APPENDIX

MASTER THESIS, INTEGRATED PRODUCT DESIGN
INDUSTRIAL DESIGN ENGINEERING

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TABLE OF APPENDICES

A. INITIAL DESIGN BRIEF

PHASEONE
what the world's best photography is made of

12. april 2017

Designing a medium format mirrorless camera.

Medium format cameras is commonly known as rather larger cameras, but they are also equivalent with modularity. Removing the mirror from the camera body would make it possible to make a smaller mirrorless camera body, but not to compromise the modularity a separate capture engine (digital back) should be kept.
Making the camera system smaller will change the balance of the camera and the system interaction will change radically. Therefor focus on these two key parameters most be highly prioritised.

Kind regards

Anders A. Raabo
R&D manager, Mechanics

B. TERMINOLOGY: CAMERA TECHNOLOGY

(sorted by English terms)

Term (Dutch)	Term (English)	Explanation
Antialias filter	Antialias filter	A filter that is used before a signal sampler to restrict the bandwidth of a signal.
Archetype	Archetype	The primal description of an entity.
Bayer patroon (sensor)	Bayer pattern	A mosaic of a colour filter array (CFA) for arranging RGB colour filters on a square grid of photosensors.
Centraalsluiter	Central shutter	A *central shutter* describes the position of the shutter: it is typically a leaf shutter (or simple leaf shutter), and located within the lens assembly where a relatively small opening allows light to cover the entire image
	Chief ray angle	The angle between the optical axis and the chief ray. The chief ray connects the object point with the center of the entry pupil.
Parallax	Coincidence rangefinder	A type of rangefinder that uses mechanical and optical principles to allow an operator to determine the distance to a visible object.
Compact Flash	Compact Flash	A type of memory card commonly used in professional cameras.
Kleinbeeld	Crop factor	A smaller version of its original parent sensor.
Gordijn	Curtain	A part of a focal-plane shutter (FPS). It is a metal blade that moves within the FPS to either block and allows the light.
Achterwand	Digital Back	A capture engine that contains a sensor, processor, storage and an user interface.
Elektronische zoeker	Electronic viewfinder	An ocular that fits a small screen and magnifier, it imitates the old optical viewfinder.
Belichting / blootstelling	Exposure	A common term to identify the amount of luminosity
	Film magazine	A part of the medium format camera that houses the film roll and transport the film correctly so the images don't overlap each other.
	Flange Focal Distance	The distance between the flange of the lens mount and the sensor. This is one of the important aspects for lens design.
Spleetsluiter	Focal-plane shutter (FPS)	A type of shutter that is used to time the amount of exposure. It consist of two curtains that drop down after each other when taking a photo. The distance between the two curtains corresponds to the shutter time.
Volbeeld	Full frame	The largest version in its category (eg. 35 mm small format)
	Global shutter	This is an electronical shutter where the entire image is scanned in one instance.
Hyperfocale scherpstelling	Hyperfocal Point Focussing	The distance between the camera and the first object
Blad sluiter	Leaf shutter	This shutter is located inside the lens. Spring-loaded metal blades move over each other to block light.

Term (Dutch)	Term (English)	Explanation
	Lens Cast Calibration (LCC)	Lens cast is a result of the sensor being exposed to light from a very sharp angle. It typically occurs as green cast in the corner stretching into a magenta cast in the opposite corner. The LCC is a photo of a neutral white plate that only show the cast effect. Software can scan the effect and compensate.
	Modulation Transfer Function (MTF)	It is used by optical engineers to describe how the optics project light from the object or scene onto a photographic film, detector array, retina, screen, or simply the next item in the optical transmission chain. The MTF is formally defined as the magnitude (absolute value) of the complex OTF
	Pressure plate	A section of a camera's internal system. A smooth plate found on the inside of the camera back that is forced towards the front of the camera by springs, causing it to hold the film evenly in place for exposure
Meetzoekercamera	Rangefinder camera	A **rangefinder camera** is a camera fitted with a rangefinder, typically a split-image rangefinder: a range-finding focusing mechanism allowing the photographer to measure the subject distance and take photographs that are in sharp focus.
	Rolling shutter	This is a more common electronical shutter where the exposed image on the sensor is scanned from top to bottom. It is more common because it demands less processing.
Gestoken scherp	Tack sharp	In reviewing a photo the focus point is perceived as clean sharp, it is a type of sharpness that is purely caused by sublime optics and distortion-free processing.
Meetzoeker	Viewfinder	An instrument, usually mounted on the camera, provides visual feedback.

C. CAMERA TYPES AND ARCHETYPE ANALYSIS

Figure 1. lay out of different types of cameras. 1. box camera 2. Twin-relfex camera with waistlevel viewfinder (WLF) 3. Single-lens reflex (SLR) medium format camera with WLF 4. SLR small format camera with pentaprism 5. SLR small format (grip introduced) 6. SLR medium format with prism viewfinder (WLF optional) 7. Digital mirrorless small format camera 8. Medium format technical camera (also mirrorless)

The evolution of the camera can be explained with the visual (Figure 2).

The box camera, 'The Kodak' for example, made it possible to capture an image handheld.

After invention of the box, people needed a better view to review their composition. The twin-lens reflex camera enabled this, however due to the dual lens construction it creates a parallax effect. However having a topview viewfinder, shooting from the hip, created a more stable grip which in turn enhanced the succes rate of steady photos.

The 35 mm film made sure that a camera can be more compact and that enabled photographers to go mobile and capture the moment.
With the invention of the single-lens reflex system, photographers were able to look 'though the lens'. People would now have an accurate review of their composition. In terms of design the camera gained a top nudget that was fitted with the pentaprism (one of the key elements of a SLR).

In the time autofocus system was invented, the sidegrip also added to the camera archetype. One could think that this not necessarily solely was triggered from an ergonomic point of view, but also a way to create space for mounting the mirror, film, autofocus metering system, motordrive and batteries.

Latest innovation, the digital mirrorless system, completely elliminates the need for space for any mechanical parts. It also cut off the physical link for the viewfinder since it only needs a data connection for the LCD display.

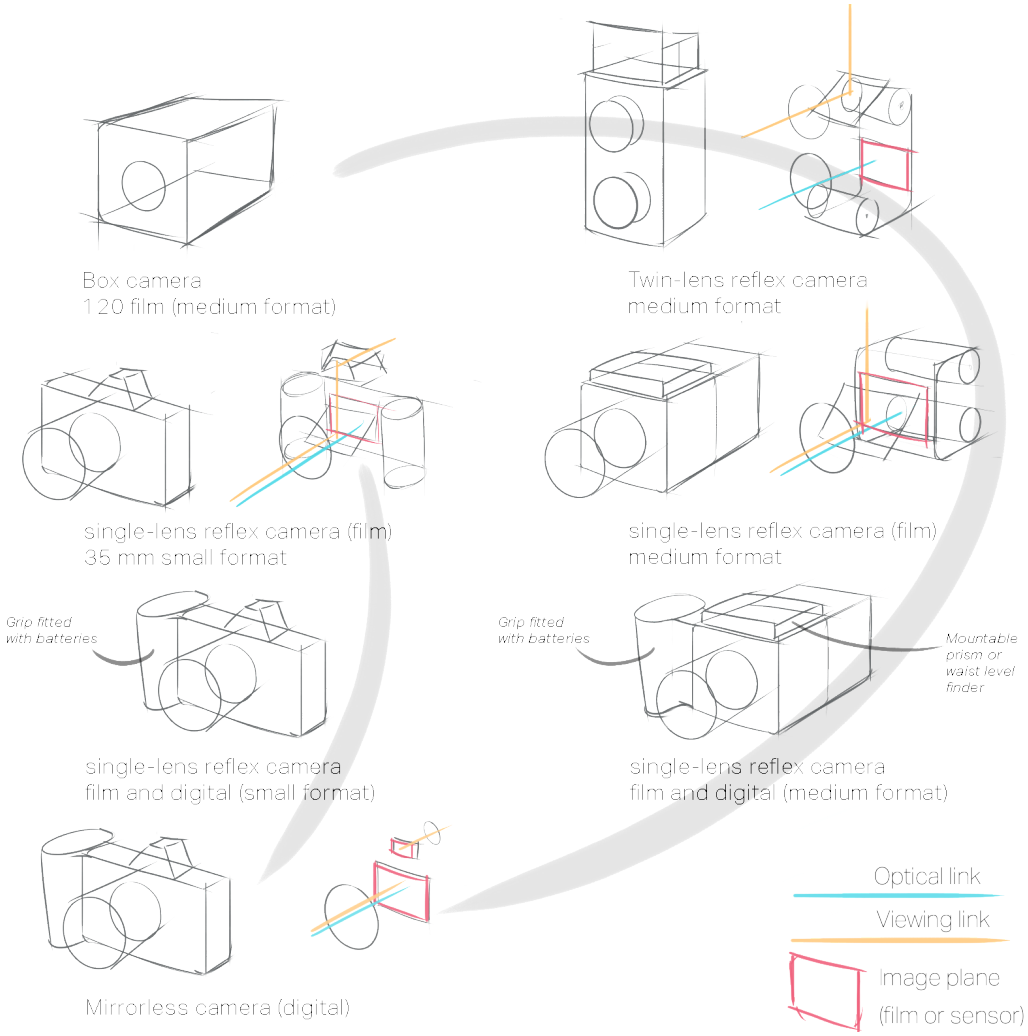


Figure 2. Archetype evolution of the camera.

D. RECORDS OF MEETINGS

D1 June 21st 2017

Meeting with Anders & Morten
Anders is R&D Manager of Mechanics and Optics, Morten is R&D Manager of Electronics.

Topics
Project update
Functionality mirrorless camera system (connectivity, new features?)

- Estimation size and weight of new digital back
- Estimation size and weight of EVF on top of digital back
- Distance between lens and digital back (flange focal distance) XF = 64,2 mm
- Consequences for lens (re)design and image quality?

Notes
The meeting first started on the roadmap, strategic proposition from R&D's point of view. The new system starts without electronic VF + extension tube to use with existing lenses.
What's the interim solution?

Reduce flange will cause to have more compact lenses in the range of wide angle lenses. Starting point for the focal flange distance = 15-25 mm

Camera system packs battery due to increased battery consumption (live view).

What is the added value of a mirrorless system? Why not screw a handle next a Magnar system? (new industrial mirrorless camera)

The meeting stayed at this topic. It's a fair question but this caused to think again about the effectuation of the camera.

D2 July 14th, 2017

First milestone meeting
with Anders Raabo, Antone Jellema, and Ruud van Heur (Skype)
Subject: Research findings and preliminary ideas.

Notes

The presented materials fairly demonstrates the problem definition. However the general impression after the presentation is that the strategic positioning of the product is more complicated and lacks fundamental backing.
After the presentation the supervisory team came to the conclusion the project needed more background information and a systematic approach in discovering opportunities.

Therefore it is decided to extend the research period with another two weeks to gather more data.

D3 July 20th, 2017

Peter Marshall
Support Department

List of wishes from current photographers:

Overlay in viewfinder – Commercial photographer

AF focus Check zoom to 100% (Something we spoke about yesterday) – Travel Photographer / Portraits

Live view exposure preview. (Basically EVF on Live view) –Landscape Photographer

Filter recommendation (Say if you exposure for the forground and your sky is too bright. Camera and look at how many stops over exposed it can be and suggest which filter to apply (Grad filters etc) to make sure all detail is captured. – Landscape

Built in GPS (With direction the camera is pointing)– Travel photographer

Head up display in EVF for the following. Virtual horizon – Vibration – DOF preview – Zebra striping focus. – Many requests from all types

Touch focus on the DB – Product / car photographers

For shooting from hip in MF a light or some confirmation that focus has been achieved. Live the WLF view on XF – Street

Digital lens interface – Ability to add "Marks or points" on a lens either with a light up on the lens or body or a beep. – Street and Adventure photographer

D4 July 21st, 2017

Stephanie Emory
Marketing

The only information Stephanie could pull about gender is in Google analytics. She has segmented the web traffic on those who visit hardware pages over the past 3 months. It is 88.65% male to 11.35% female.
Looking generally at the collaborations and social media contact, this is a pretty relevant split and is likely indicative of the actual hardware customer database.

Using the same criteria, the top 10 countries visiting Phase One hardware website are:

United States	25,58 %
Germany	7,74 %
Japan	6,24 %
UK	5,04 %
Brazil	3,65 %
Italy	3,4 %
Singapore	3,22 %
Denmark	2,79 % (probably skewed by employees)
Israel	2,54 % (propably skewed by employees)
France	2,46 %

Note that China would likely be in the top 5 if phaseone.com.cn did not exist. We do not have access to analytics about that site, but we do know that it has much more traffic than the Chinese pages on phaseone.com – and China comes in at number 11 on the list.

