



Seminar
Smart and Safe Work Wear

*5th of February, 2019
Rovaniemi*

3D Body Scanning, New Measurement Tables

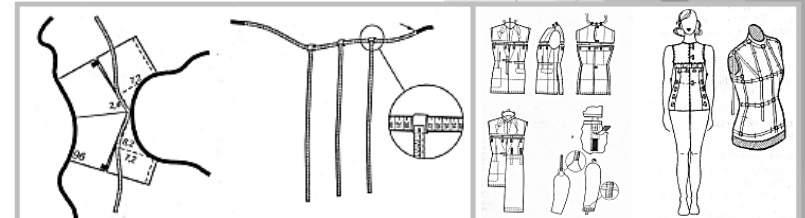
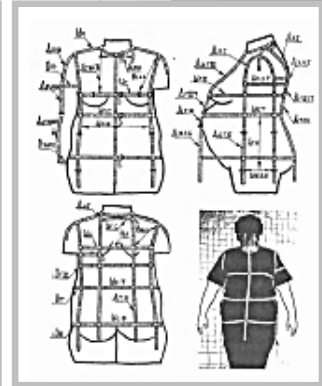
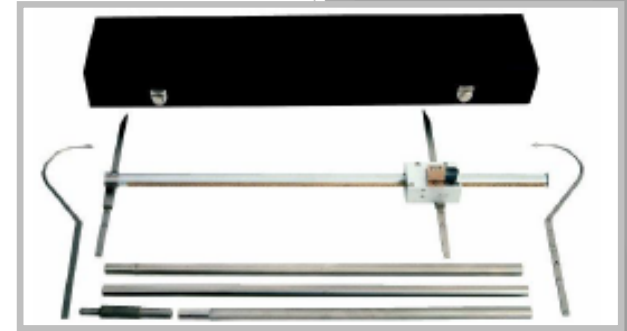
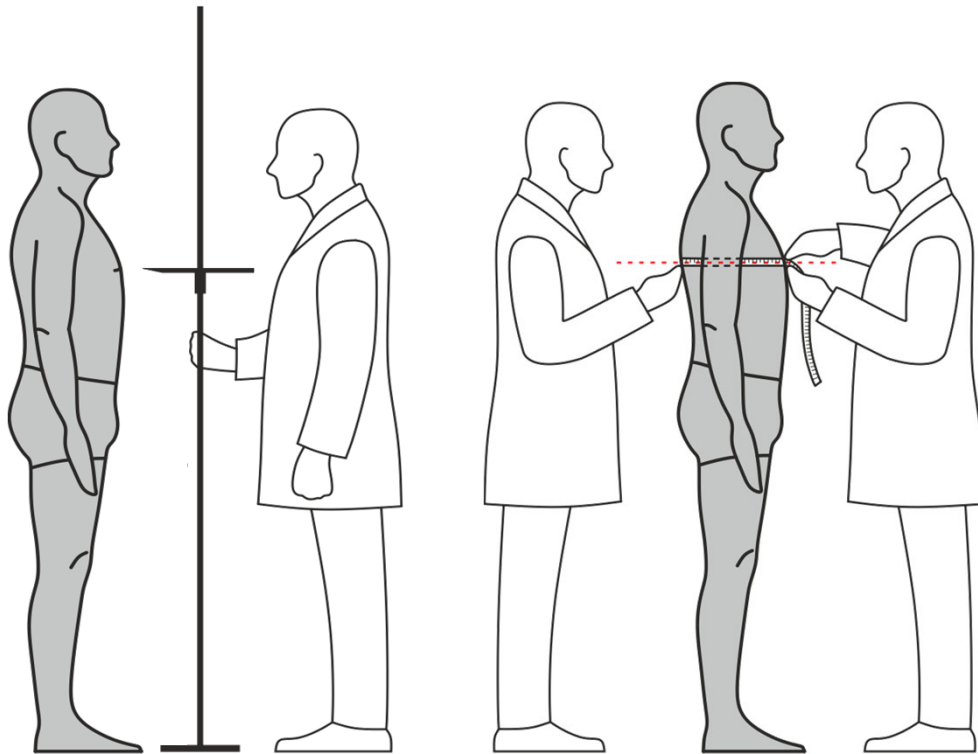
Dr.sc.ing. **Inga DĀBOLIŅA**
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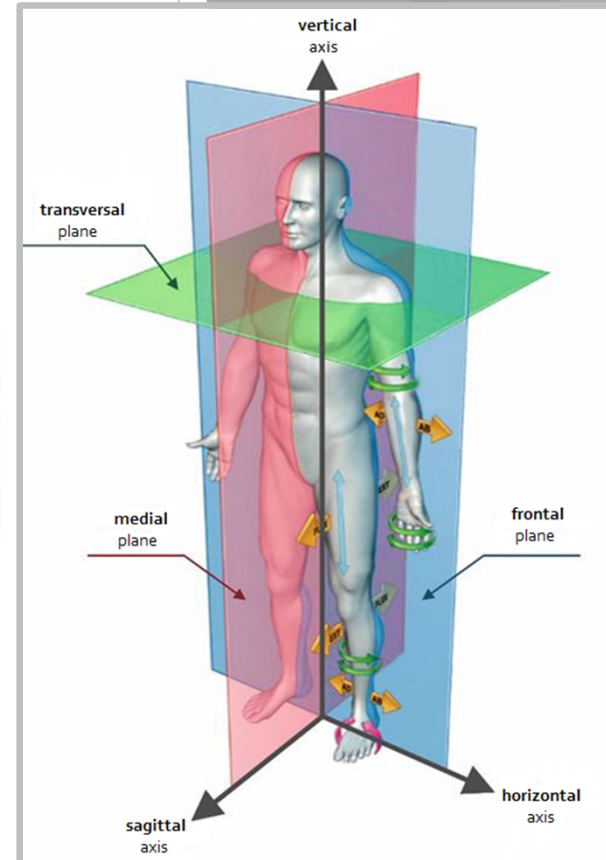
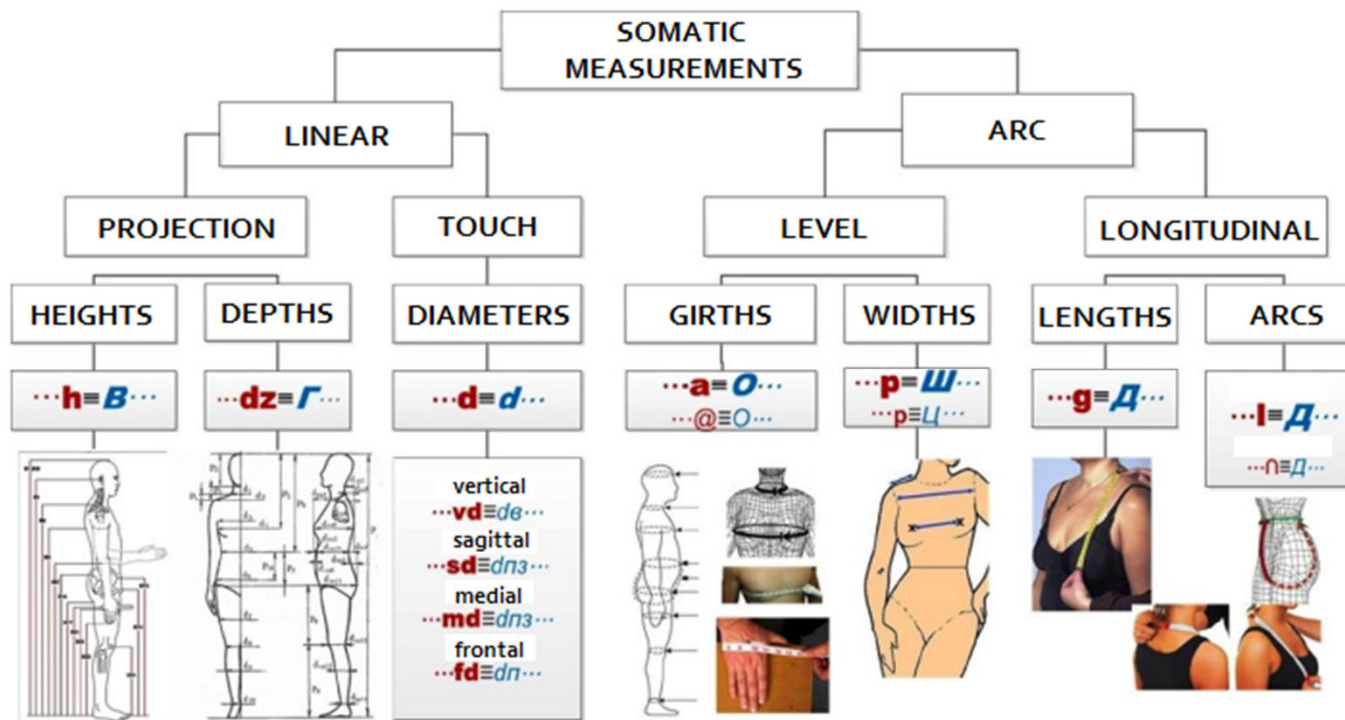
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Anthropometry



