

New Prototype of Work Wear



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Agenda

- ❖ Introduction
- ❖ Analysis of questionnaires – general issues
- ❖ New prototypes
- ❖ Verification of the new prototype of workwear clothing under environmental conditions

Introduction

Clothes, depending on the purpose, fulfil the appropriate functions. In professional clothing, this should mainly be the protective function of the employee's clothing in the case of workwear clothing and the protection of the health and life of the worker in the work environment.

The dimensional and size analysis made for the selected clothing in each partner country and a summary of the questionnaire surveys carried out in order to evaluate the currently produced workwear clothes gave the opportunity to determine the direction of changes in these products in terms of improving their fitability and functionality according to the expectations of users.

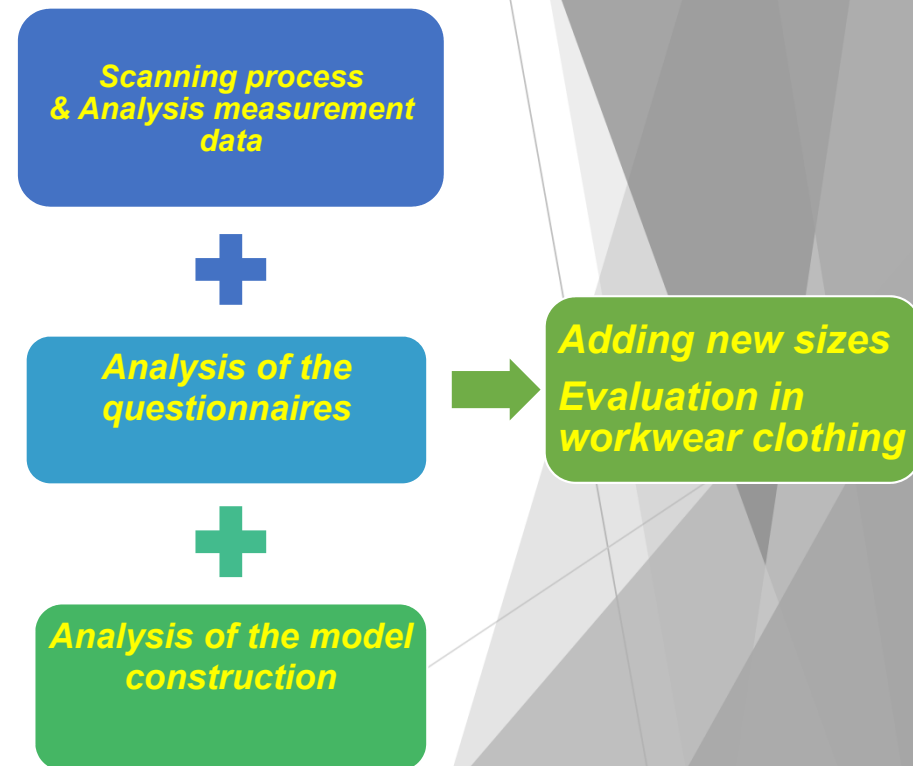
The selected groups of end users

Country	Group of end users
Finland	chemical industry workers
Estonia	soldiers
Latvia	soldiers
Poland	construction workers
Lithuania	firefighters

Introduction

The new prototypes were developed based on:

- ▶ 1. 3D scanning process and fulfilling the questionnaire,
- ▶ 2. Statistical elaboration the results of scanning process,
- ▶ 3. The measure of end users' garments & images,
- ▶ 4. Comparison of scanning results and work wear dimensions,
- ▶ 5. The analysis of questionnaire survey,
- ▶ 6. Preparing the new prototype of workwear,
- ▶ 7. Assessment of new prototype suitability.



Analysis of questionnaires

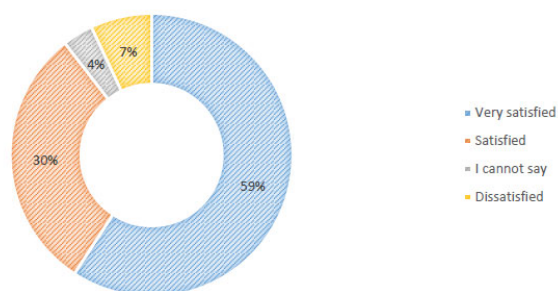
In the next stage of the project implementation, an analysis of the surveys related to:

- End users sizing and fitting
- Functionality and safety of current workwear
- End users' suggestions what to change in workwear
- Integrating RFID, textronic system into workwear yes or no?