E. CENTER OF GRAVITY (XF SYSTEM)

In order to calculate the center of gravity of the entire XF system, every component was examined separately to determine its center of gravity. From there on, an average value was calculated by taking each component's weight and the distance up until the edge of the system (either the back or the side of the grip).

The weight of each component was determined by using a scale, instead of using the data from the brochure.

The center of weight was determined by using a narrow ridge to balance the component. When in balance, the position determines the COG and marks a reference point. Later in CAD, the distance was measured by using the same reference point.

In terms of the lens, it was assumed that the center of gravity is located in the center. Having the weights and distances, the average value could be calculated.

The crossing point indicates the average centre of gravity of the total system. As can been seen in the illustration (Figure 4), the centre of gravity is not located in the centre of the camera.

Figure 3. Photos of locating the center of gravity by balancing the separate components.

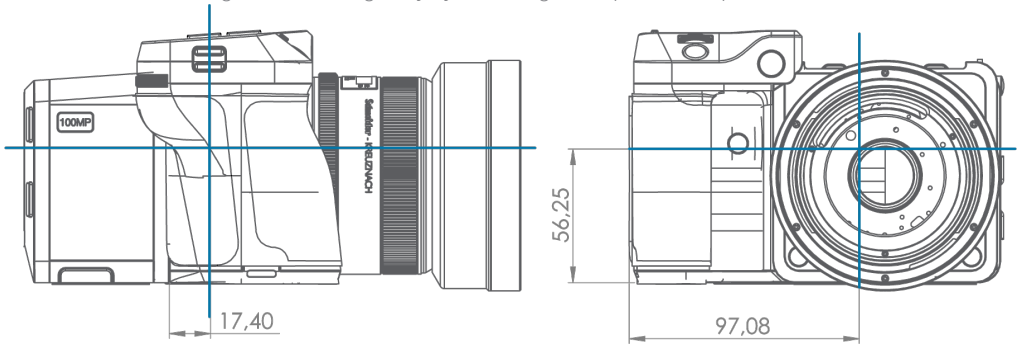


Figure 4. Centre of gravity for the entire system.

F. XF GRIP ANALYSIS

In order to design a new grip for a different camera, insights are gathered by analysing the prominent touchpoint of the XF camera; the grip. This study will include basic biomechanical principles, how the grip size relates to different sizes of hands and quantification of applied forces.

Figure 5. Holding the camera.

WORKING PRINCIPLE OF THE GRIP

To take a photo while looking in the prism viewfinder, holding up the camera with only the right hand is solely based on grip force. (Figure 5) This is because the camera is not supported underneath (when considering only the right hand), the user is not able to close his or her hand and therefore needs to apply force in order to clamp on the grip. The total weight of the XF system is 2.635 gram, this results in a vertical force load of 25,8 N.

The use of rubber on the grip creates friction in order to reduce the grip force and improve comfort. Rubber has a friction coefficiency of 1,16.

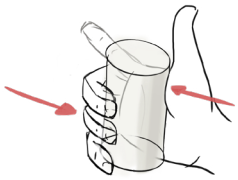


Figure 6. How the clamp is established.

The index finger will never be used for the clamp and the thumb in general as well, since they are used to actuate dials (e.g. the shutter release button). By not using the index finger, there's a reduction of maximum grip strength of 26,5% (Freivalds, 2004). The clamp therefore is established by pulling the lower three fingers towards the thumb. (Figure 6) Attached to the thumb there's a group of muscles that is called the thenar. It is fleshy and provides a comfortable area to put pressure on.

Figure 7. Moment of inertia from side view.

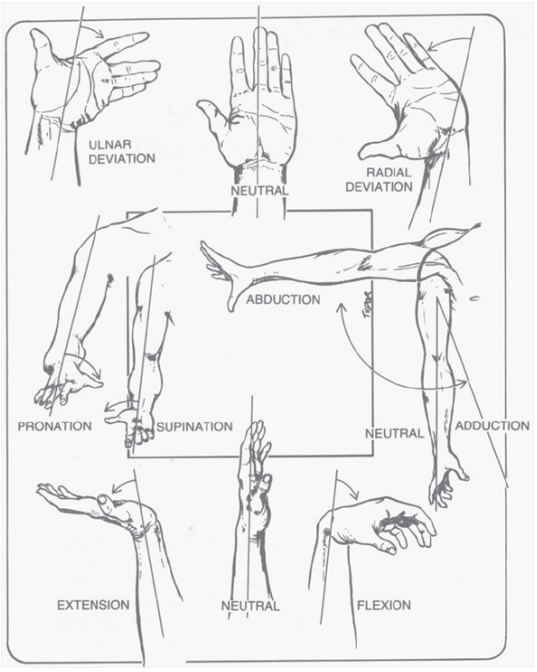


Figure 8. Joint movement of the wrist (eclosh.org)

By observing the upper limbs when a user holds the camera, the hand is fixated on the grip. (Figure 7) This fixation forces the wrist to be in ulnar deviation (Figure 8) while taking a photo from eye level. For taking a photo from waist level, this creates an impossible angle in a combination of extension and pronation.

The angle of the wrist has an affect on the grip strength (Figure 9). In ulnar deviation, the maximum achievable grip strength is reduced by 20-30% (Freivalds, 2004).

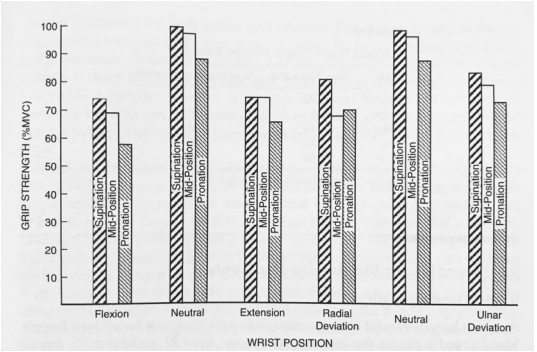


Figure 9. Grip strength as a function of wrist and forearm position (Adapted from Terell and Purswell, 1976.)

Apart from the loss of grip strength, the grip puts the angle of the wrist (in some cases) in maximum ulnar deviation. This reserves no freedom of movement for the wrist to rotate the camera in different angles or directions. If a photographer desires to do this, he or she has to move with his whole body. The ulnar deviation affects the total stability of the body for taking a photo.

To summarise the maximum grip strength a user can apply on the grip has been reduced by 26,5% due to not having an index finger and an additional 20% due to the ulnar deviation of the wrist. The working principle of the grip causes the user only to use 59% of the his or her grip strength.

SIZE OF THE GRIP

The XF has an average grip span (it is not a perfect symmetric handle) of 62 mm. In a study to a relation between grip size and grip strength (University of Nottingham, 2000), several grip sizes were used to measure maximum one handed static grip strength (Figure 10).

70, 50 and 30mm handles

Experimental trial: 1 handed grip strength (70mm handle)

Figure 10. Grip handles used in study for grip strength.

A grip size of 62 mm was not tested, however it assumed that the average of 50 mm and 70 mm can be used as an indication for the maximum static grip strength. Results from both male and female in the age groups of 31-50 and 51-60 were used to asses the XF grip.

The range in maximum grip strength,
for male (31-60): 39,8 - 49,6 N
for female (31-60): 22,4 - 35,8 N

However if we apply the reduction of 41% (ulnar deviation and 4 fingers strength) for the maximum achievable grip force, than the range would be:
for male (31-60): 23,5 N - 29,3 N
for female (31-60): 13,2 N - 21,1 N

If the required grip force is simplified to the vertical force load and friction coefficient, then the required grip force is is 22,2 N.

This shows that women, according to the study, won't be able to hold up the XF with one hand at all. This means they have to use two hands all the time. And although this does not limit their functioning. It does restrict them in freedom of movement when in some cases one hand is preferred, even if that is for just a short moment.

1 handed grip strength

Age years	Sex	No.	Small handle - 30mm (N) Mean	SD	Range	Medium handle - 50mm (N) Mean	SD	Range	Large handle - 70mm (N) Mean	SD	Range
2-5	m	8	5.80	3.84	2.00 - 11.30	5.95	3.05	2.90 - 11.1	5.59	3.98	2.42 - 12.4
	f	9	4.60	1.44	2.84 - 6.18	4.43	1.78	2.33 - 8.31	3.18	1.15	2.20 - 5.50
6-10	m	7	17.20	2.68	13.90 - 20.70	18.99	6.00	12.50 - 29.10	17.58	6.12	10.10 - 27.90
	f	11	14.01	4.28	8.10 - 19.90	15.45	5.50	9.20 - 24.90	14.32	6.76	7.50 - 27.10
11-15	m	10	24.78	7.92	14.20 - 37.90	29.21	9.91	18.40 - 52.10	30.20	11.87	18.90 - 57.10
	f	10	19.32	3.73	12.80 - 24.80	23.44	5.86	14.10 - 32.10	23.14	7.03	12.40 - 34.50
16-20	m	9	43.83	11.31	25.80 - 61.20	52.28	12.96	34.80 - 79.80	49.23	7.68	39.60 - 64.70
	f	7	22.28	6.12	16.80 - 30.80	34.51	9.85	24.20 - 50.40	32.91	6.77	25.90 - 43.40
21-30	m	7	41.77	10.33	21.50 - 51.80	49.90	9.80	33.70 - 63.40	46.26	11.77	28.70 - 68.00
	f	7	25.93	4.84	20.80 - 33.70	28.20	4.25	23.60 - 36.80	27.21	5.10	18.30 - 31.90
31-50	m	6	46.38	6.44	37.40 - 54.00	54.03	7.04	43.10 - 64.40	52.07	6.32	44.00 - 60.30
	f	11	25.28	7.01	13.60 - 35.60	31.42	4.99	21.50 - 37.30	28.89	3.52	23.30 - 34.30
51-60	m	4	29.85	3.95	25.50 - 33.30	44.45	4.08	38.70 - 47.90	44.38	4.69	40.90 - 51.20
	f	6	21.18	4.64	16.60 - 28.30	29.47	5.49	24.30 - 36.20	28.00	6.03	21.40 - 38.60
61-70	m	6	32.42	8.17	20.30 - 40.80	43.07	5.49	36.40 - 50.30	42.95	7.04	35.20 - 52.10
	f	9	16.47	5.12	11.90 - 26.70	24.39	5.47	16.80 - 32.80	23.67	5.53	14.60 - 32.00
71-80	m	8	30.71	3.98	24.30 - 37.20	35.60	6.06	25.30 - 40.00	38.05	3.09	32.90 - 41.80
	f	12	16.83	6.34	6.86 - 30.50	21.17	4.76	13.20 - 28.60	22.98	4.94	17.20 - 34.30
81-90	f	6	12.08	5.12	4.05 - 19.60	16.00	4.56	7.81 - 21.00	16.32	2.99	11.80 - 19.80

Figure 11. Maximum static gripping force of 1 hand, exerted for 5 seconds, in Newton (N).
A study by University of Nottiingham / IOE, sponsored by Dept. Trade & Industry DTI UK

LEVELLING THE CAMERA

Although photos are being taken in any direction, levelling the camera horizontally (landscape orientation) or vertically (portrait orientation) is the most common scenario. This section is divided into two parts where the points of force engagement are analyses from side and front view. The minimum force that is needed to level the camera is calculated by using the average center of gravity (COG) (Appendix E) in an equilibrium of interia.

SIDE VIEW

With the camera's mass inertia, it's preferable to have the COG as close as possible in the palm of the hand. From side view it is clear the XF camera is well balanced. (Figure 12) When rotating the camera, the centre of gravity shifts and increases the moment on the wrist.

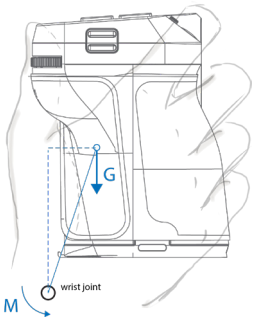


Figure 12. FBD side view

restart;
Coordinates | wrist joint - centre of gravity
$OC := \text{sqrt}(0.065^2 + 0.025^2)$

$OC := 0.06964194139$

$m := 2.635 : g := 9.81 :$

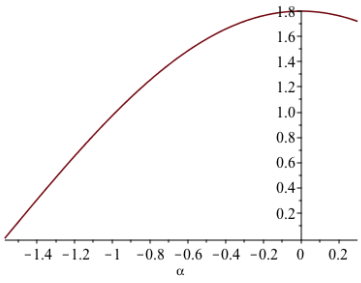
Moment of force on the wrist as result of gravitational force
$M := m \cdot g \cdot (\cos(\alpha) \cdot OC)$

$M := 1.800198918 \cos(\alpha)$

$levelled := \arccos\left(\frac{0.0174}{OC}\right)$

$levelled := 1.318271567$

$plot(M, \alpha = -1.57..0.3)$



$eval(M, \alpha = 0)$

1.800198918

Figure 13. Calculation of the moment of inertia when rotating the camera.