Somatic measurements



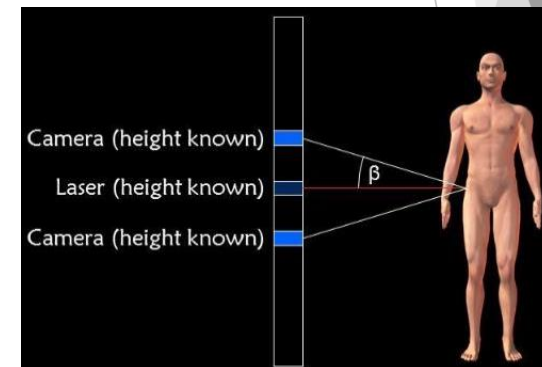
Standardization

- ▶ **EN 13402-1: 2002 Size designation of clothes** - Part 1: Terms, definitions and body measurement procedure
- ▶ **EN 13402-2:2002 Size designation of clothes** - Part 2: Primary and secondary dimensions
- ▶ **EN 13402-3:2017 Size designation of clothes** - Part 3: Size labelling based on body measurements and intervals
- ▶ **ISO 5971:2017 Size designation of clothes** -- Tights
- ▶ **ISO 8559-1:2017 Size designation of clothes** -- Part 1: Anthropometric definitions for body measurement
- ▶ **ISO 8559-2:2017 Size designation of clothes** -- Part 2: Primary and secondary dimension indicators
- ▶ **ISO 8559-3:2018 Size designation of clothes** -- Part 3: Methodology for the creation of body measurement tables and intervals
- ▶ **ISO 18163:2016 Clothing** -- Digital fittings -- Vocabulary and terminology used for the virtual garment
- ▶ **ISO 18831:2016 Clothing** -- Digital fittings -- Attributes of virtual garments
- ▶ **ISO 18825-1:2016 Clothing** -- Digital fittings -- Part 1: Vocabulary and terminology used for the virtual human body
- ▶ **ISO 18825-2:2016 Clothing** -- Digital fittings -- Part 2: Vocabulary and terminology used for attributes of the virtual human body
- ▶ **ISO 7250-1:2017 Basic human body measurements for technological design** -- Part 1: Body measurement definitions and landmarks
- ▶ **ISO/TR 7250-2:2010 Basic human body measurements for technological design** -- Part 2: Statistical summaries of body measurements from national populations
- ▶ **ISO 7250-3:2015 Basic human body measurements for technological design** -- Part 3: Worldwide and regional design ranges for use in product standards
- ▶ **ISO 20685-1:2018 3-D scanning methodologies for internationally compatible anthropometric databases** -- Part 1: Evaluation protocol for body dimensions extracted from 3-D body scans
- ▶ **ISO 20685-2:2015 Ergonomics -- 3-D scanning methodologies for internationally compatible anthropometric databases** -- Part 2: Evaluation protocol of surface shape and repeatability of relative landmark positions

3D Body scanning

Stationary 3D body scanner VITUS Smart XXL[®] (Human Solutions GmbH and VITRONIC GmbH)
with data processing system AnthroScan

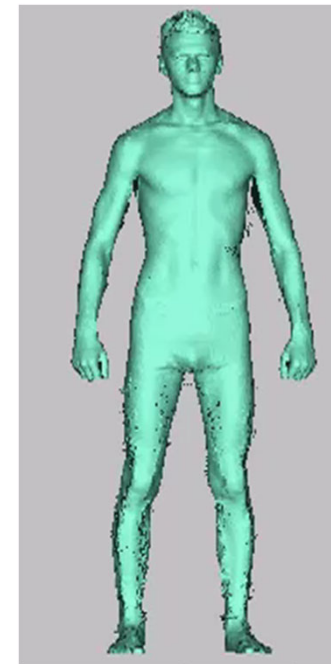
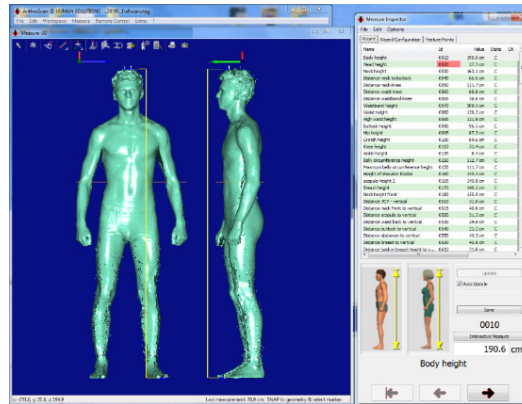
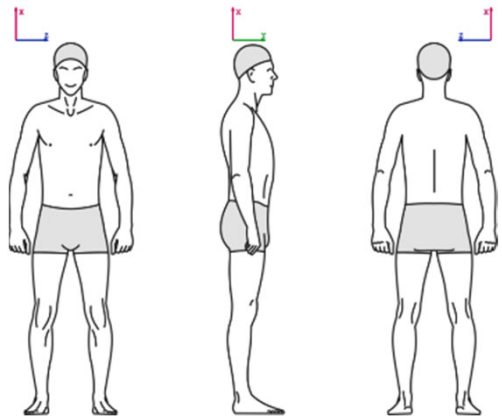
- Technically based on 4 laser beam optical triangulation which results are registered by 8 sensors in 4 laser radiation generator columns



3D Body scanning

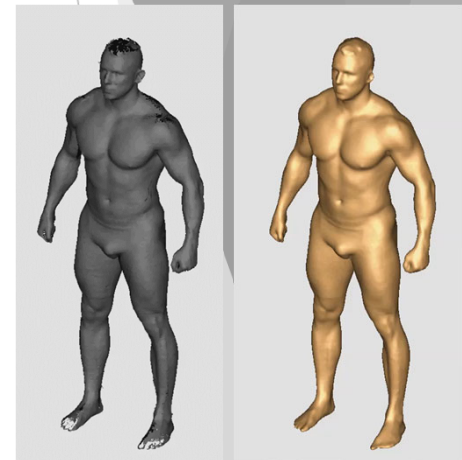
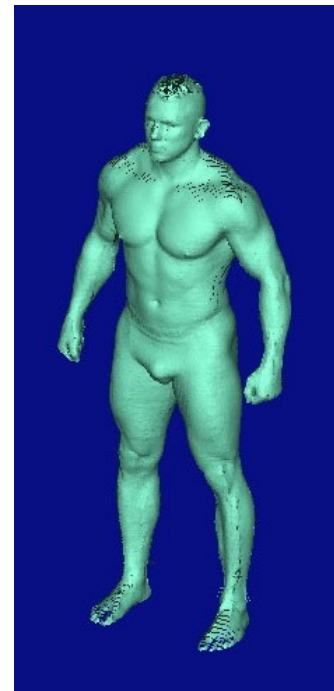
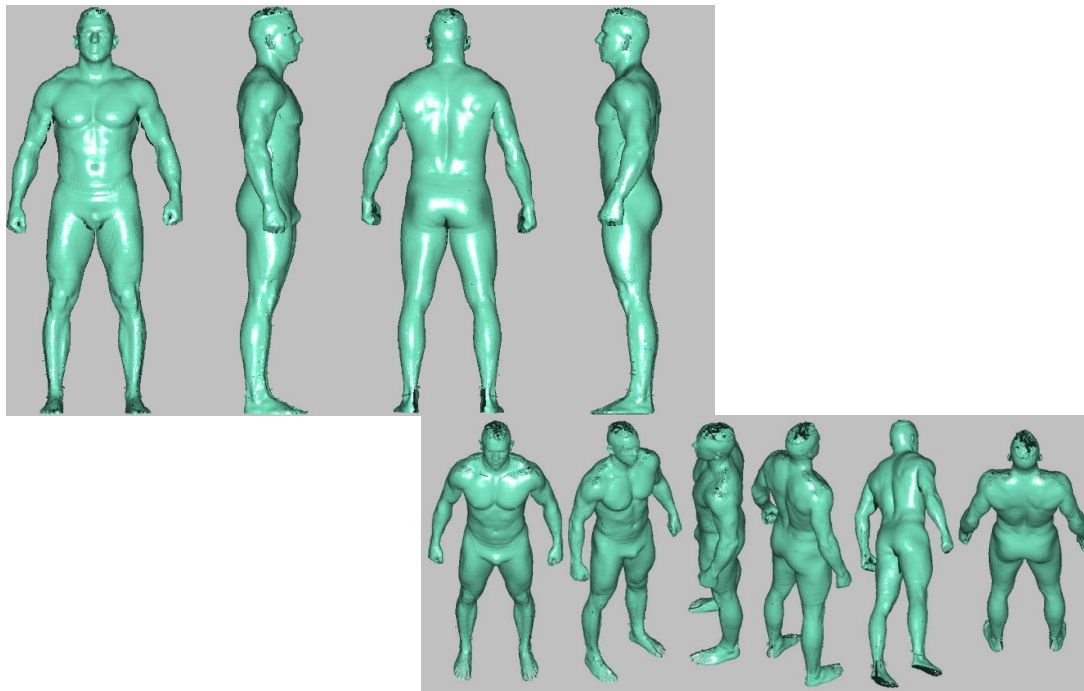
Stationary 3D body scanner VITUS Smart XXL® (Human Solutions GmbH and VITRONIC GmbH)
with data processing system AnthroScan

- ▶ Scanner dimensions: 2100 mm wide, 2100 mm deep and 2950 mm high.
- ▶ Scanning volume: 1100 mm width, 1000 mm depth and 2100 mm height.
- ▶ One scan: lasts ~ **12 seconds**.
- ▶ Resolution: 27 dots per cm².
- ▶ Measurement accuracy: ± 1 mm.



