
Front and back view of 'Suspend skirt' by Annabelle Fitzgerald along with the pattern with directions and points marked.

Fig. 224 [right]
Close-up front view of 'Suspend skirt' by Annabelle Fitzgerald.
6. DISCUSSION, EVALUATION OF THEORY

Fig. 225
Pattern with directions and points marked for 'Urban gardener jacket' by Jesper Danielsson.

Fig. 226 [right]
Back view of 'Urban gardener jacket' by Jesper Danielsson.

Fig. 227 [far right]
Side view of 'Urban gardener jacket' by Jesper Danielsson.
6. DISCUSSION, EVALUATION OF THEORY

Fig. 228
Pattern with directions and points marked for 'Urban explorer insulation jacket' by Jesper Danielsson.

Fig. 229 [right]
Side view 'Urban explorer insulation jacket' by Jesper Danielsson.

Fig. 230 [far right]
Front view 'Urban explorer insulation jacket' by Jesper Danielsson.
6.4 Generality of the theory – not about one piece

The kinetic garment construction theory is intended to be a general theory for garment construction, just as the prevalent theory of the tailoring matrix is. As one can see, it is not a theory for creating one-piece garments. The one-piece patterns may be split and adjusted into different forms regarding fabric widths, desired grain lines, etc., and the garments may then consist of any number of pattern pieces. The one-piece constructions and patterns are merely a means to an end and may be compared to the notion of beautiful proofs in mathematics or as a “beautiful evidence” (cf. Tufte 2006) connecting the garment and pattern to the theoretical framework.

This can be seen in contrast to the one-piece shell jacket, Fuse Uno, presented by North Face in 2014 (Liszewski 2014) in which its one-piece construction is highlighted (together with developments in fusing techniques) as the key development. The jacket is cut from of a single piece of fabric with a large number of darts shaping it. If analysing its pattern by applying block patterns on top of it, it is highly assumable that the jacket is constructed with a jig-saw approach from traditional block patterns and the developments is, from a construction perspective still within the prevalent discourse of the tailoring matrix work, i.e., working from the pattern towards the body.

6.4.1 Fit – form – size – consumption

As part of discussing the generality and applicability of the kinetic garment construction theory, the yellow hard-shell jacket in Section 5.2.7 was graded in three sizes, illustrating how the length and angles of the directions changed and how the points shifted position (see Fig. 231). Further graded traditional block patterns were placed on the grading principles, which were extracted from the yellow jacket. Illustrating that the fundamental construction points of the body then followed the same axes (see Fig. 232) as with a one-piece pattern, if being graded.

The grading visualisations for this discussion utilised traditional grading principles (cf. Shoben et al. 2004) that were derived from the tailoring matrix by first splitting the one-piece pattern into smaller pieces and then grading each piece separately before joining the pieces in the different sizes again to one-piece patterns. Hence, these visualisations do not discuss relationships between the two diverse theories, as both patterns were graded according to principles derived from the tailoring matrix. Instead, the comparison to the graded basic blocks was made so as to illustrate that
Fig. 231
Graded pattern for yellow hard-shell jacket, with direction lines and points marked in three sizes (top). The grading principles were derived from the yellow hard-shell jacket pattern, with direction lines and points marked in three sizes (bottom).
the kinetic garment constructing theory is, in the same manner as the tailoring matrix, supposed to be applicable to any type of human body, specific or general, and that it may be adapted to both sizing systems and individual bodies.

These visualisations should not be considered as precise instructions for grading, as they are made for an illustrative purpose, without the precision demanded for actual grading; however, they show that it is possible to grade these patterns, and furthermore suggest possible areas for further research. Since the grading principles used in the fashion industry today are derived from the horizontal and vertical lines of the tailoring matrix, the introduction of the kinetic construction theory allows for new findings and methods in the area of grading. For such investigations and possible methodological developments, it may be advisable to construct the same garment on a number of different bodies and then analyse the outcome of shape and proportions of directions and points on the flat pattern, as has been done in this thesis.

If spread and adopted, the introduction of the human kinetic construction theory may contribute to a change of the notions of fit that are derived from the tailoring matrix, predisposed beliefs of the utilisations of woven fabrics with anisotropic qualities, standards for the positioning of seams, etc.