The moment of force on the wrist when horizontally levelled is 0,45 Nm. For a minimum effect of the COG while rotating the camera, it is desired to have it as low as possible and rather in the back than in the front. When aiming the camera completely downwards, the moment of inertia on the wrist is at its highest 1,8 Nm, increased by factor 4. (Figure 13) Lowering the COG and or the weight of the camera would decrease this factor.

FRONT VIEW

The COG seen from front view is further away from the palm. (Figure 14) This results in higher reaction forces to level the camera when considered in an equilibrium of inertia.

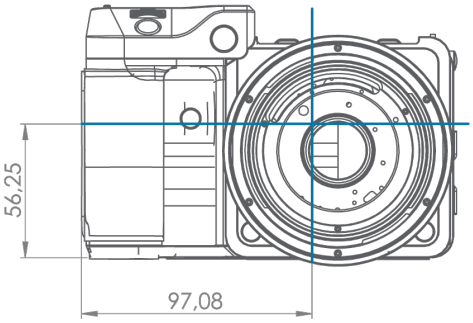


Figure 14. COG of the XF system, seen from front.

The rotation axis for leveling is located where the middle finger is positioned on the grip, close underneath the shutter release button. Leveling the camera is done by rotating the wrist lengthwise of the forearm. The middle finger therefore has a mechanical advantage by being the middle metacarpal (MCP) (Figure 15). It is also the highest point of contact with the grip.

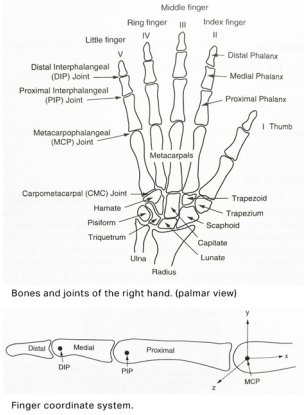


Figure 15. Bones and joints of the right hand (palmar view) with a finger coordinate system (source: Freivalds).

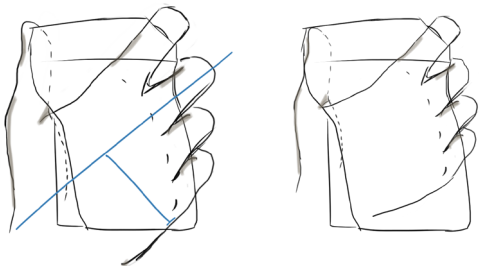


Figure 16. Comparison of how a large and a smaller hand is positioned on the grip.

If the middle finger acts as a rotation axis for levelling, the MCP of the little finger acts as a main point of force engagement for levelling the camera.

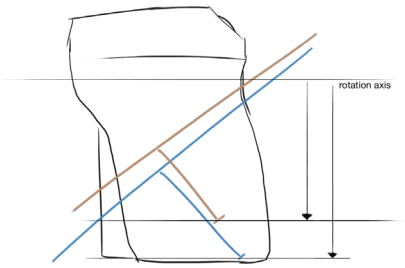


Figure 17. Size comparison of a small (orange) and big (blue)hand.

In order to apply this force, the wrist needs to deliver a moment of force that can be calculated with the distance between the little finger MCP and the middle finger MCP. This is where smaller hands are not in favour. Having a smaller hand affects the point of force engagement for levelling the camera. The smaller the hand, the smaller the lever becomes to react on the inertia force from the camera. (Figure 17) For the MCP of the little finger to be at the lowest point, the user should have a hand breadth of 90,5 mm. (Figure 18)

POPULATION

The width of the area to place a hand (perpendicular to the direction of the index finger) is measured at 90,5 mm. (Figure 18) By comparing this with anthropometric data (Figure 19, DINED), only >P42 for Dutch male adults would be able to make full use of the grip size. For women, the percentile is at P99.

When assessing the effect of size of hand breadth on the static equilibrium, the hand breadth of P50 women is 80 mm.

The reduction for the lever, in percent, comes down to 12% (80/90mm). This needs to be compensated by 12 % more force from the wrist. In comparison the hand breadth of Asian women P50 is 75 mm. This affects the equilibrium with 17%.

Measures	Percentile Hand breadth (withouth thumb)
Populations	XF grip size 90,5 mm
Dutch adults 20-60, male	P42
Dutch adults 20-60, female	P99
International male	P75
International female	P99,6
South East Asia, male	P99,96
South East Asia, female	P>99,99

Figure 19. Source: DINED

Although an increasement of 12% and 17% is not significant, in combination with the results from the static grip strength this becomes problematic for people with hands smaller than the P50 Western male.

Clearly the grip is dimensioned only for a limited range of users and everyone outside this range needs to compensate by applying more force. It seems that during the design phase of this camera, the product and system ergonomics was an undervalued aspect according to the four pillar model. (Dirken, 2008)

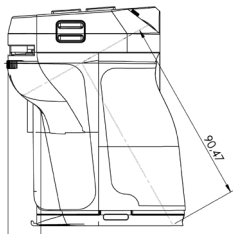
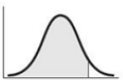


Figure 18. Distance for hand breadth



Design for the tall

G. POSTURE ANALYSIS


BlackJack
Aaron's


AUTO FOCUS
LS
35mm
1:35


Profoto
PHASE ONE


KAYU


PHASEONE

Image source: screenshots from Phase One's official YouTube channel.

H. PROJECT STORM - USE CASES

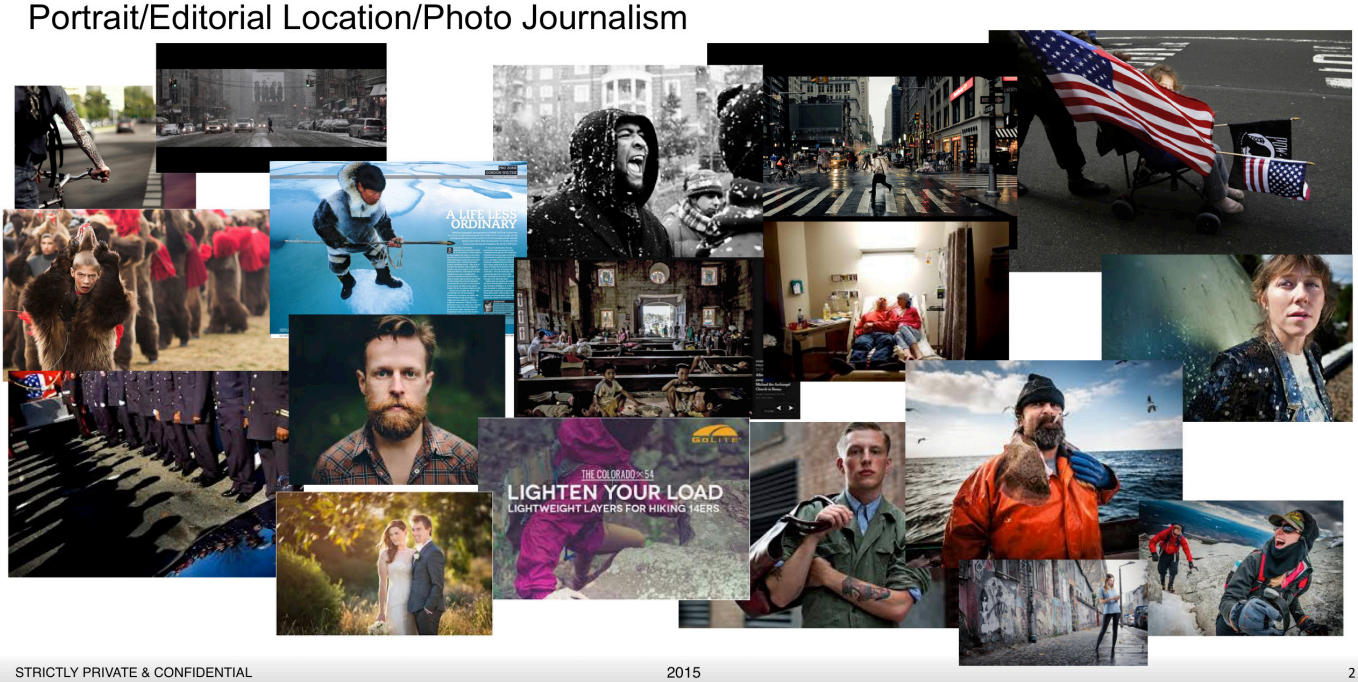
(old mirrorless camera project)