3D Body scanning

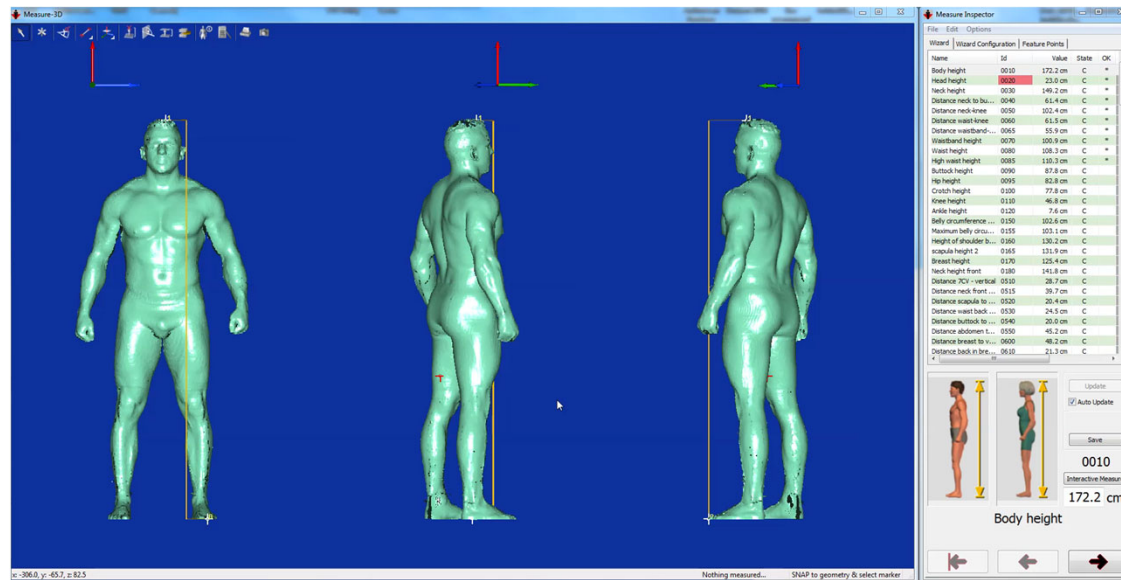
Stationary 3D body scanner VITUS Smart XXL[®] (Human Solutions GmbH and VITRONIC GmbH)
with data processing system AnthroScan



3D Body scanning

Stationary 3D body scanner VITUS Smart XXL® (Human Solutions GmbH and VITRONIC GmbH)
with data processing system AnthroScan

- **153 measurements** are automatically acquired: numerical values of different types of measurements of circumferences, lengths, widths and depths

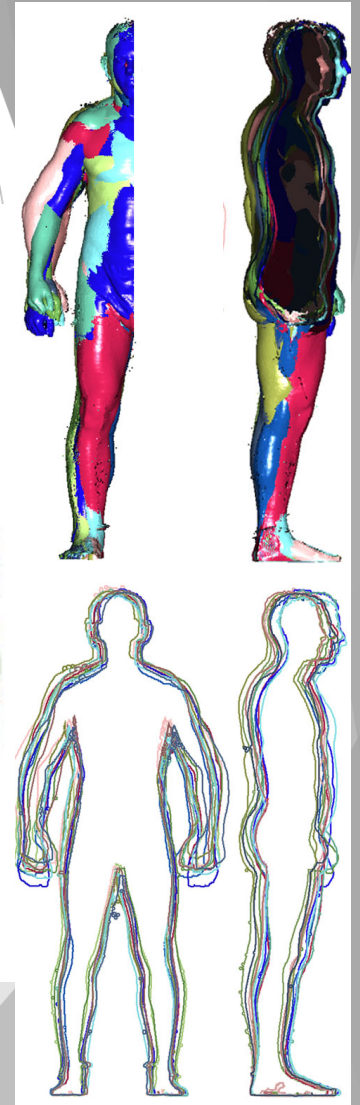
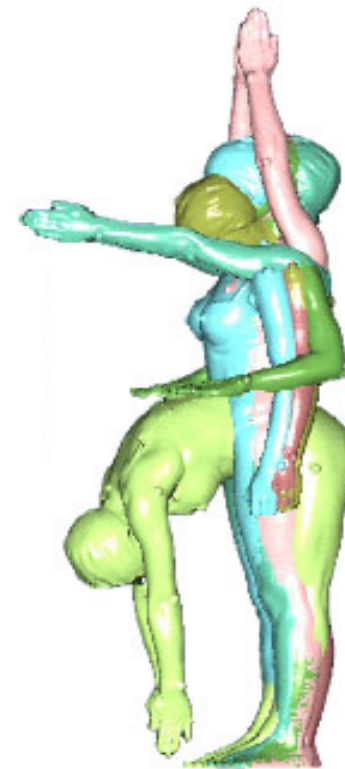
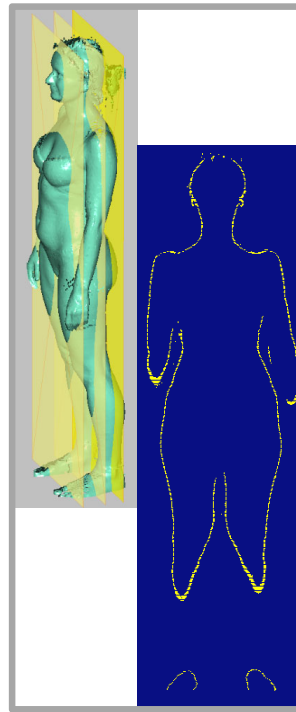
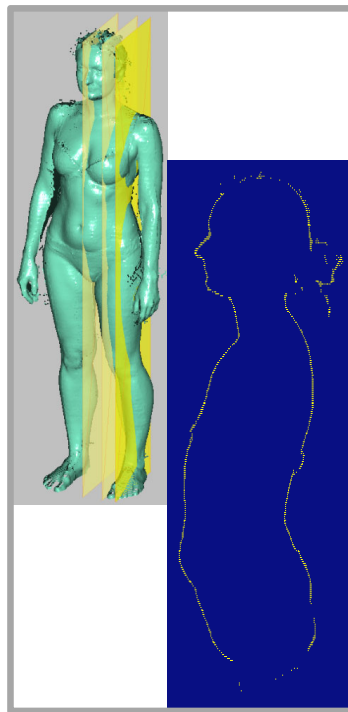
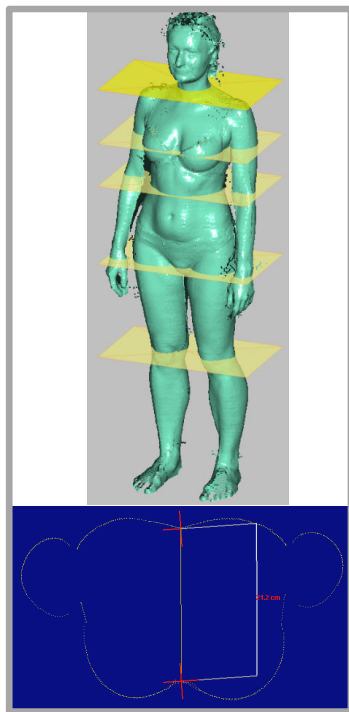


	A	B	C
1	Measurement Names	Measurement IDs	cm
2	Body height (cm)	10	172.5
3	Head height (cm)	20	23.3
4	Neck height (cm)	30	149.2
5	Distance neck to buttock (cm)	40	61.4
6	Distance neck-knee (cm)	50	102.4
7	Distance waist-knee (cm)	60	61.5
8	Distance waistband-knee (cm)	65	55.9
9	Waistband height (cm)	70	100.9
10	Waist height (cm)	80	108.3
11	High waist height (cm)	85	110.3
12	Buttock height (cm)	90	87.8
13	Hip height (cm)	95	82
14	Crotch height (cm)	100	77.8
15	Knee height (cm)	110	46.8
16	Ankle height (cm)	120	7.6
17	Belly circumference height (cm)	150	102.6
18	Maximum belly circumference height (cm)	155	103.1
19	Height of shoulder blades (cm)	160	129.2