The fact that the consumption for the hard-shell jacket in Section 5.2.7 is less than that of a comparable jacket on the market does not, of course, prove anything, necessarily, but – together with the possibility of splitting the pattern, as in the experiment in Section 5.2.16 – it does show that the theory and methodology suggested in this thesis cannot be dismissed because of any hypothetical fears of increased fabric consumption.

More generally, today’s industrial manufacturing techniques are often closely correlated with the theoretical framework of the tailoring matrix; for example, the vertical straight seams along the grain are utilised as they are easy to stitch due to the fact that the fabric does not stretch, there are special machines for setting tailored sleeves, etc. The introduction of alternative theories may lead to new manufacturing and assembling methods where traditional ones fall short.
Fig. 232
Traditional block patterns, on which has been placed the directions and points from the hard-shell jacket (top), in three sizes with graded direction lines and points (middle), and in three sizes with foundational points only (bottom).
6. DISCUSSION, EVALUATION OF THEORY

Fig. 233
The tailoring matrix constituting the framework for both general grading principles, utilising the X- and Y-axes, and for traditional drafting methods (top). The directions and points from the yellow hard-shell jacket in Section 5.2.7, used as the framework for the grading experiments in Figs. 231 and 232 and for the drafting experiment in Fig. 234–248.
6.4.2 A present body or an approximation – possible development of a new drafting methodology

Just as the tailoring matrix is utilised for both three-dimensional modelling on the dress-stand and for two-dimensional drafting and construction, similar utilisations are possible for the kinetic garment construction theory, as it is assumed to be a general theory. Here, an experiment has been carried out that drafts a pattern for a jacket with a bent sleeve based on the matrix of directions and points taken from the yellow hard-shell jacket in Section 5.2.7.

The drafting was done in the CAD software Lectra Modaris V7R2. The directions and points from the yellow hard-shell jacket were digitised, and they constituted the foundation for the drafting as outlined in Figs. 234–248. During the drafting process, three-dimensional avatars were extracted in the computer software from the flat construction so as to gradually visualise the three-dimensional result. This is not a presentation of a developed construction methodology but, rather, a potential trigger for such a development. As for the grading visualisations above, this experiment is an attempt to visually discuss the generality of the kinetic construction theory and to highlight potential areas of further research.

The experiments presented in Chapter 5 and Section 6.3 were constructed on a living body, while formulating the kinetic garment construction theory. If the theory will be used to develop alternative drafting methods based on the organic matrices derived from the patterns in Chapter 5, how then will the garments constructed in this manner interact with the moving body? Will such a possible development of a methodology, based on a theory that is derived from the actual living body, have less of a tendency to create rigid garments with questionable interactive qualities than the drafting methods that are based on the tailoring matrix? Or is it the presence of an actual body during the construction process needed to make a difference?
6. DISCUSSION, EVALUATION OF THEORY

Fig. 234
Avatar and pattern of the draft as in the stage of development pictured in Fig. 236.
Fig. 235
The left-hand side of the matrix and the points digitised from the yellow hard-shell jacket in Section 5.13, displayed in the Lectra Modaris software.

Fig. 236
The centre front line is drafted X cm in front of and the centre front line is drafted X cm in front of and parallel to the front gravity direction, ending at the same length as the direction line.

The neckline is drafted from the centre back neck point, following the front gravity direction, and continues towards the marked centre front line. The centre back is marked with a vertical line that crosses the centre back neck at the starting point.

Fig. 237
Chest width + X cm (as indicated by the balance direction line) is drafted in a 90° angle to and from the bottom of the front line.

A straight horizontal line is drafted, connecting the centre back line to the back armpit point.

Fig. 238
The distance from the crossing point of the front length and the centre back line minus the top back length is drafted in a 90° angle, passing the end of the torso balance direction line from the end of the bottom line, creating the centre back seam.
6. DISCUSSION, EVALUATION OF THEORY

Fig. 239
Avatar and pattern of the draft as in the stage of development pictured in Fig. 240.
The same distance as between the centre back line and the back armpit point is drafted in a 90° angle from the top of the centre back line.

A curved line, constituting the scye, is drafted, which passes through the foundational front armpit point, marked on the torso balance direction line and ending at the derived shoulder point.