STORM: Use Cases

DJA

PHASEONE
what the world's best photography is made of

Portrait/Editorial Location/Photo Journalism

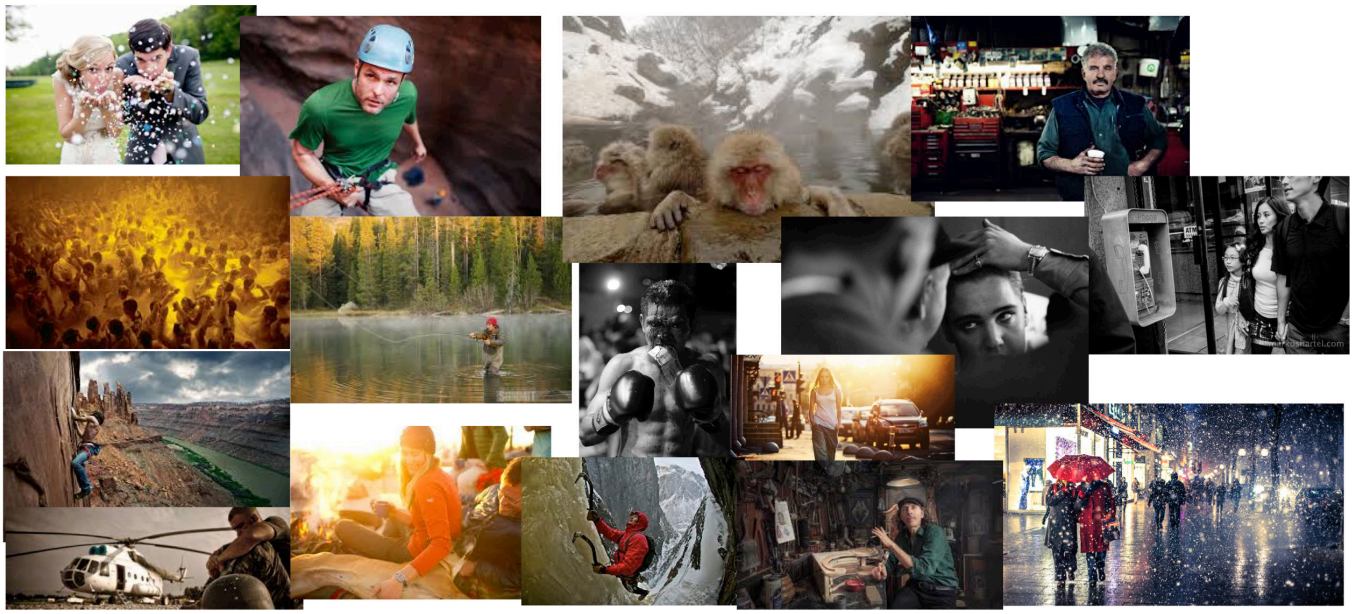


STORM: Use Cases

DJA

PHASEONE
what the world's best photography is made of

Portrait/Editorial Location/Photo Journalism con't

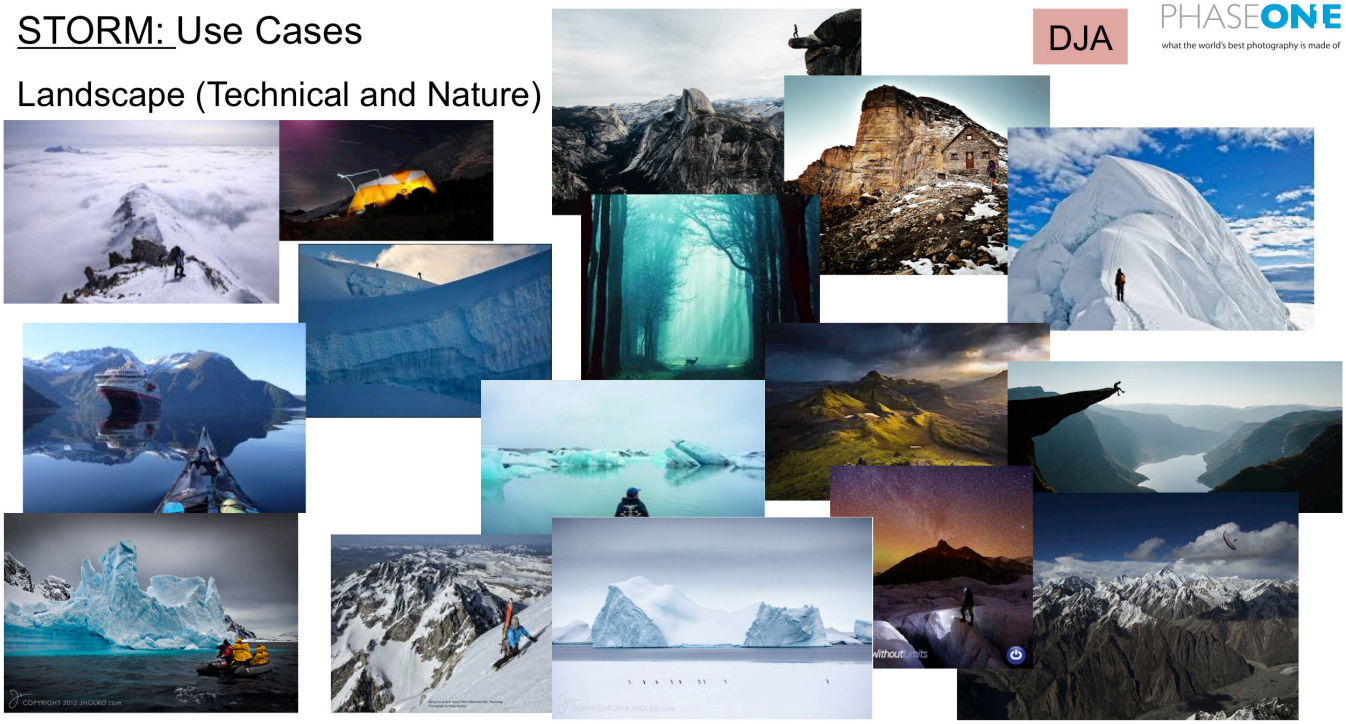


STORM: Use Cases

DJA

PHASEONE
what the world's best photography is made of

Landscape (Technical and Nature)



STORM: Use Cases

DJA

PHASEONE
what the world's best photography is made of

Product Editorial/Lifestyle

I. SEQUENCE OF ACTIVITIES

I1. Action & Adventure photographer

Scenario
Photoshoot of a rockclimber during an ascent on a vertical cliff. The idea is well preconceived, planning and preparation are crucial for a succesfull end result.

Goal
A mix of documentary and advertising for an outdoor company. The goal is to capture the climber's efftort from multiple angles.

Goal-related tools
High-end camera as a main tool with a very limited variety of lenses. A small carry-on bag is used to be able to switch lenses on the cliff. Photoshoot is often impossible to replan.

Environment
Remote location in nature on a vertical cliff.

the probability of non-intended use is low since the professional has a thorough knowledge of the equipment.
the probability of malfunction is slightly higher due to extreme conditions.

Main Process Groups: Originate - Distribute - **Use** - Discard

Creating footage for marketing campaign of an outdoor company.

Get product on location
- Transport camerabag (in vehicle)
- Carry camerabag / trolley
- Unpack: open bag + take product
- Assemble camera
  - mount digital back
  - mount viewfinder
  - mount lens
  - check battery
  - check memory

Prepare Photoshoot
- Conversation client / subject (aligning goals)
- Put on climbing gear (harness and safety devices)
- Put on camera carry-on bag
- Put on camera, hanging on body
- Start climbing to preferred first spot. (angle 1)

Taking the shot
- Fixate on first spot.
- Set camera settings
- Test exposure
- Observe situation / wait for moment
- Ready posture
- Frame the shot
- Set focus
- Recompose the shot
- Take the shot
- Review the image
  - Review image
  - scroll to next image
  - Zoom in on image
  - Rate image
  - can repeat from frame the shot
- Adjust camera settings
- can repeat from start climbing ...

Variables for the posture applicable to scenario
Hanging in rope | handheld | eye VF | prime lens | intermediate pace |

I2. Journalism & Documentary (editorial)

Scenario
Photoshoot of behind the scenes in a restaurant. The idea of the end result can be preconceived.

Goal
Create a story-telling ambience by documenting in-action moments, the scenery and portraits of role figures.

Goal-related tools
High-end camera as a main tool with a variety of lenses. Backup can be either the same type, a smaller 35 mm digital camera or no backup at all. Photoshoot can be replanned.

Environment
Restaurant kitchen, dining area and/or street.

the probability of non-intended use is low since the professional has a thorough knowledge of the equipment.

Main Process Groups: Originate - Distribute - **Use** - Discard

Creating an ambience in a behind-the-scenes of a restaurant.

Get product on location
- Transport camerabag (in vehicle)
- Carry camerabag / trolley
- Unpack: open bag + take product
- Assemble camera
  - mount digital back
  - mount viewfinder
  - mount lens
  - check battery
  - check memory

Discuss and prepare Photoshoot
- Conversation client / subject (aligning goals)
- Walk around scenery
- Framing shots for ideas

Taking the shot
- Walk up to scenery
- Set camera settings
- Test exposure -
- Observe situation / wait for moment
- Ready posture
- Frame the shot
- Set focus
- Recompose the shot
- Take the shot
- Review the image
  - Review image
  - scroll to next image
  - Zoom in on image
  - Rate image
  - can repeat from frame the shot...
- Adjust camera settings (+repeat framing)
- Can repeat again from walk to scenery...

Variables for the posture applicable to scenario
Flat ground / object (chair) | handheld | eye VF / WL VF | prime lens |

J. VARIABLES FOR THE WORKFLOW AND POSTURE

1. type of camera	DSLR | Technical Camera | mirrorless
2. Environment	Ground (flat/slope) | Object | Hanging (in rope) | Vehicle | Underwater
3. Mount	Handheld | Leaning | Tripod | UAV
4. Visual feedback	(prism) Viewfinder | Waist Level viewfinder | External monitor
5. Type of Lens	Prime lens | Zoom lens | Tilt-Shift
6. Orientation Photo	Portrait | Landscape
7. Add-on	Without vertical grip | with vertical grip | remote flash trigger
8. Perspective	Low from ground | Waist level (kneeling / bow) | Eyesight | Overhead
9. Pace photoshoot	Slow (static) | Intermediate | Fast (dynamic)

K. APPLICATION CLUSTERS FOR SYSTEM CONCEPT

The following groups are classified by looking for similarities in key values of their workflow, most used attributes and variables that influence their postures.

The size of the groups are based on market sizing research, commisioned by Phase One. This is included in the confidential appendices.

Group A.
Applications:
- Action & Sports
- Journalism & Documentary
- Events & Weddings

Rationale: Handheld outdoors. Dynamic interaction and switch faster between activities. The need to move around easily. A high ISO performance in order to be less dependent on ambient light.

Group B.
Applications:
- Portrait
- Fashion & Beauty

Rationale: Handheld indoors. Focus-capture responsiveness and accuracy is key. Control external flash and tethering workflow.

Group C. Applications:
- Landscape & Wildlife
- Architecture & Interior
- Automotive

Rationale: Mostly used on tripod in the outdoors. Technical performance is key. In the workflow reviewing the exposure and composition is desired. Note: in automotive flash and composite technique is used often, but does not interfere with other values.

Group D.
Applications:
- Food
- Creative Still Life
- Product
- Other (repro)

Rationale: Always on tripod indoors (studio environment). Absolute control of composition and control of light. Tethering workflow on a slow pace.

EVALUATION

Group C & D are expected to be mergeable into 1 camera design. They have a big similarity in terms of the variables that influence the posture and workflow. Yet Group C is used mostly outdoors, therefore the body needs to withstand elements of nature (eg. operating temperature, UV, rain and humidity). Merging group C&D will create the largest cluster of target users.

Group A & B are both handheld applications and are likely to be mergeable, although the type of environments is significantly different. It's worth investigating different concepts for different scenarios. Since the design brief focuses on a handheld camera, group A and B are taken into consideration for further development.

Distinctive elements.
Group A:
Dynamic interaction - fast switch between activities
Move around easily
Long handheld situation (in relation to other applications)

Group B:
Wireless trigger and control of external light sources (flash)
Autofocus response + accuracy

For communicating these groups, the groups have been given (Danish) names to symbolize what they stand for.

Group A = Momentum [momentum]

Group B = Udtryk [expression]

Group C&D = Stilhed [serenity]

L. FOAM SCULPTURES

A logbook of all the foam sculptures that show the evolution and steps towards the final concept. While sketches were used for aesthetical inspiration, the foam process provided more inspiration on new working principles for the grip.

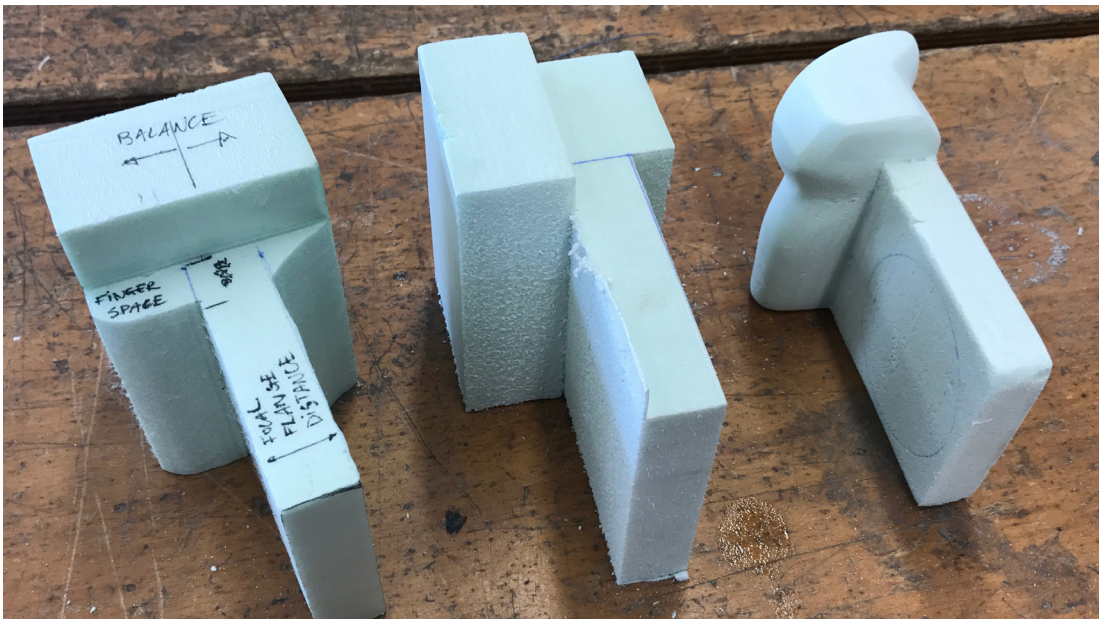


Figure 20. 3 steps towards the first ideas: parameters, basic cut and grinded.