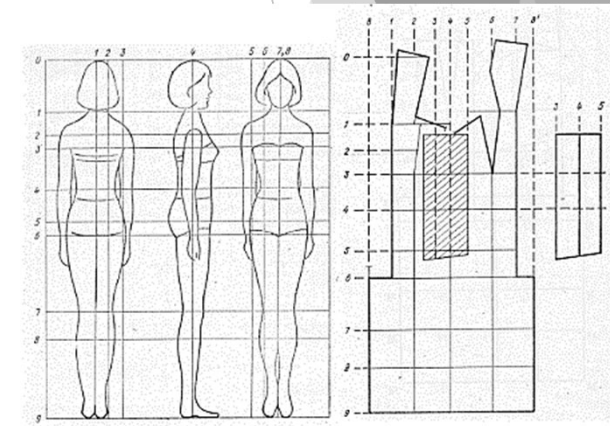
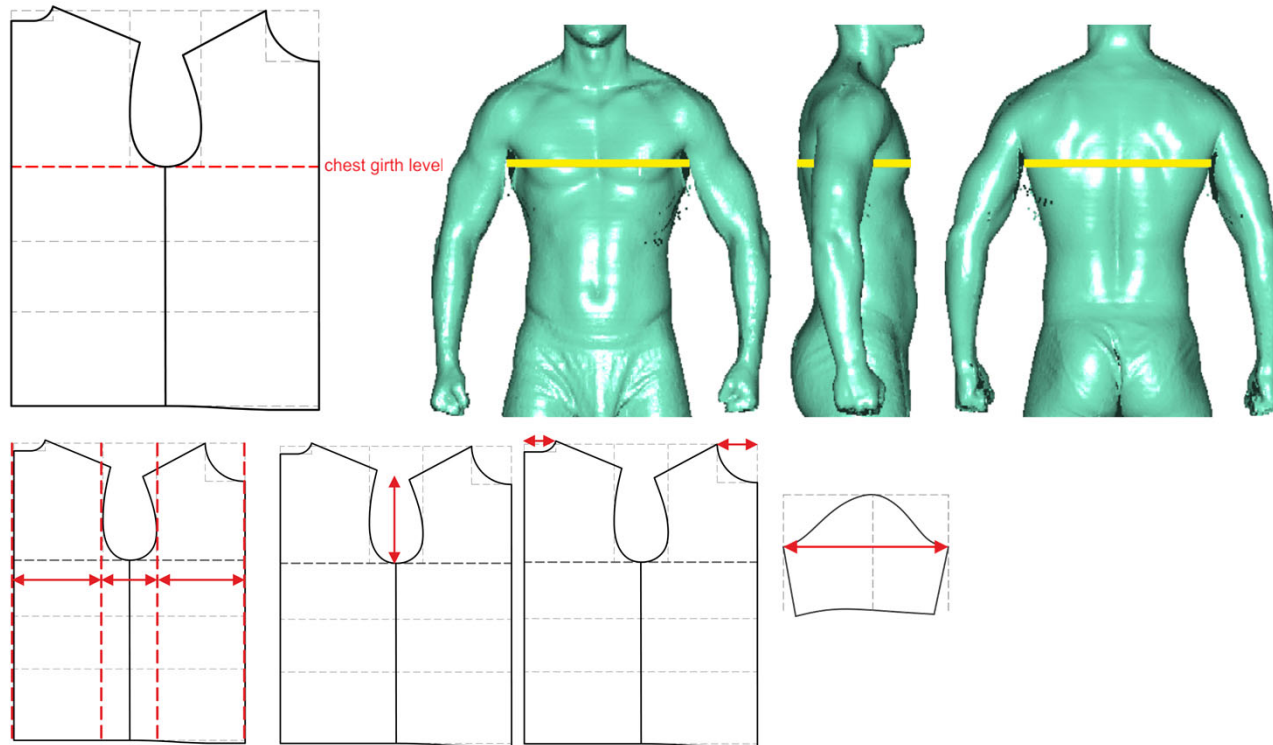
3D Body scanning

Cross-sections

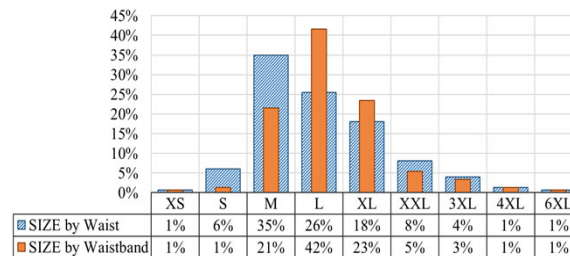
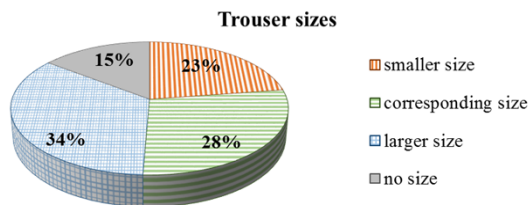
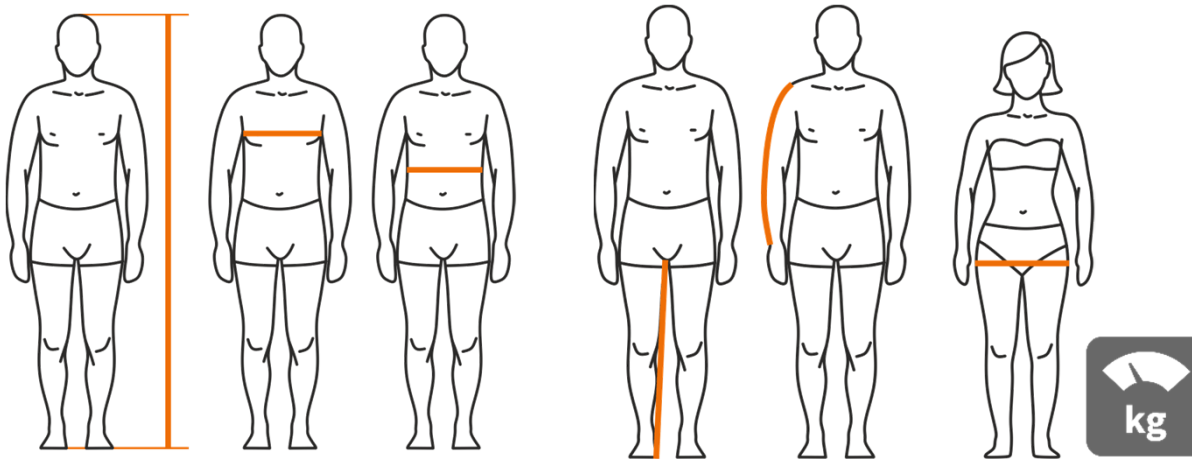
Superimpositions



Anthropometry for pattern development

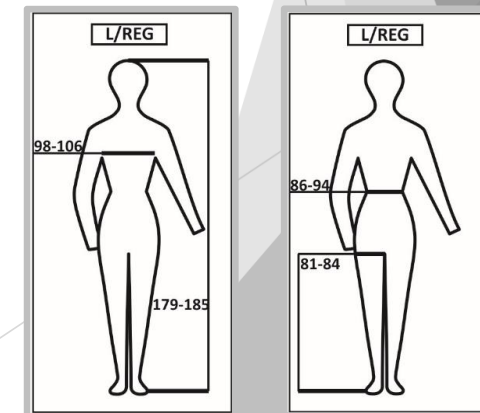


Anthropometry for sizing



Trousers								
Waist girth →	XS	S	M	L	XL	XXL	3XL	4XL
Body height ↓	62-70	70-78	78-86	86-94	94-102	102-110	110-118	118-126
2XSH	161-167	XS/2XSH	S/2XSH	M/2XSH	L/2XSH	XL/2XSH	XXL/2XSH	3XL/2XSH
XSH	167-173	XS/XSH	S/XSH	M/XSH	L/XSH	XL/XSH	XXL/XSH	3XL/XSH
SHO	173-179	XS/SHO	S/SHO	M/SHO	L/SHO	XL/SHO	XXL/SHO	3XL/SHO
REG	179-185	XS/REG	S/REG	M/REG	L/REG	XL/REG	XXL/REG	3XL/REG
LON	185-191	XS/LON	S/LON	M/LON	L/LON	XL/LON	XXL/LON	3XL/LON
XLO	191-197	XS/XLO	S/XLO	M/XLO	L/XLO	XL/XLO	XXL/XLO	3XL/XLO
2XLO	197-203	XS/2XLO	S/2XLO	M/2XLO	L/2XLO	XL/2XLO	XXL/2XLO	3XL/2XLO

Trousers								
Waist girth →	XS	S	M	L	XL	XXL	3XL	4XL
Inseam ↓	62-70	70-78	78-86	86-94	94-102	102-110	110-118	118-126
2XSH	72-75	XS/2XSH	S/2XSH	M/2XSH	L/2XSH	XL/2XSH	XXL/2XSH	3XL/2XSH
XSH	75-78	XS/XSH	S/XSH	M/XSH	L/XSH	XL/XSH	XXL/XSH	3XL/XSH
SHO	78-81	XS/SHO	S/SHO	M/SHO	L/SHO	XL/SHO	XXL/SHO	3XL/SHO
REG	81-84	XS/REG	S/REG	M/REG	L/REG	XL/REG	XXL/REG	3XL/REG
LON	84-87	XS/LON	S/LON	M/LON	L/LON	XL/LON	XXL/LON	3XL/LON
XLO	87-90	XS/XLO	S/XLO	M/XLO	L/XLO	XL/XLO	XXL/XLO	3XL/XLO
2XLO	90-93	XS/2XLO	S/2XLO	M/2XLO	L/2XLO	XL/2XLO	XXL/2XLO	3XL/2XLO