The same distance as the scye line is drafted from the back armpit point at an angle of X degrees [angle and shape of this line determine sleeve setting design].

A line is drafted from the end of the scye line towards the marked back elbow point and from there to the marked front elbow point.

A 5 cm-long line is drafted across and centred at the back elbow point with even angles towards the earlier drafted lines.

The two lines pointing towards the elbow are shifted toward the end of the 5 cm-long line.
6. DISCUSSION, EVALUATION OF THEORY

Fig. 244
Avatar and pattern of the draft as in the stage of development pictured in Fig. 248.
Fig. 245
A 2 cm-long line is drafted at a 90° angle to the line at the front elbow point.

Fig. 246
A line is drafted at 90° to the 2 cm-long line and is connected at 90° to the point at the end of the sleeve direction line. This second line constitutes the hand width.

Fig. 247
A line is drafted from the end of the sleeve head line towards and past the elbow point and is connected to the hand width line and checked to make sure that it has the same length as the already drafted sleeve seam.

Fig. 248
The pattern is replicated on the other side to achieve symmetry, and the way that the pattern is stitched together is marked.
6.5 Anisotropic material qualities

Due to the construction of weft and warp, few woven fabrics are isotropic, i.e., “the same in all directions”, but instead – to a higher or lower degree – are anisotropic, i.e., “different in different directions” (Gordon 1981:251). Based on this technical knowledge of the general formal qualities of woven fabrics, a common preconception regarding the utilisation of the grain line is one similar to the opinion expressed by Gordon:

*If the circumstances are such that the cloth is pulled at 45 degrees, that is to say ‘on the bias’, then we shall get much larger distortions, which will, however, be symmetrical. But, should we be so inept that the cloth ends up by being pulled in some intermediate direction, which is neither one thing nor the other, then we shall not only get large distortions, but these will be highly asymmetrical. Thus the cloth will pull into some weird and almost certainly unwelcome shape. (Gordon 1981:253)*

Hence, the traditional way of utilising the grain line is to either ‘cut on the square’ – i.e., to place the grain line vertically in relation to the body to minimise stretch and distortion (cf. Efrat 1982:55) – or to cut ‘on the bias’, as introduced by Vionnet (cf. Kirke 1998; Bunka Fashion College 2002), in order to take advantage of the elastic qualities that appear and to the different drape or fall that emerges when cutting the fabric on the bias.

In addition to presenting an alternative theoretical approximation of the body and new methods of constructing garments, the kinetic garment construction theory questions these conventional utilisations of the grain direction of fabric. While wrapping the fabric around the body, the direction of the grain varies (instead of running straight vertically or being on a 45° bias) over the garment, creating diverse expressions and functions in different ways across the garment. Arguably, these asymmetrical distortions, addressed by Gordon as “weird and almost certainly unwelcome” instead have a great potential to create enhanced functions and new diverse expressions if applied in a manner congruent with the biomechanical and kinetic functions of the body. Determining how this application is best utilised, precisely, requires further research. This notion of grain direction may possibly be connected or related to the notion of Langer’s lines (Langer 1861; Li 2006:113) and the biomechanical properties of the skin (cf. Wilkes et al. 1973) that are utilised in plastic surgery and which denote the “grain direction” of the human anisotropic skin, as well as the influence of body posture and gravitational forces on the skin (Nizet et al. 2001), see Fig. 249-250.
Fig. 249
Langer’s lines denoting the “grain direction” of the skin marked with thin red lines. Along these lines the skin is less elastic than across the lines. The fundamental directions and points of the kinetic garment construction theory together with the lilac break points are marked on top of the red lines.
6.6 Representation or interaction?

The prevalent paradigm of the tailoring matrix may be the best model available for representing a static body in an upright position, but it has little to offer in explaining how the living body interacts with fabric. With its straight, horizontal and vertical guidelines, it has been proven reliable and effective in the communication of drafting systems, as well as for comparably measuring bodies, patterns, and garments. As the prevalent paradigm on which to base communication of body and garment measurements, it has also facilitated the widespread industrial praxis of designers who draw
flat sketches of front and back views of garments that are then handed over (or sent abroad) to pattern cutters in order to be constructed.