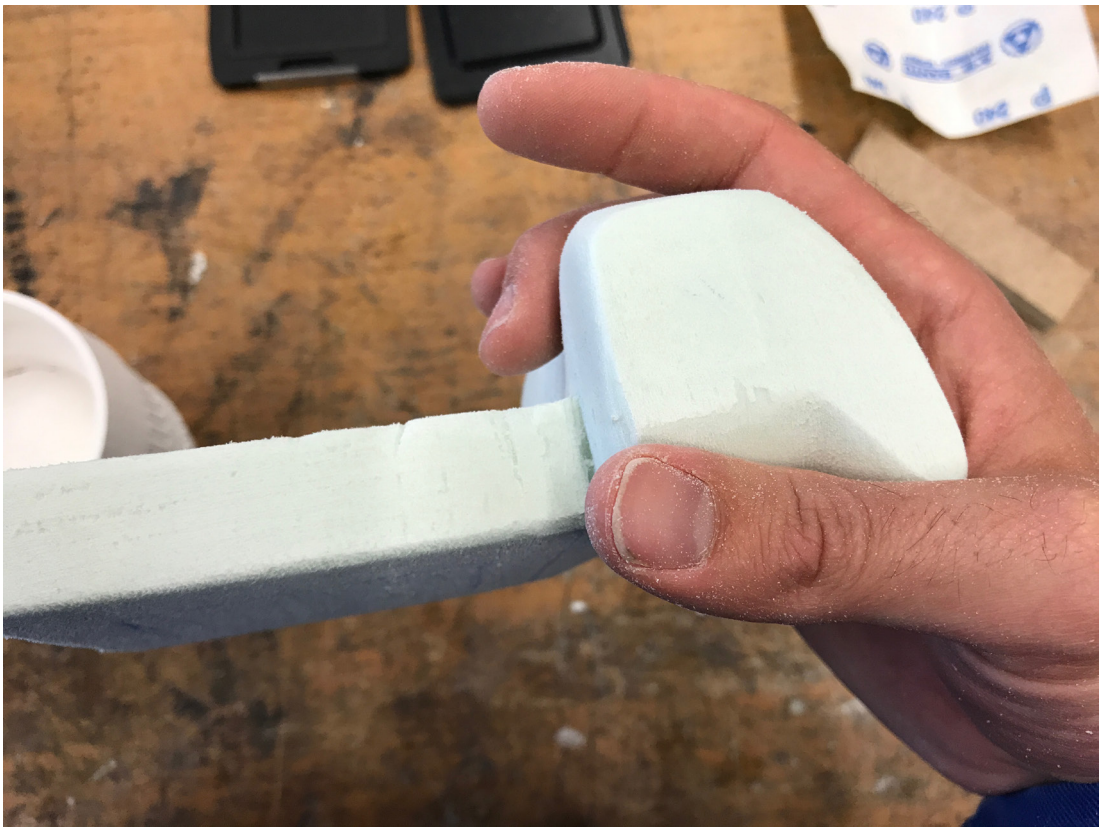
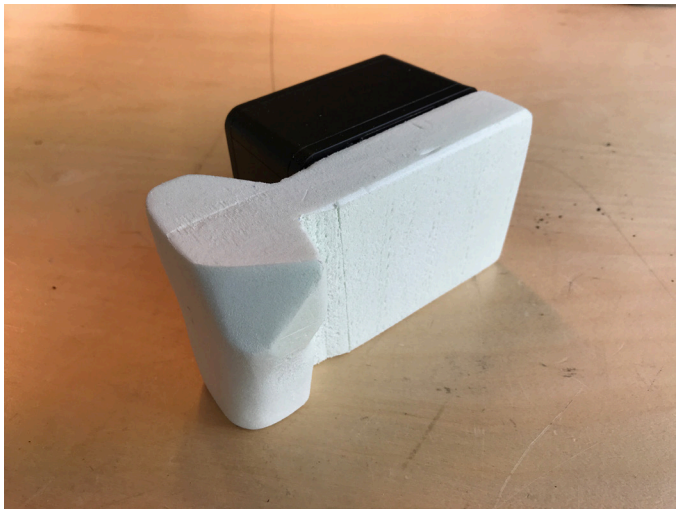
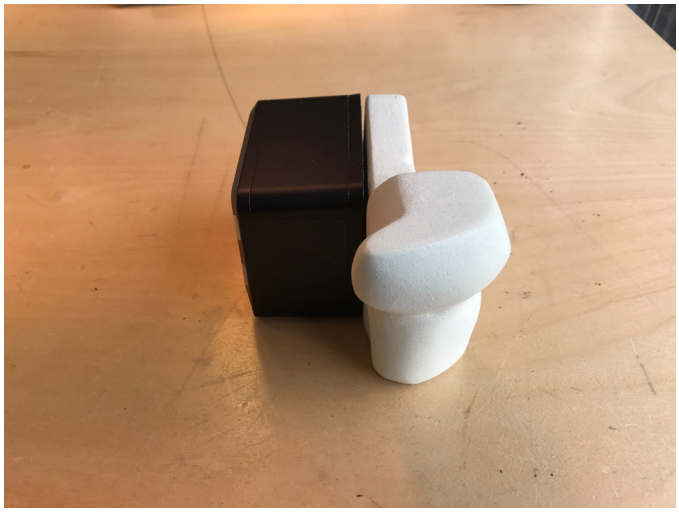


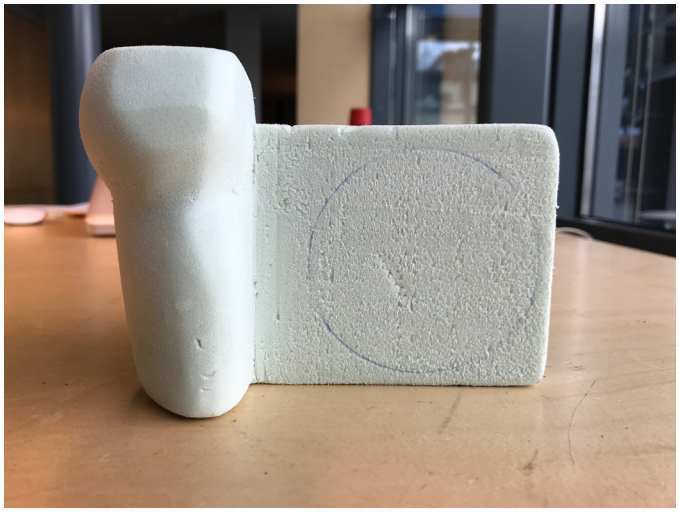
Figure 21. In this stage I discovered also a new way of holding the grip for a different body position. The top part, that is called the UI by Phase One, can be considered as extra volume to grip.



Idea 1. Cubical appaerrance.
This idea works on the principle of having the middle finger as a anchor point for switching between eye-level and waist-level posture. This idea shows at the front a good distinction for two different shutter release buttons. This idea carries an extra idea; it uses a pressure plate instead of a regular button. This both maintains the aesthetics and adds more margin for the hand length. In this idea the whole surface acts a button instead of single small point.

Points for improvement: the top front volume where the shutter release is located can be extruded to the right (towards the lens). This creates more space for the second shutter release and adds a little hook for picking up the camera.





Idea 2. Organic and traditional appaerrance.
This idea works on the principle of having the middle finger as a anchor point for switching between eye-level and waist-level posture. In waist-level posture the index finger wraps around the top volume, causing the distal digit of the index finger to sit next the first shutter release button.

Points for improvement: The radius of the thumb recess becomes critical for the comfort ands a re-work in a new foam model. Also the top front volume needs extra volume.

Idea 3. A cut-out for the palm grip.
This idea has a cut-out that causes the hand palm sit underneath the camera. It both reduces the clamp force and provides a more neutral wrist position.

Point for improvement: Although the principle of the cut-out clearly has its positive effect, the overall sculpture needs a rework aesthetically.

Idea 4. Traditional grip twisted backwards.
This idea radically changes the orientation of the grip. It completely provides neutral wrist position.

Points for improvement: Although the principle of angle clearly has its positive effect, the overall sculpture needs a rework aesthetically. And the grip for a waist-level posture is not implemented yet. In this appearance it is arguable if that's even possible.

The foam sculptures were personally reviewed based on my perception of how to hold the grip, basic feel of the shape and volume and the aesthetics. In some cases preliminary ideas could be made for the placement of control actuators for the user interface.

All ideas were sculptured once more, anticipating on the points to improve. However idea 4 was eventually excluded for a do-over since it seemed that the backwards twisted grip did not leave much space for the top part, the UI.

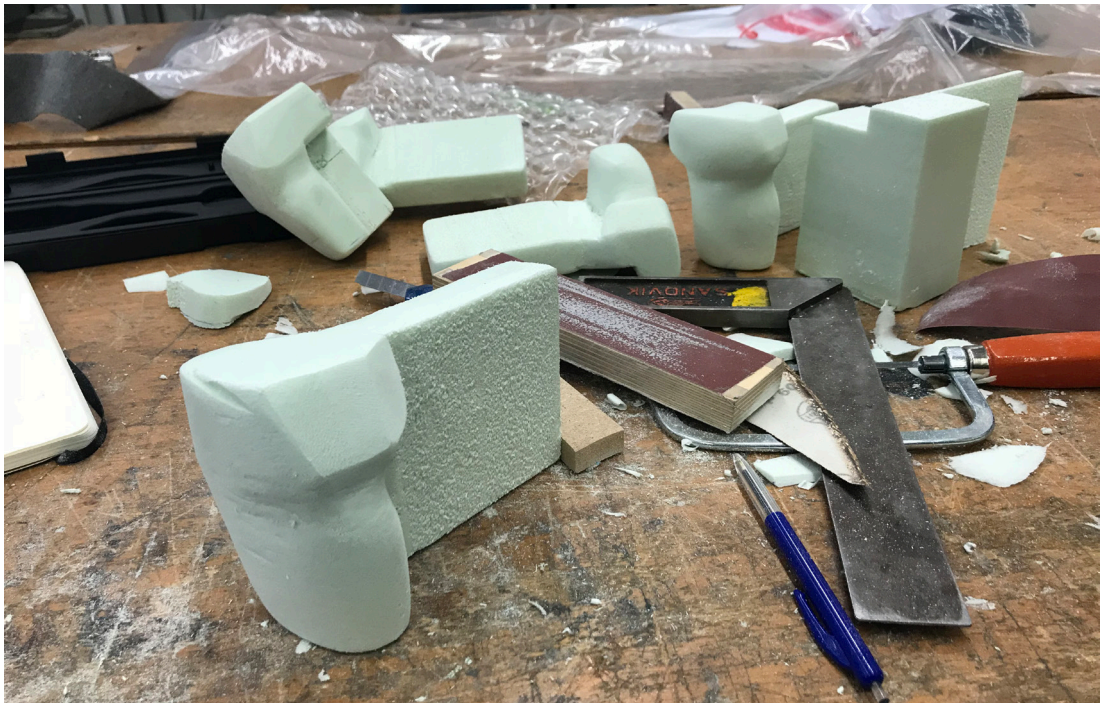


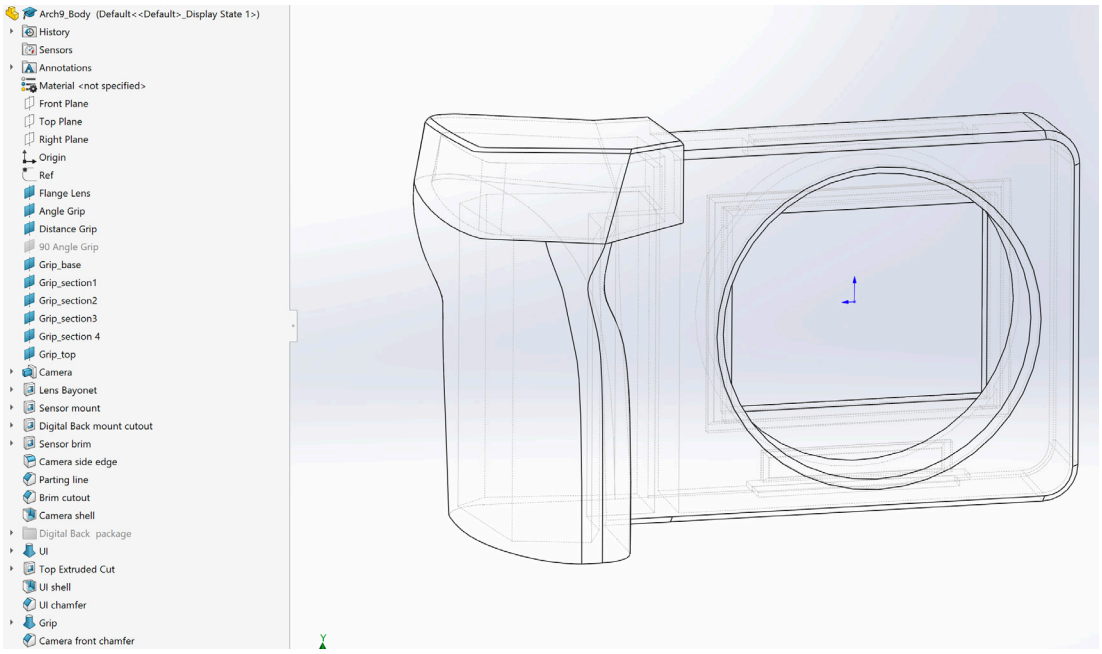
Figure 22. Idea 2 has been sculptured again, anticipating on the points for improvements from the first model.