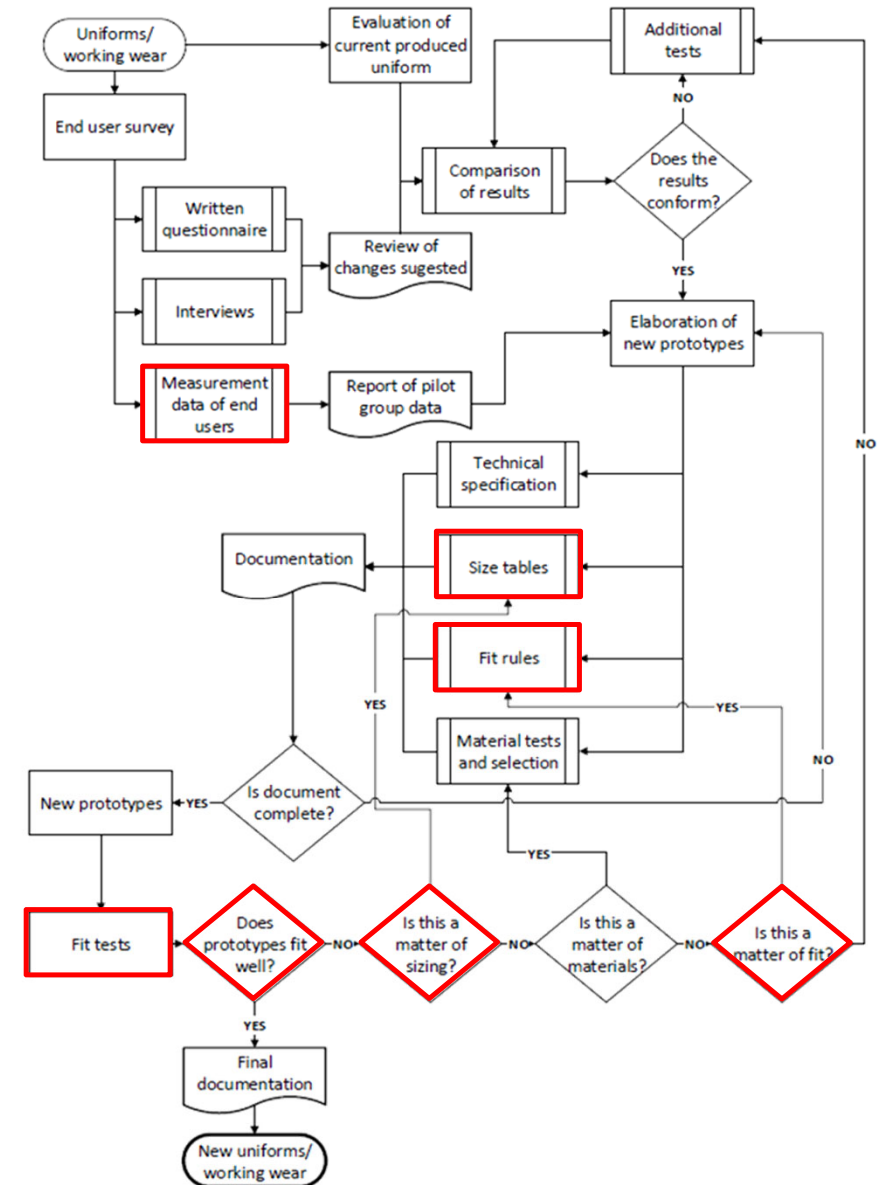




Re-design of PPE

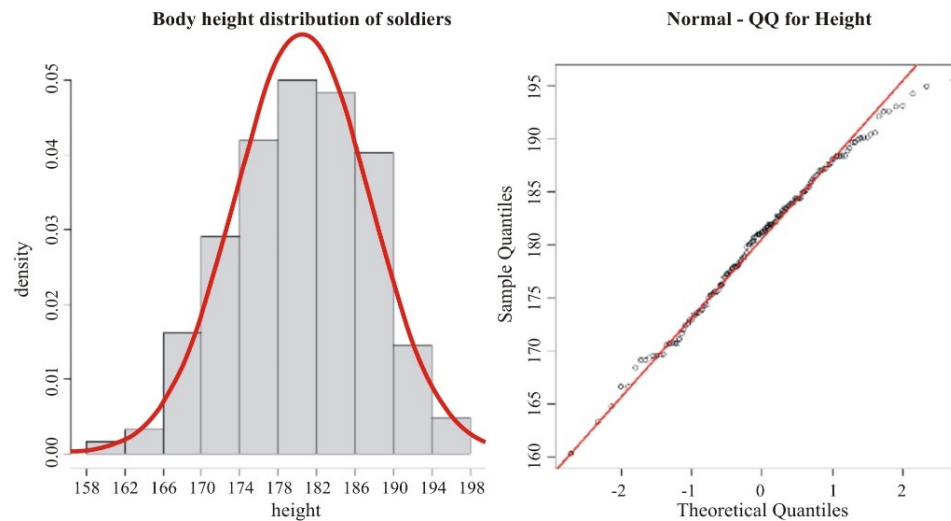
Methodology

- End-user survey:
 - ❑ questionnaire
 - ❑ interviews
 - ❑ **anthropometrics**
- New prototypes:
 - ❑ specifications
 - ❑ **size tables**
 - ❑ **fit rules**
 - ❑ material tests
- Final documentation

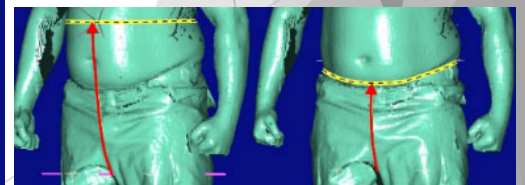
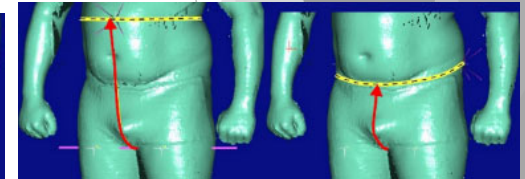
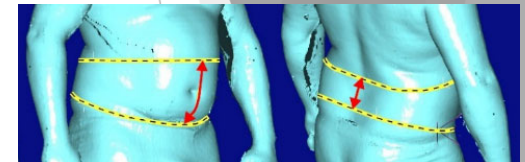
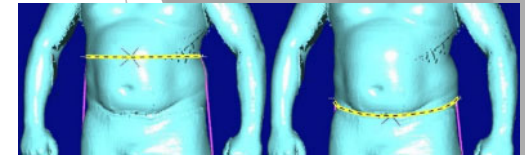
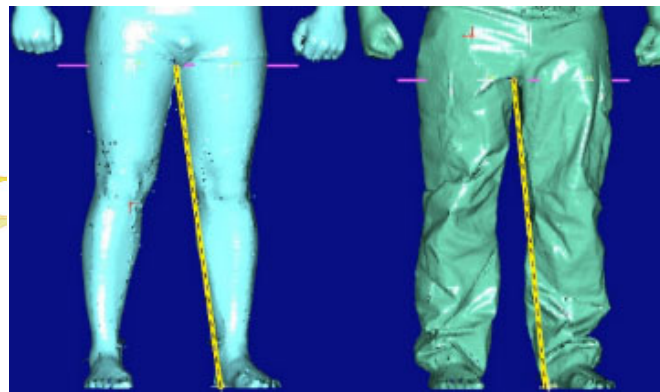
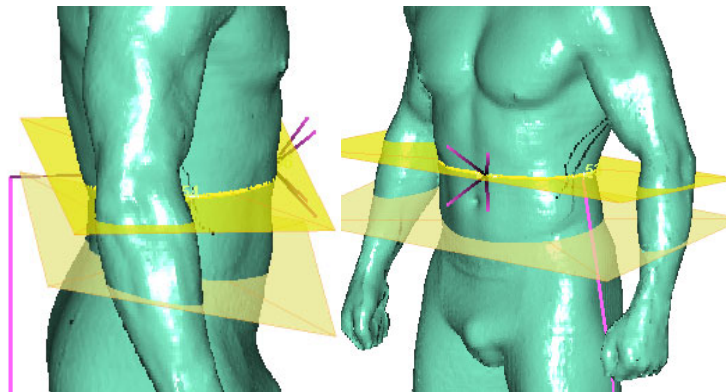
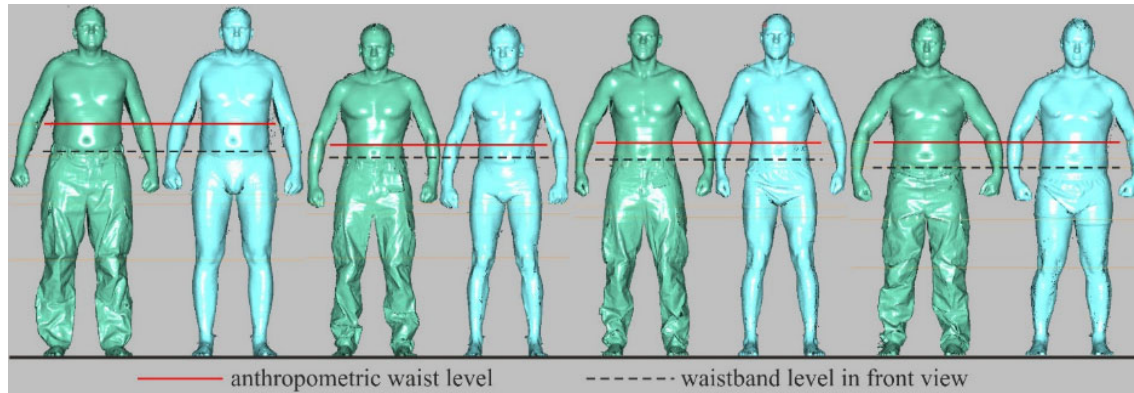