The proposed paradigm of kinetic garment construction is supposed to allow for developments and describing phenomena in garment construction in which the prevalent one falls short; in the interaction between the moving body and the fabric. Arguably, “a sound knowledge of the human form” (Hulme 1945:23) and an ability to envision the body while shaping pattern pieces are insufficient criteria for becoming a skilled pattern cutter, and an understanding of the interaction between the living body and materials, i.e., fabrics and garments, is also needed.

If the kinetic construction theory is a preferable way of describing and understanding interaction between the shapes and movements of the living body and the material qualities of fabrics and garments, will that ultimately mean that the kinetic construction theory has a potential to be considered a more graspable and rational theoretical framework than the tailoring matrix? Will methods based on this theory derived from the living body in interaction with the material ultimately be easier to learn and master as compared to those derived from the tailoring matrix?

6.7 Research methods

Research focusing on how the human kinetic and biomechanical functions of the body relate to clothing and garment construction is mainly performed from an engineering perspective and, as such, utilises “quantitative investigations of the relationship between clothing mechanical performances and human sensory (physiological and psychological) factors” (Li 2006:9). Such research is primarily focused on evaluating and refining already established theories.

The development of the kinetic garment construction theory shows that, for developing the field and introducing new theories and methods for garment construction, concrete experimentation and qualitative studies of the relationship between the living body and fabric are valid and productive research methods.

In explaining the development of the kinetic construction theory and utilising the reasoning of Francis Bacon, a proposal for an experimental methodology for design and design research is presented. The methodology – in which visual analysis of causes is followed by strict use of experiments – moves in two directions: (i) from cases to formal determination of material cause, and (ii) from formal determination of material cause to cases. With this utilisation of experiments in design research, making becomes knowing, and knowing, likewise, is making.
7. CONCLUSIONS
This thesis introduces and demonstrates an alternative paradigm of garment construction. The method of kinetic garment construction, working from the body outward instead of from the fabric or pattern and inward, is explained and clarified through a theoretical framework; a dynamic qualitative approximation of the body is presented in contrast with the prevalent static, quantitative paradigm, which is based on the horizontal and vertical measurement grid. Along with bodily movement and balance in direct interaction with fabric during the design process, this kinetic garment construction theory allows for innovative expressions in dress, as well as functional possibilities for wearing.

The human kinetic garment construction theory should be seen as a general theory; just like the traditional tailoring matrix, it can form the foundation for any kind of dress, be it wholly standardised or customised to a certain body. It is not primarily a system for creating one-piece garments. The one-piece block may be split and adjusted into different forms, and then consist of any number of pattern pieces.

Moreover, the theory is not limited in application to the method of modelling with fabric on live bodies as outlined in Chapter 5 but may also serve as a foundation for the development of flat construction methods and new grading principals that are based on various kinetic matrices derived from the living body. To further explore the hypotheses and discussion points highlighted in the discussion, a more rigorous and systematic testing and analysis is needed. In order to expand the proposed paradigm further research may focus on refining the theoretical model; exploring and defining connections between shear forces in the skin; bodily movements and anisotropic fabric qualities; further grading principles; three-dimensional modulation possibilities; etc. Though the main functions of the theory are explored and visualised in the experiments in Chapter 5, some more distinct qualities of this system may require further analysis in order to understand the difference in result between this kinetic theory of the body and the prevalent theory, which is based on traditional measurements of the body.

The questions that arise as a result of this paradigm of garment construction naturally touch on the paradigm’s expressive and functional possibilities and limitations. While the examples illustrate the basic expression and function of the kinetic construction theory, the question remains as to what extent this theory may affect garment construction practice.

Will it benefit designers to understand and take advantage of the way that the living body interacts with fabric while being dressed? May it eventually be easier to construct garments for a living body with a theoretical framework derived from the living body in interaction with fabric instead of one based on horizontal and vertical
measurements?

The human kinetic construction theory has been shown in a number of examples to be useful for creating design examples that point towards various further developments and explorations. It is a model for understanding the body, as with all models, it is inherently imperfect and incomplete, and this thesis thus ends with an open call for anyone to refine the theory or reject it outright by presenting an alternative theory for understanding the body while constructing garments.
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