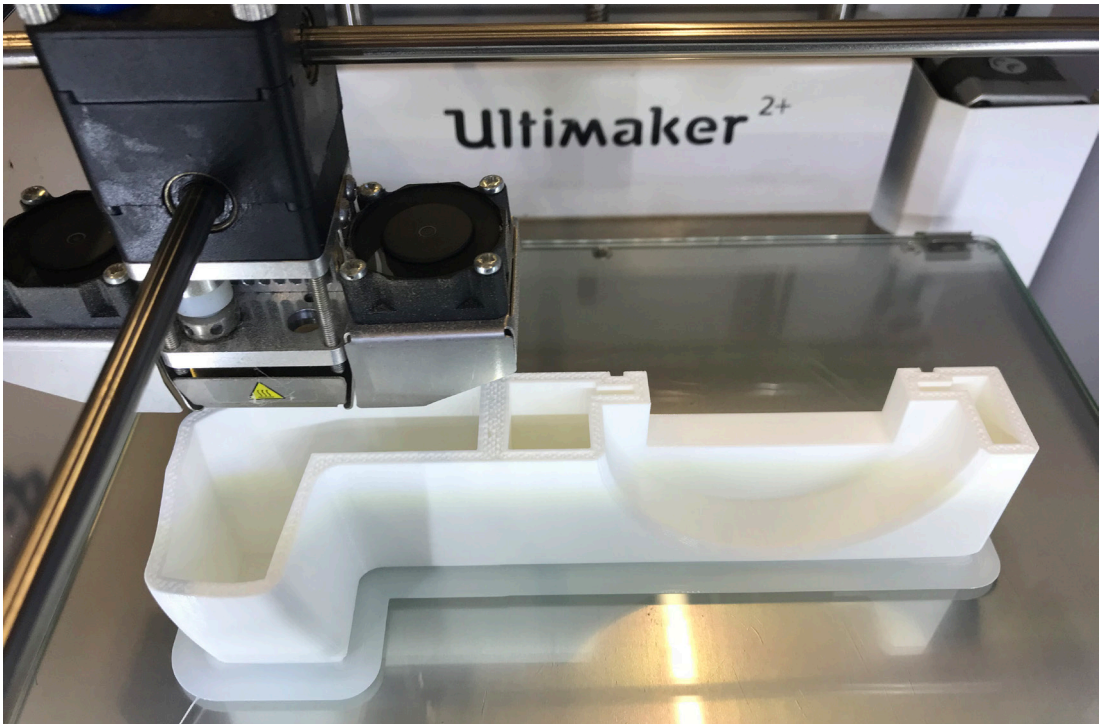
Figure 23. A digital calliper was used to measure the grip section for section. This formed a base for building a 3D loft in SolidWorks.

M. PROTOTYPING

In order to have an adequate representation of the size and weight (with its corresponding balance), rapid prototyping technique 3D printing was used to produce accurate models with the ability to simulate its estimated final weight.

A digital caliper was used to measure the foam sculptures, which in turn was used to build up a 3D CAD model.



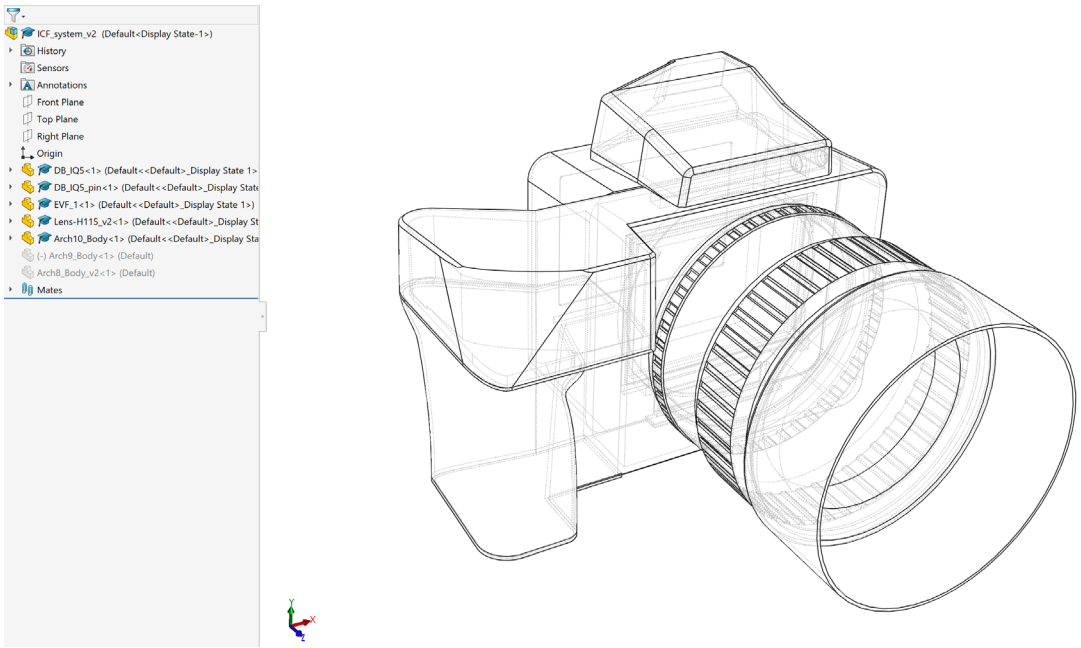


The CAD models, thus printed models as well, are hollow, which makes it possible to fill it with an aggravating material (such as sand). For the camera it is possible to make weight distinction between the grip and mounting area, to simulate the presence of a battery in the grip.

After printing the first models, another personal assessment was made to verify its similarity with the foam sculpture. Transforming into a CAD model can be a challenge due to some relatively complex 3D shapes. With the first iteration, easy improvements could be made. This led to a second iteration of 3D printed models.

One of the key parameters of the project is modularity, in that regard every component was modelled separate from each other but intended to be mounted once produced.

In that sense, assumptions have been made in order to have a full camera system. The size of the digital back and lens (Appendix E8) is based on estimations, the size and design of the EVF is assumed and therefore still a premature concept.



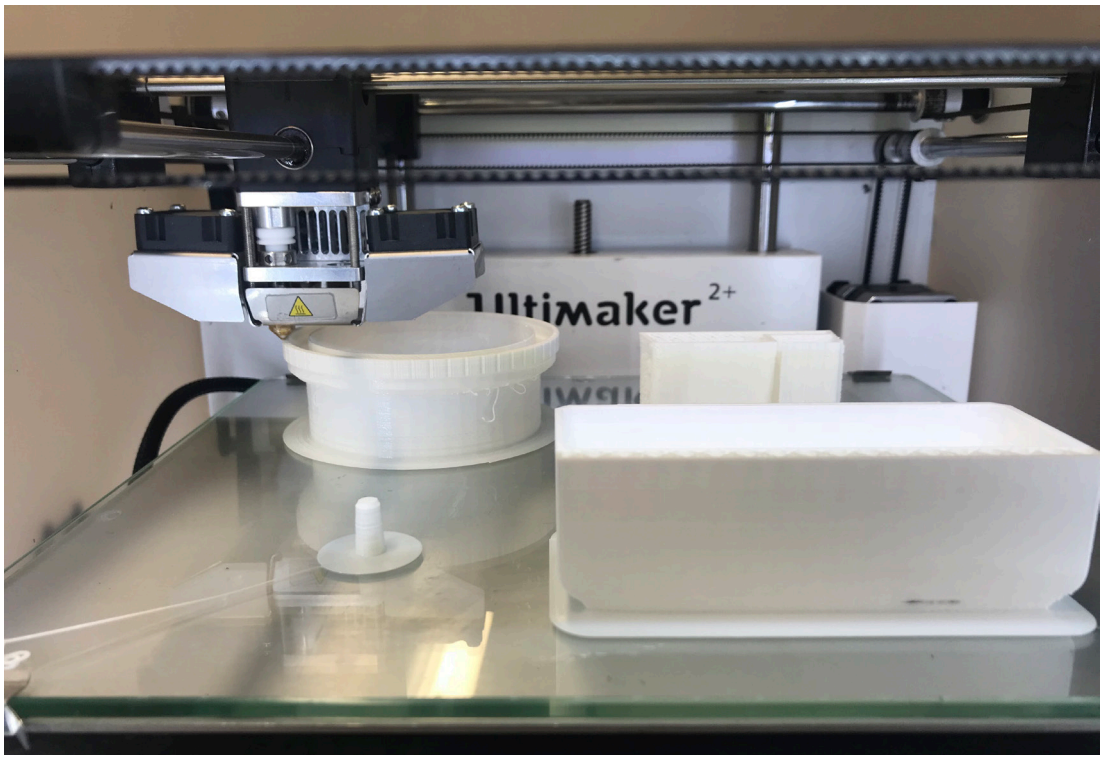
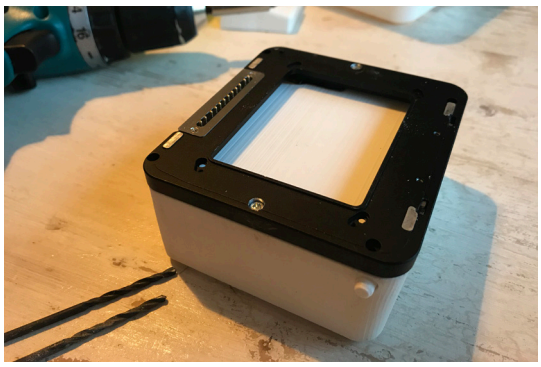


Figure 24. The process from a foam model towards a concept.

Before going back to the Netherlands, a numerous amount of spare parts were shipped to the Netherlands. This mostly involved construction parts that would help with maintaining the digital back form factor (and its construction) and the connectivity. The metal brackets from the cover plates were used in the 3D printed models to attach to a digital back.



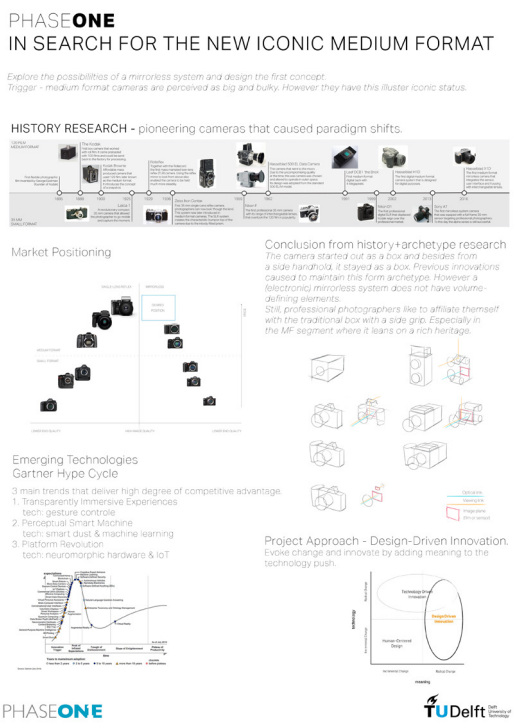
The front metal plate of a digital back was used to screw on the 3D printed digital back, making a mechanical and interchangeable connection possible. This front plate needed to be adjusted to fit appropriate screws, milled holes needed to be slightly bigger.

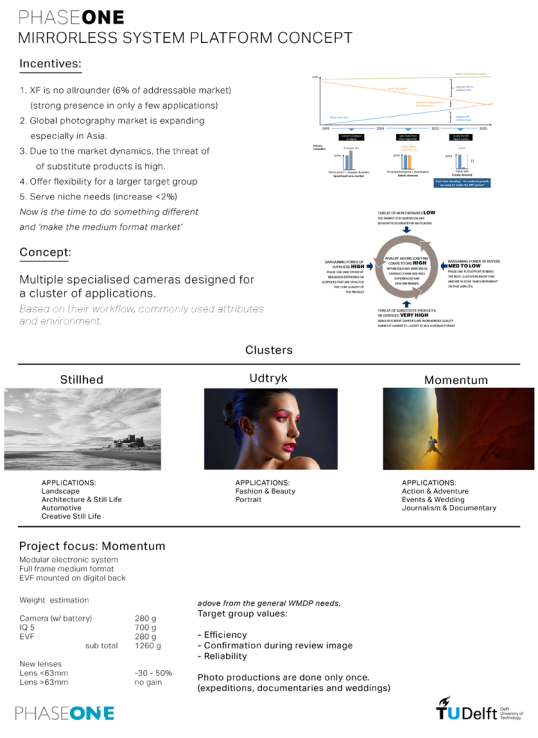
After the mechanical connections were done, all elements needed to be weighted to its estimated weight. For almost all parts plain sand was sufficient to get to the estimated weight, however the digital back needed a different approach. Sand was not dense enough, therefore used alkaline batteries in combination with sand were used to get the accurate weight.

N. INTERVIEW MATERIALS

A3 posters were used during the interviews to introduce the context and visual appearance of the concepts.

I have talked to five photographers in house of Phase One. Although they are not professional photographers, they do however much experience with photography and medium format equipment in particular.





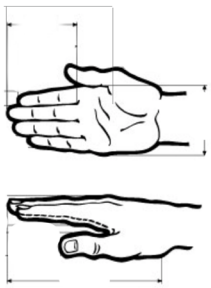
The Comfort Questionnaire for Hand Tools (## Kuijk, 2006) accompanied with a handmap were used to record the measures and their input. The 3D printed concepts handed over to the subjects for them to review.

In the first session I invited 3 employees from the Support department. They are highly skilled with all the hardware and software features that Phase One offers. Earlier in the project Peter Marshall provided a list of all features he gathered from talking to WMDPs.