Target group research

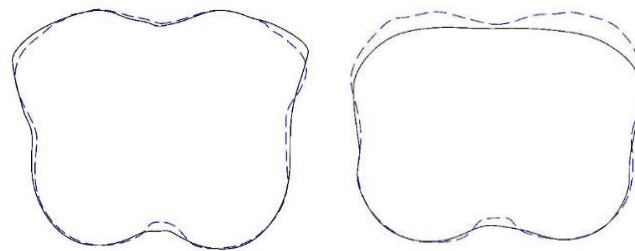
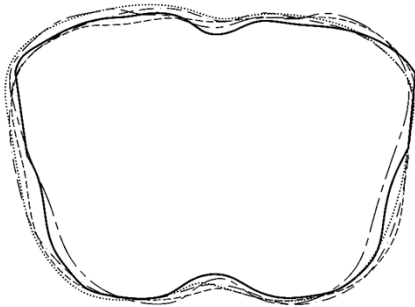
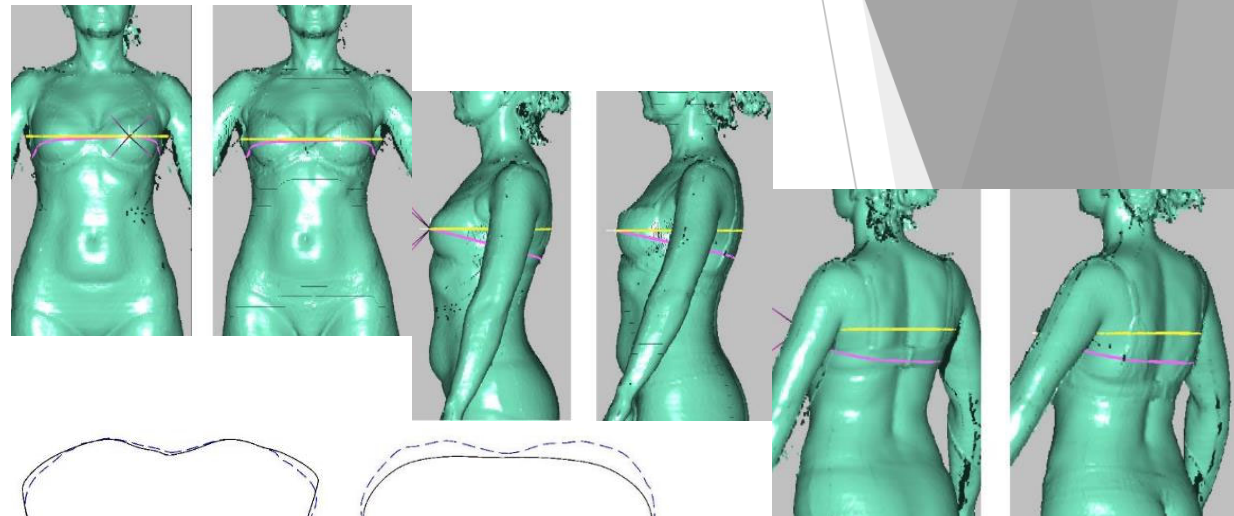
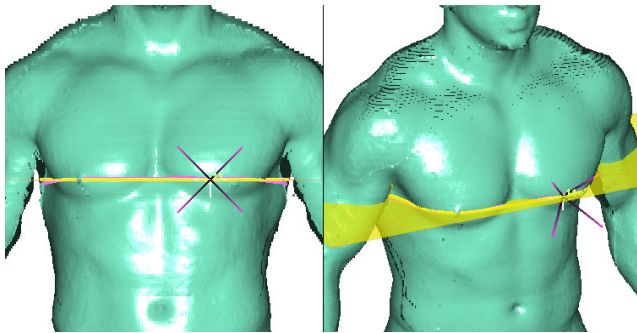
- ▶ 122 soldiers measured. Comparison of distribution of soldiers' body height with normal distribution according to the mean value and variation of sampling data shows that data comply well with the normal distribution curve – such a correspondence is also shown by QQ plot where distribution line of sample and theoretical quantiles is the line specifying data – the data points are arranged around the line in the biggest part of the interval. Therefore, it is considered that normal distribution density function approximates the selection data well and as such is suitable for data validation and analysis.



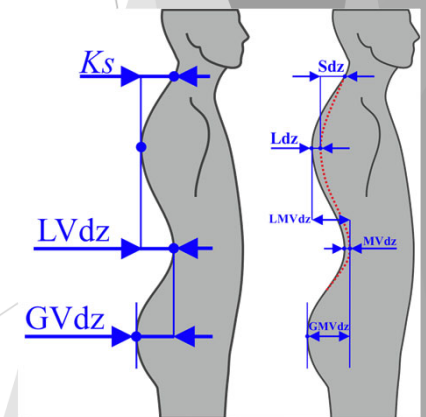
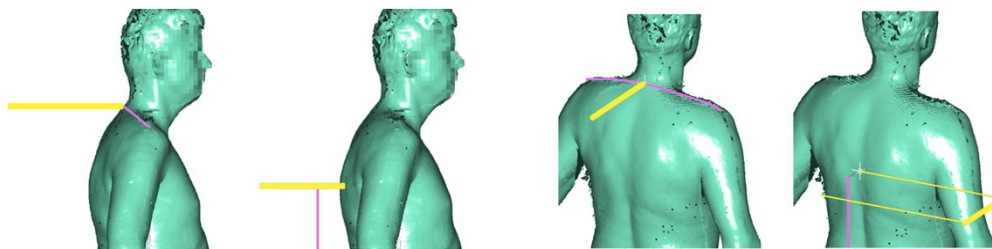
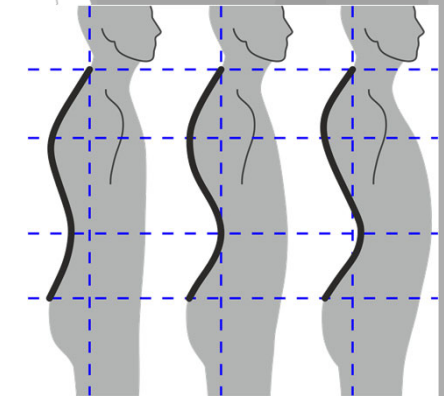
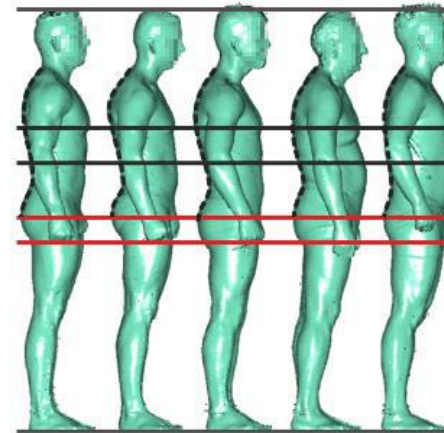
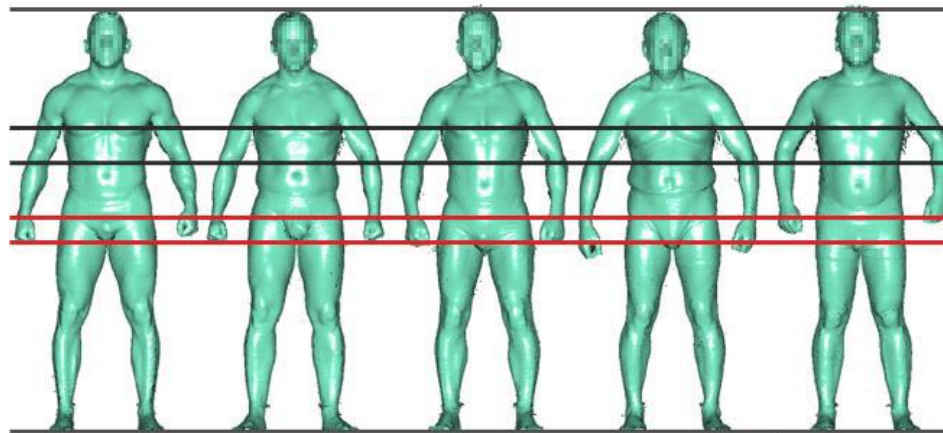
Body measurement research