In the second session I invited 2 employees from Marketing. They both have a strong background and experience in photography. They are keen on both practical use and aesthetic appearance

CONCEPT 3

Measurements:



Please use this hand map to indicate discomfort

CONCEPT 3

Comfort Descriptors

This hand tool	Totally disagree	•	Disagree somewhat	•	Agree somewhat	•	Totally agree
Fits the hand	1	2	3	4	5	6	7
Is functional	1	2	3	4	5	6	7
Is easy in use	1	2	3	4	5	6	7
Has a good force transmission	1	2	3	4	5	6	7
Is a high quality tool	1	2	3	4	5	6	7
Has a nice-feeling handle	1	2	3	4	5	6	7
Offers a high task performance	1	2	3	4	5	6	7
Provides a high product quality	1	2	3	4	5	6	7
Looks professional	1	2	3	4	5	6	7
Needs low hand grip force supply	1	2	3	4	5	6	7
Has a good friction between handle and hand	1	2	3	4	5	6	7
Causes an inflamed skin of hand	1	2	3	4	5	6	7
Causes pressure on the hand	1	2	3	4	5	6	7
Causes blisters	1	2	3	4	5	6	7
Feels clammy	1	2	3	4	5	6	7
Causes numbness and lack of tactile feeling in hand	1	2	3	4	5	6	7
Causes cramped muscles	1	2	3	4	5	6	7

Comfort after use

	Very uncomfortable	•	A little uncomfortable	•	A little comfortable	•	Very comfortable
This hand tool is	1	2	3	4	5	6	7

0. INTERVIEWS

After a short introduction of the concepts and their context, the hands of the participants were measured and recorded on the paper sheet together with the handmap. The photographers then were invited to hold the cameras and review it. Assignments like taking photos and reviewing a photo were given. During these assignments they were asked to fill in the handmap and then the questionnaire. Special remarks were recorded either by note-taking, audio-recording and/or photos.

Figure 25. Participants from Support department are reviewing the concepts.

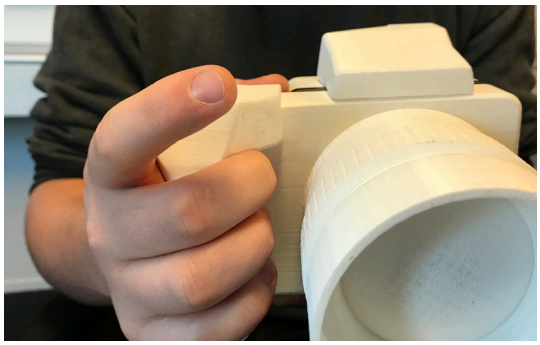


Figure 26. Captions clockwise: concept 1 showed the lack of space for people with big hands; participants reviewing the concepts accompanied by presentation posters; concept 2 showed that the UI has a sharp edge underneath.

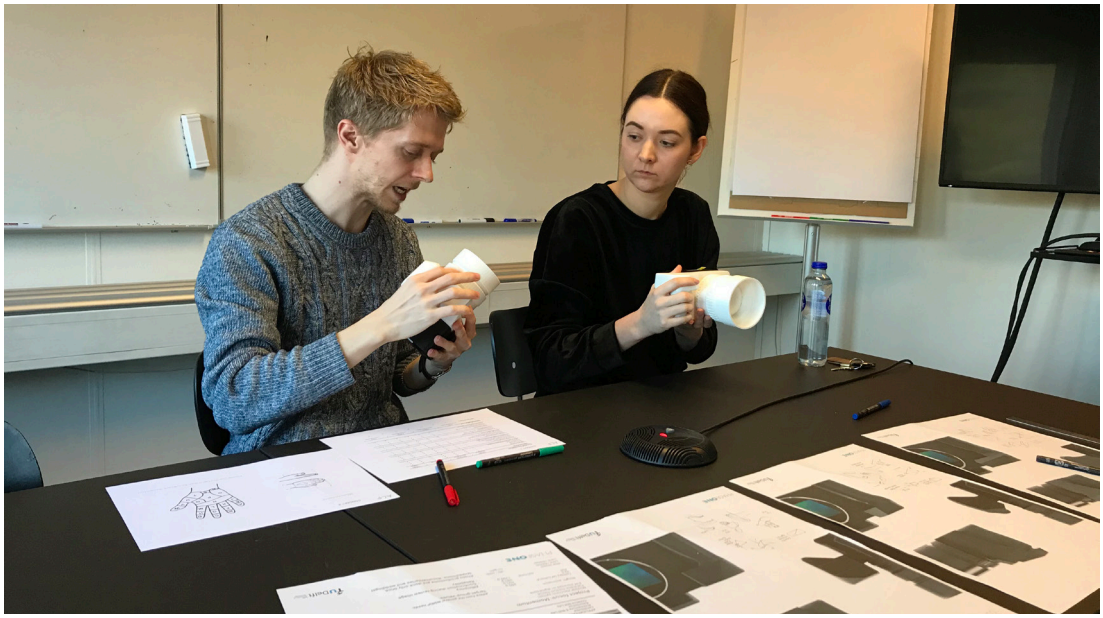


Figure 27. Participants from Marketing are disussing the concepts with each other.

In addition to the interviews, more data was gathered from other employees at Phase One. The company has a broad variety of nationalities. But due to the small time window of my visit, and the employees are often very busy, these session were limited to measuring the hand and filling in the handmap for discomfort.

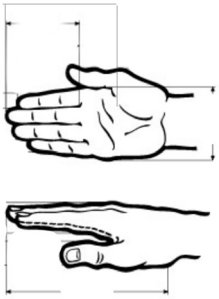
DATA - SCORES FROM THE QUESTIONNAIRE

Questionnaire - scores Concept 1	Participants								
Comfort Descriptors	1	2	3	4	5	6	7	8	Average score
Fits the hand	3	7	7	6	7				6,00
Is functional	5	6	7	5	7				6,00
is easy in use	6	6	7	6	7				6,40
has a good force transmission	3	6	7	5	7				5,60
									6,00
Is a high quality tool	7	6	7	6	7				6,60
Has a nice-feeling handle	4	5	7	6	7				5,80
Offers a high task performance	6	6	6	6	7				6,20
Provides a high quality product	6	6	7	7	7				6,60
									6,30
Looks professional	6	7	7	7	7				6,80
Needs low hand grip force supply	4	5	6	6	5				5,20
Has a good friction between handle and hand	5	5	6	6	5				5,40
									5,80
Causes an inflamed skin of hand									
Causes pressure on the hand	5								5,00
Causes blisters	1		2						1,50
Feels clammy	1		2						1,50
Causes numbness and lack of tactile feeling in hand	1	2	2						1,67
Causes cramped muscles	1	1	2						1,33
Comfort after use	4	5	7	6	7				**5,80**
Notes	Thumb grip needs less thickness								

Questionnaire - scores Concept 2	Participants								
Comfort Descriptors	1	2	3	4	5	6	7	8	Average score
Fits the hand	6	6	6	4	6				5,60
Is functional	6	6	5	4	6				5,40
is easy in use	6	7	5	6	6				6,00
has a good force transmission	6	5	7	4	5				5,40
									5,60
Is a high quality tool	6	6	7	5	7				6,20
Has a nice-feeling handle	6	7	7	3	6				5,80
Offers a high task performance	6	6	6	4	6				5,60
Provides a high quality product	6	6	7	6	7				6,40
									6,00
Looks professional	6	7	7	5	7				6,40
Needs low hand grip force supply	4	6	4	3	4				4,20
Has a good friction between handle and hand	5	6	5	4	5				5,00
									5,20
Causes an inflamed skin of hand	1	2	1						
Causes pressure on the hand	1	6	5						4,00
Causes blisters	1	2	1						1,33
Feels clammy	1		2						1,50
Causes numbness and lack of tactile feeling in hand	1	1	2						1,33
Causes cramped muscles	1	1	2						1,33
Comfort after use	6	6	5	4	5				**5,20**
Notes									

Questionnaire - scores Concept 3	Participants								
Comfort Descriptors	1	2	3	4	5	6	7	8	Average score
Fits the hand	3	6	3	5	3				4,00
Is functional	4	6	3	6	3				4,40
is easy in use	4	6	3	5	3				4,20
has a good force transmission	3	5	3	6	4				4,20
									4,20
Is a high quality tool	5	7	5	5	6				5,60
Has a nice-feeling handle	4	5	2	5	2				3,60
Offers a high task performance	5	6	4	6	4				5,00
Provides a high quality product	5	6	3	6	6				5,20
									4,85
Looks professional	5	7	5	6	7				6,00
Needs low hand grip force supply	4	5	2	6	5				4,40
Has a good friction between handle and hand	4	5	2	4	5				4,00
									4,80
Causes an inflamed skin of hand	1								
Causes pressure on the hand	1		7						4,00
Causes blisters	1								1,00
Feels clammy	1		3						2,00
Causes numbness and lack of tactile feeling in hand	1	3	3						2,33
Causes cramped muscles	1	2	6						3,00
Comfort after use	2	5	2	5	3				**3,40**
Notes	Ike this version								

		Hand Measurement [mm]			
Participant	Gender	Hand length	Thenar - middle finger	Middle finger	Hand breadth
1	M	195	135	85	92
2	M	178	130	80	88
3	M	198	130	82	95
4	M	175	135	82	88
5	F	172	125	80	80
6	F	169	129	80	80
7	F	177	122	80	82
8	M	182	140	83	95
9	M	197	152	90	95
10	M	190	150	85	105
11					
12					



Concept 1																					
Participant	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	A				E									O		Q				U		
2																						
3									J							Q				U		
4														O							V	W
5																						
6					E									O								W
7														O							V	W
8							G															
9							G						N	O								W
10			C				G													U		
11																						
Subtotal	1	0	1	0	2	0	3	0	1	0	0	0	1	5	0	2	0	0	0	3	2	4

Concept 2																						
Participant	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1														O								
2										K	L									U		
3			C											O								
4			C				G															
5																						
6					E	F								O								
7							G							O							V	W
8												M										
9														O								
10			C				G															
11																						
Subtotal	0	0	3	0	1	1	3	0	0	1	1	1	0	5	0	0	0	0	0	1	1	1

Concept 3																						
Participant	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	A				E			H												U	V	
2					E		G		J				N		P	Q						
3					E				J						P	Q						
4					E	F	G							O								
5					E	F	G															
6					E	F								O								
7						F															V	W
8					E																	
9	A	B	C											O								
10					E	F	G									Q				U	T	
11																						
Subtotal	2	1	1	0	8	5	4	1	2	0	0	0	1	3	2	3	0	0	0	2	2	1

Please use this hand map to indicate discomfort

P. DISCOMFORT & EMG MEASUREMENT

Introduction

Medium format cameras are usually perceived as bulky and are heavy due to bigger glass and mechanical components compared to smaller 35 mm (small format) cameras. When designing a new medium format camera system, a mirrorless system is a stripped down version of the traditional single-lensreflex (SLR). This reduces weight and creates a different interaction due to its electronic system. With the use of an electronic viewfinder (EVF), a given system configuration, the centre of gravity will likely to shift more to the back compared to a SLR.
In order to anticipate on this system switch, a serie of new body archetypes have been designed. The goal is to provide better stability, which results in better handheld performance thus sharper images, and a higher level of comfort. This research is set up in order to investigate whether the concepts are performing better than the traditional camera and if there's a preferred concept in terms of comfort.

Research questions

In comparison with the current Phase One XF camera, do the new concepts have a better ergonomic grip that provides better comfort and stability?
And if so, is there among the concepts a significant difference?

Method

A camera can be considered as a hand tool. In order to find valid answers, a combination of subjective and objective measurement method will be used.
The objective measurement is done by using Electromyography (EMG). (Raez, 2006) Muscle activity is measured when using the cameras and compared among the concepts. -Localisation of the vital muscles (zygote)-

The subjective measurement provides an assessment of (dis)comfort and is done with the Comfort Questionnaire for Hand tools (CGH) (Kuijt-Evers, 2007). The questionnaire is held after the objective measurement. Any points of discomfort will drawn in a hand map, based on Corlett and Bishop (1976).

Apparatus

Subjects:

1. Phase One XF camera fitted with IQ3 digital back, prism viewfinder and 80 mm lens (total weight of 3.050 g)
2. 3 concepts, 3D printed and weighted to simulate assumed final weight and COG. Fitted with lens, 3D printed digital back and EVF mounted on top. (total weight of 1.950 g)

Objective measurement

3. PC (with Biometrics software and bluetooth connection)
4. EMG Biometrics datalogger
5. Stopwatch

Subjective measurement

6. Questionnaire (Comfort Questionnaire for Hand tools) (CGH)
7. Hand map

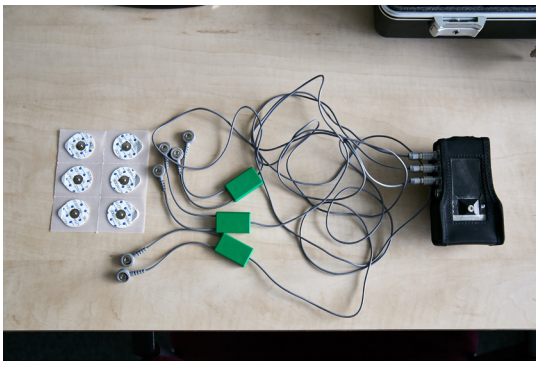


Figure 28. Biometrics wireless Datalogger with electrodes

Protocol

Cameras are used in various situations and environments, however most body postures are similar. The workplace has an effect on the comfort experience (Vink et al., 2005), therefore among participants this will be kept the same.

First of all, demographic information of the participant is collected before the test. In addition the right hand of participants will be measured and drawn on a piece of paper. All subjects are covered and every concept remains to be covered until it is used to test in order to avoid preconception on the use and comfort of the cameras.

For the EMG, electrodes needs to be placed on specific places on the forearm. These electrodes will be kept in place between testing the concepts.

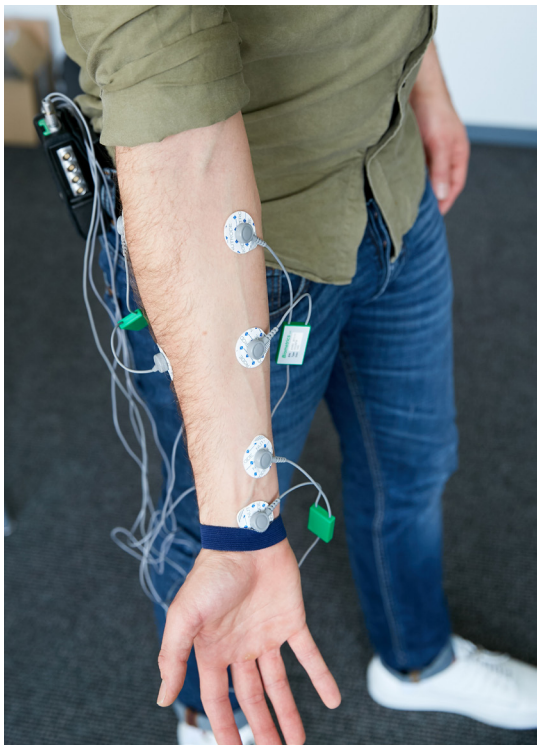


Figure 29. Placement of electrode to measure local muscle activity.

Every participant will be given the task to take 6 photos. To take a photo, the participant has to hold up the camera still for 3 seconds with one arm. The participant has to wait 5 seconds. Muscle activity will be measured during these tasks. Every participant will perform these tasks for every concept and the Phase One XF camera.
After each objective measurement for a camera, the subjective measurement will be performed. This will also provide resting time for the muscles.

Figure 30. Rest-state and active-state

Participants

For this project only one participant, a professional photographer, participated. Due to confidentiality and pressing time schedule this resulted in a qualitative study.

DATA ANALYSIS

All concepts show lower muscle activity compared with holding up the XF. However decreased muscle activity can not be related to comfort, however increased muscles activity can be related to (local) discomfort (Looze et al., 2003). Concept 1 has the most points of discomfort, although with 4 point of discomfort still being relatively low compared to the Copenhagen visit. Muscle activity with Concept 1 is the highest of the three. Concept 2 and 3 are similar, although in active state Concept 3 shows less muscle activity. This is assumed due to the grip design affecting a more neutral wrist position.

Figure 31. Participant assessing a concept while filling in the questionnaire.

Figure 32. Participant is simulating several poses.

	C1	C2	C3
Points of discomfort	4	1	3
After easy solvers	(3)	(1)	(0)

Descriptors	C1	C2	C3
Fit	4,00	6,25	6,25
Task Performance	6,00	6,50	6,00
Feel	6,33	6,00	5,67
Comfort after use	6,00	7,00	6,00

EMG values

Phase One XF
Peak: 0,3 mV
Active range: 0,15 - 0,25 mV
Rest range: 0,08 - 0,15 mV

Concept 1
Peak: 0,18 mV
Active range: 0,12 - 0,16 mV
Rest range: 0,08 - 0,12 mV

Concept 2
Peak: 0,16 mV
Active range: 0,12 - 0,14 mV
Rest range: 0,06 - 0,1 mV

Concept 3
Peak: 0,17 mV
Active range: 0,1 - 0,13 mV
Rest range: 0,06 - 0,1 mV

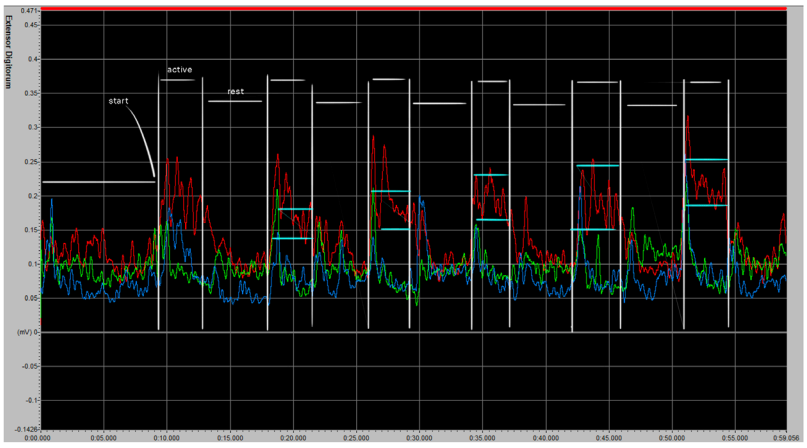


Figure 33. Graph muscle activity with the XF

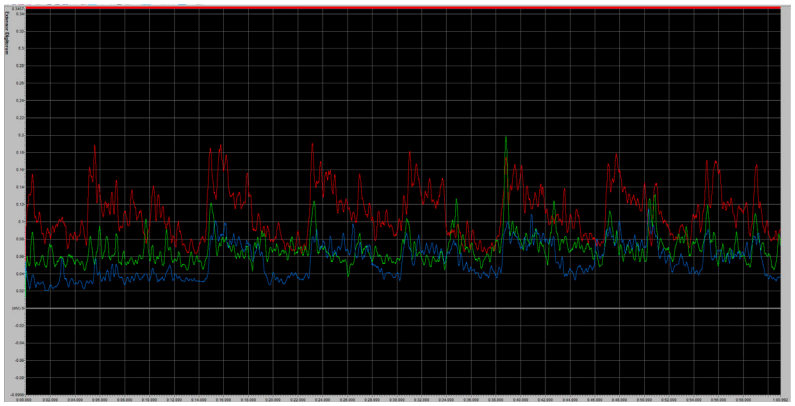


Figure 34. Graph muscle activity with Concept 1

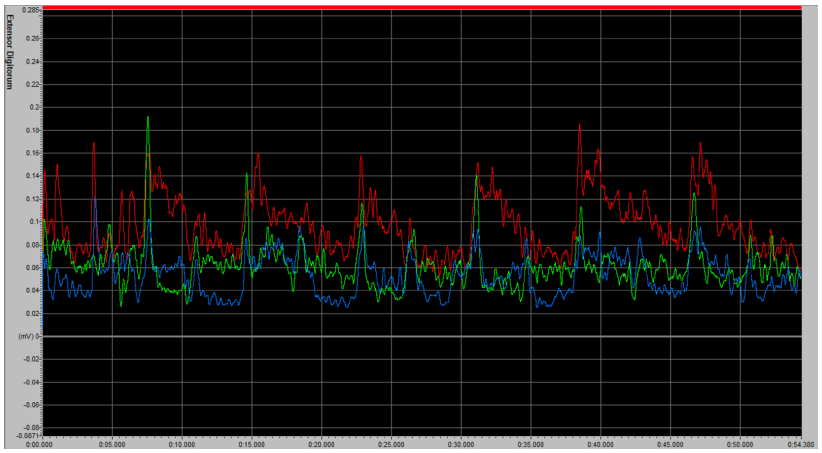


Figure 35. Graph muscle activity with Concept 2

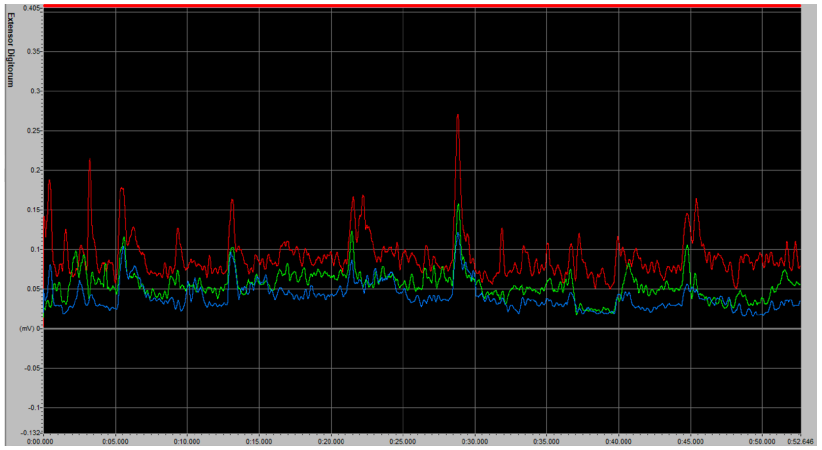


Figure 36. Graph muscle activity with Concept 3

R. PROGRAM OF REQUIREMENTS

1. **Safety**
   - 1.1. The product must not injure, impede and/or load the user (more) in any way, compared to the current situation
   - 1.2. The product must not invoke any hazards for the user during use
   - 1.3. No sharp edges or angles are to be exposed
   - 1.4. No exposure to harmful chemicals and bacteria must occur

2. **Operation**
   - 2.1. The camera is intended as fully capable, therefore always stand-alone operable (without tethering, off camera control or external power dependence)
   - 2.2. Operating temperature between -25C to 50C.

3. **Image Capture**
   - 3.1. The mirrorless camera will have two shutter modes:
   - 3.2. Electronic shutter, performed by the sensor.
   - 3.3. Leaf shutter, performed by the lens.
   - 3.4. Latency ?

4. **System**
   - 4.1. The camera body must be equipped with a wireless control unit for camera control and flash control/trigger.
   - 4.2. Any form of visual feedback (during the act of photography) will be performed by the digital back.
   - 4.3. It's favourable if the system backwards compatible with older lenses and other systems like the XF camera.

5. **Construction**
   - 5.1. Optical elements need to be placed in line with the digital sensor, creating a straight line direction for the light entering the lens towards the digital sensor.
   - 5.2. The distance between sensor and optical elements is a crucial aspect of image quality, therefore the margins for the interconnecting mechanical must be reduced to a minimum.
   - 5.3. The mirrorless camera system consists at least of a lens, a digital back and an interconnecting mechanism that will be named as the camera body.

6. **Physical ergonomics**
   - 6.1. Due to the preference of shooting from multiple perspectives, the grip for the camera has to allow different hand positions. [define angles of wrist (linkage biomechanics)
   - 6.2. To lower the force impact significantly on the primary hand, the total weight of the mirrorless camera needs to be reduced, preferably to the equivalent of a professional 35mm full frame camera with a professional 50 mm lens. (1900 gram)

6.3. The camera body should allow hand position(s) that have a bigger freedom of movement for the wrist compared to the traditional camera archetype.

6.4. The camera is designed to work with two hands, but the primary functions need to be executable with one hand as well without support from the second hand.

7. Usability

7.1. All actuators for camera control need to be configurable to meet the photographer's specific needs.

7.2. It is preferred to have feedback from the camera that displays the metering and/or feature specific information such as a time-lapse timer.

8. Dimensions

8.1. The focal flange distance is estimated at 25 mm.

8.2. The camera should perform equally for Western and Asian users, both male and female. A proposition is to have multiple sizes for the same camera.

9. Appearance

9.1. It must resemble (and or update) the visual brand identity of Phase One.

9.2. All surfaces must be scratch resistant. (level undefined)

9.3. All outer components must have either the same appearance (in terms of colour and surface treatment) or distinctively different if it serves the visual identity.

9.4. Visual inspection is done by Phase One standard. Half arms length, max duration of 5 seconds.

9.5. All actuators for control (buttons and dials) will not have symbols or icons.

10. Branding

10.1. The name of the camera should not evoke any performance or affiliation with a specific application in order to avoid misunderstanding and encourage creative use. Instead, use positive and/or abstract name giving.