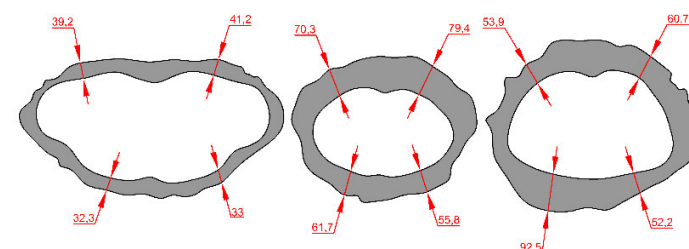
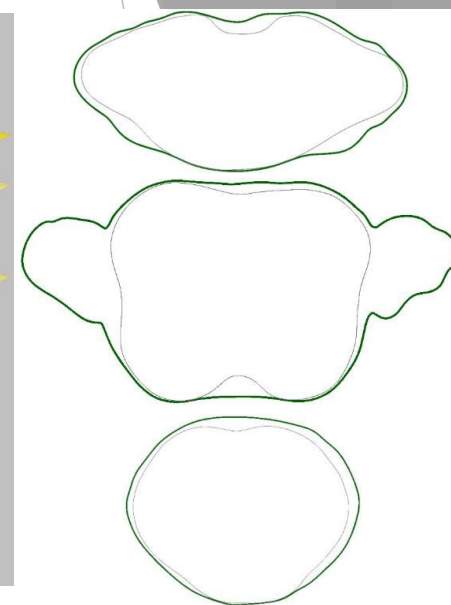
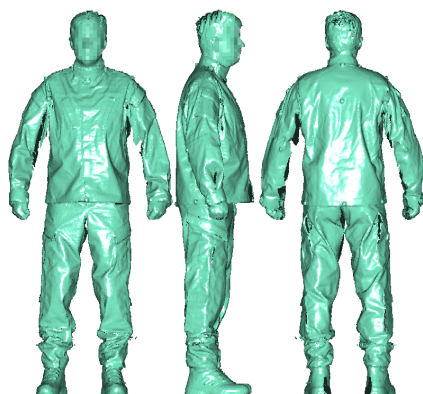
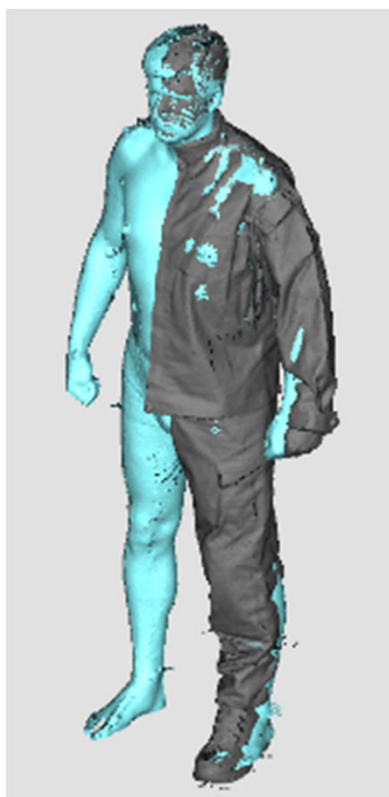
Body measurement research



Posture research



Body surface and clothing layer interactions



X-Fit

Project

USPIT

Menu

- Scans
- Persons
- Size Assignment
- Clothing Analysis
- Measurement Analysis
- Item Administration
 - Items
 - Item Type
 - Item Documentation
 - Item List
 - Fitting Rates Forecast
- Measure Administration
 - Measures
 - Measure Lists
- Rules Administration
 - Fitting Rules
 - Fitrate Analysis
 - Training Sets
 - Bodymeasure Analysis
 - Fitting Rates History
 - Expert
- Fit Assessment Admin.
 - Acquisition
 - Fit Assessments
 - Sizes Distribution
 - Distribution over Time
 - Item Comparison
- Quality Rating
 - Scans
- Project Configuration
 - Locations
 - Personal Data
- User Administration

Account

Logged in as: admin (Administrator)

Logout

Change Password

Scans

Filter

Location: Sex:

Person ID: Scan Type:

Scan Date from: to:

[Apply] [Reset]

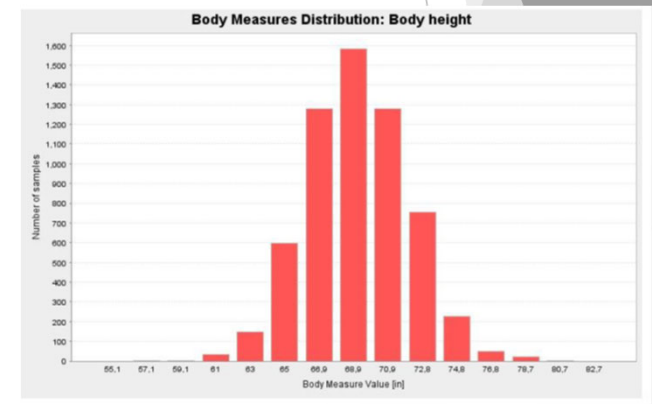
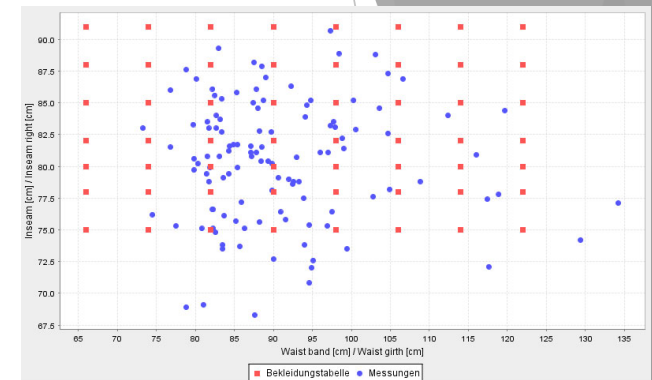
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Back Next > 1 2 3 4 5 6 7 8 9 10 ... 276 [Page off] Scans 1 to 25 (276 total)

Choice

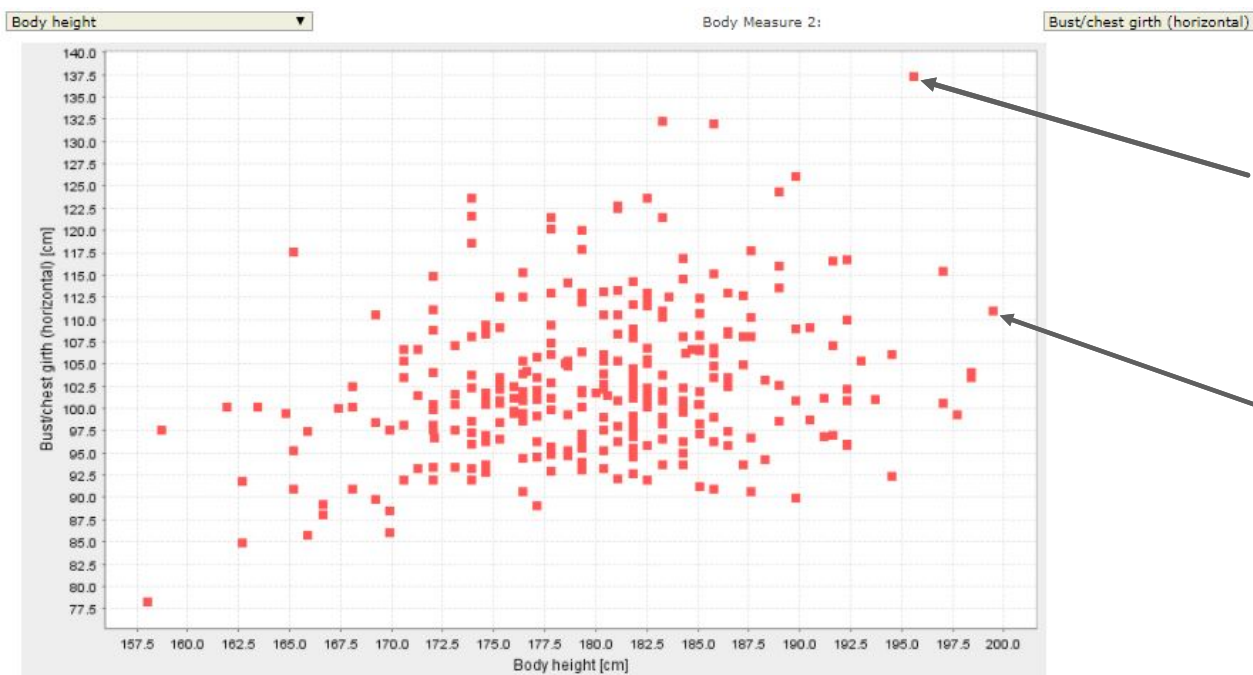
All Name Inverse Range Change Export Import CSV File

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☐		FTB101	9812698243	out.csf	male		04/01/06 08:14
☐		FTB101	6316492932	out.csf	male		05/01/06 07:16
☐		FTB101	7013091500	out.csf	male		06/01/09 06:39



X-Fit

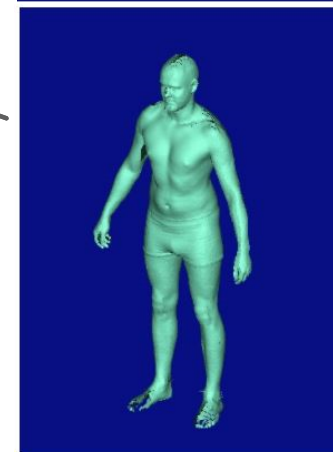
- Largest and tallest figures



Location: Uni
ID: Janar Narne
Sex: male
Scan Type:
Scan Date: 30/11/16 10:19

Body Measures		Fit Assessments
Filter for Measures: 1 TROUSERS LIST ▼		
Body height [cm]	195.60	
Bust/chest girth (horizontal) [cm]	137.30	
Buttock girth [cm]	124.00	
Hip girth [cm]	126.60	
Inseam left [cm]	88.20	
Inseam right [cm]	87.80	
Sideseam left [cm]	113.40	
Sideseam right [cm]	112.60	
Thigh girth left (horizontal) [cm]	72.10	
Thigh girth right (horizontal) [cm]	71.20	
Waist band [cm]	116.60	

Quality: not rated ▼



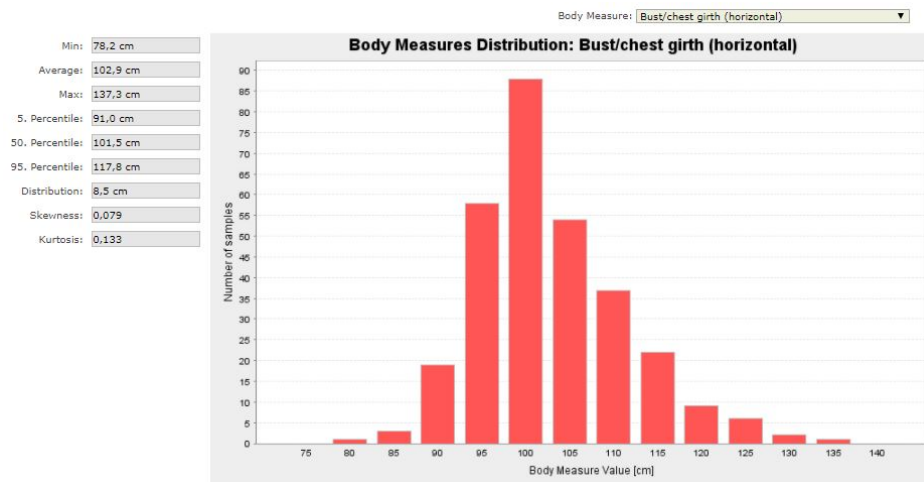
Location: Uni
ID: Jüri
Sex: male
Scan Type:
Scan Date: 24/05/16 10:55

Body Measures		Fit Assessments
Filter for Measures: 1 TROUSERS LIST ▼		
Body height [cm]	199.50	
Bust/chest girth (horizontal) [cm]	110.90	
Buttock girth [cm]	108.50	
Hip girth [cm]	111.90	
Inseam left [cm]	91.10	
Inseam right [cm]	91.10	
Sideseam left [cm]	118.10	
Sideseam right [cm]	117.80	
Thigh girth left (horizontal) [cm]	60.00	
Thigh girth right (horizontal) [cm]	62.00	
Waist band [cm]	97.90	

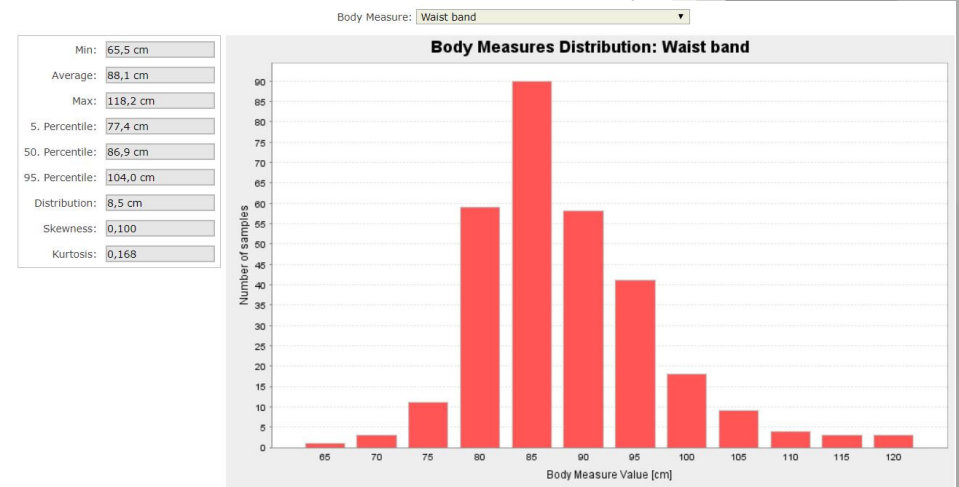
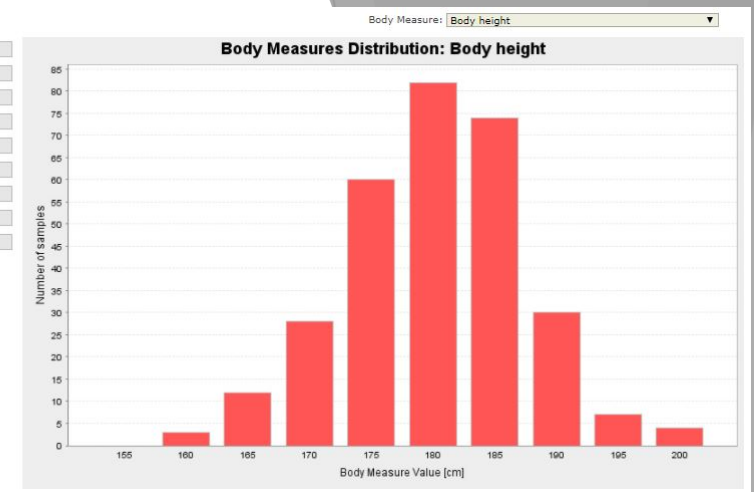
Quality: not rated ▼

X-Fit

- Distribution of body height, chest girth and waist band



Min:	158,0 cm
Average:	180,1 cm
Max:	199,5 cm
5. Percentile:	167,4 cm
50. Percentile:	180,4 cm
95. Percentile:	192,3 cm
Distribution:	7,3 cm
Skewness:	-0,011
Kurtosis:	0,030



Initial combat clothing size table

Välivormi püksid M09 (samm/ vöö/rind)	
1	75/68/84
2	75/72/88
3	75/76/92
4	75/80/96
5	75/84/100
6	75/88/104
7	75/92/108
8	80/72/88
9	80/76/92
10	80/80/96
11	80/84/100
12	80/88/104
13	80/92/108
14	80/96/112
15	80/100/116
16	80/104/120
17	85/80/96
18	85/84/100
19	85/88/104
20	85/92/108
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22	85/100/116
23	85/104/120
24	85/108/124
25	85/112/128
26	90/92/108
27	90/96/112
28	90/100/116
29	90/104/120
30	90/108/124
31	90/112/128

In USE	Hight	68/84	72/88	76/92	80/96	84/100	88/104	92/108	96/112	100/116	104/120	108/124	112/128
	70	73	73	73	73	73	73	73	73	73	73	73	73
	75	78	78	78	78	78	78	78	78	78	78	78	78
Inseam	80	83	83	83	83	83	83	83	83	83	83	83	83
	85	88	88	88	88	88	88	88	88	88	88	88	88
	90	93	93	93	93	93	93	93	93	93	93	93	93
	70	98	98,4	98,8	99,2	99,6	100	100,4	100,8	101,2	101,6	102	102,4
	75	103	103,4	103,8	104,2	104,6	105	105,4	105,8	106,2	106,6	107	107,4
Sideseam	80	108	108,4	108,8	109,2	109,6	110	110,4	110,8	111,2	111,6	112	112,4
	85	113	113,4	113,8	114,2	114,6	115	115,4	115,8	116,2	116,6	117	117,4
	90	118	118,4	118,8	119,2	119,6	120	120,4	120,8	121,2	121,6	122	122,4
WaistGirth		70	74	78	82	86	90	94	98	102	106	110	114
ButtockGirth		94	98	102	106	110	114	118	122	126	130	134	138

Suggestions for the measurement table changes

	Height	84	88	92	96	100	104	108	112	116	120	124	128
Inseam	160	78	78	78	78	78	78	78	78	78	78	78	78
	170	83 (0)	83 (9)	83 (21)	83 (27)	83 (20)	83 (18)	83 (10)	83	83	83	83	83
	180	88	88 (1)	88 (6)	88 (5)	88 (15)	88 (2)	88 (4)	88 (1)	88 (1)	88 (0)	88	88
	190	93	93	93	93 (1)	93 (0)	93 (2)	93 (0)	93 (0)	93 (0)	93 (0)	93 (0)	93 (0)
	200	98	98	98	98	98	98	98 (0)	98 (0)	98 (0)	98 (0)	98 (0)	98 (0)
Sideseam	160	105	105,4	105,8	106,2	106,6	107	107,4	107,8	108,2	108,6	109	109,4
	170	110	110,4	110,8	111,2	111,6	112	112,4	112,8	113,2	113,6	114	114,4
	180	115	115,4	115,8	116,2	116,6	117	117,4	117,8	118,2	118,6	119	119,4
	190	120	120,4	120,8	121,2	121,6	122	122,4	122,8	123,2	123,6	124	124,4
	200	125	125,4	125,8	126,2	126,6	127	127,4	127,8	128,2	128,6	129	129,4
WaistGirth		68	72	76	80	84	88	92	96	100	104	108	112
ButtockGirth		88	92	96	100	104	108	112	116	120	124	128	132

Fit Checking

- Size determination
- Visual and tactile assessment
- Ease of putting on and removing, a
- Freedom of movements

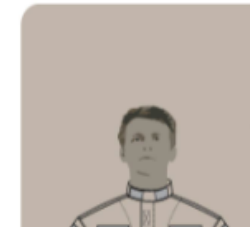
Jacket										
Bust/chest girth →			XS	S	M	L	XL	XXL	XXXL	4XL
Body height ↓			74							
2XSH	161-167	XS/2								
XSH	167-173	XS/3								
SHO	173-179	XS/4								
REG	179-185	XS/5								
LON	185-191	XS/6								
XLO	191									
2XLO	197									

JACKET WEARING COMFORT (FIT) INDICATORS

Collar of the jacket fits closely around the neck without causing any discomfort.



Jacket loosely covers shoulders and underarm (rib) area and causes no feeling of tightness



Jacket covers the shoulder and underarm (rib) area loosely enough to avoid any perceptible constraints to arms to be moved in a wide range.

Trousers cover pelvic area and thighs loosely enough to avoid encumbering such movements as standing, sitting, squatting and bending.

There are **NO** places for unexpected tears in garment parts or between them.

There are **NO** unreasonable movement limitations in any of the joints.

Thank You!

Dr.sc.ing. **Inga DĀBOLIŅA**
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