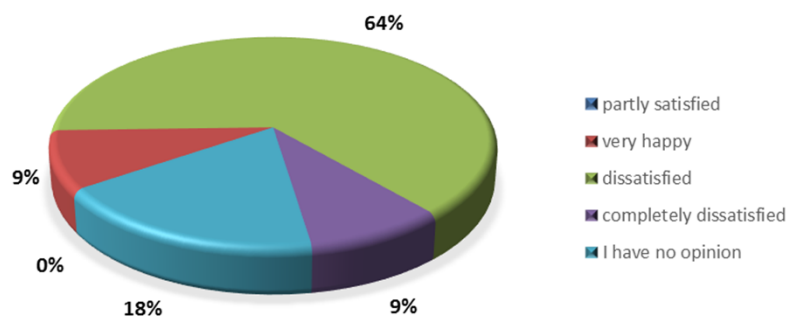
Analysis of questionnaires

Satisfaction from the size and fitting of workwear

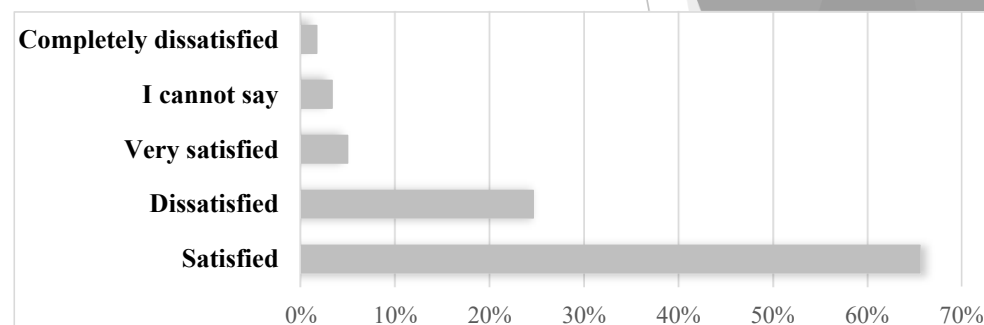
Soldiers - Estonia



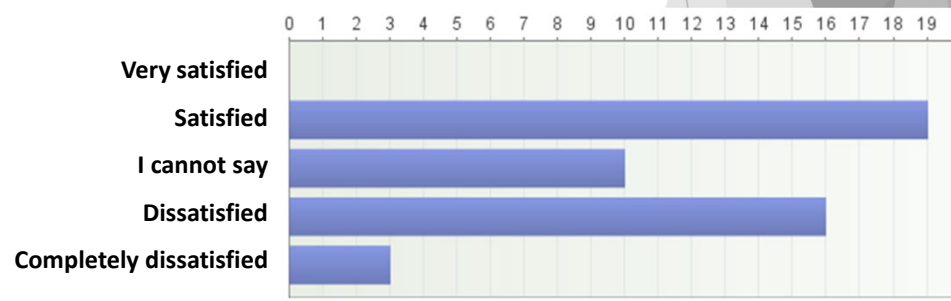
Builders - Poland



Soldiers- Latvia



Chemical industry workers - Finland



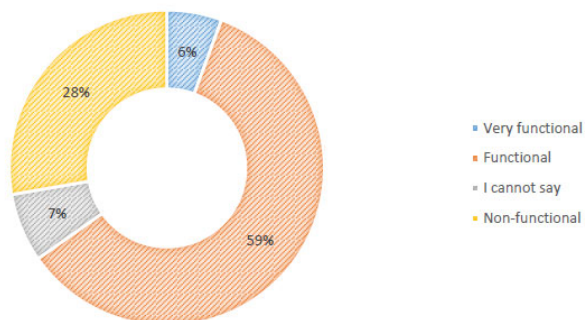
Analysis of questionnaires - Finland

End users' suggestions for improvements to sizing and fitting

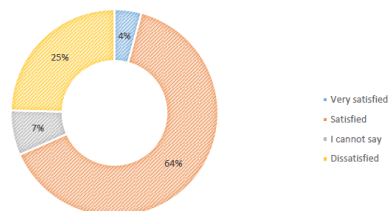
FINLAND	POLAND	ESTONIA	LATVIA
<ul style="list-style-type: none"> ✓ pant legs are too short or too long, ✓ legs are too wide, ✓ legs are too tight ✓ waist is too tight, ✓ waist is big compared to the hip, ✓ the position of the knee pocket (for padding) is not always good. ✓ too tight on hips, ✓ too long or too short sleeves, ✓ too wide sleeves, ✓ too loose jacket, 	<ul style="list-style-type: none"> ✓ shorter sleeves, cuffs adjustment, ✓ trousers more tight in the legs, ✓ a loose sleeve in the shirt, ✓ looseness in the arms and elbows,, ✓ loose legs and sleeves, ✓ legs and sleeves too short ✓ in winter bib-trousers (gardeners type), in summer waist trousers 	<ul style="list-style-type: none"> ✓ Most common problem is that the uniforms are too loose, sleeves are too short and too wide ✓ Pants crotch tears easily ✓ Uniform is too hot in the summer and doesn't breathe enough – air permeability. ✓ Need for better fitting – fitted jackets, pants with lower waistband, longer sleeves. ✓ Female soldiers should have their own uniform ✓ Difficult to roll up the sleeves ✓ There were some suggestions to integrate elbow and knee protections into the uniforms ✓ Soldiers would like more water resistant uniforms and quick drying materials ✓ More elastic fabric ✓ Also soldiers would like to have more zippers instead of buttons and Velcro 	<ul style="list-style-type: none"> ✓ Its to small, or too big ✓ To short trousers, ✓ The fit of field uniforms must be ensured. ✓ Constructive and technological solutions in crotch stitches of trousers are poor. ✓ It is necessary to reinforce knee and elbow pads , sleeve bottoms and leg bottoms to protect. ✓ The way of adjusting waistband should be changed by replacing band by elastic band or touch and close fastener (Velcro).

Analysis of questionnaires

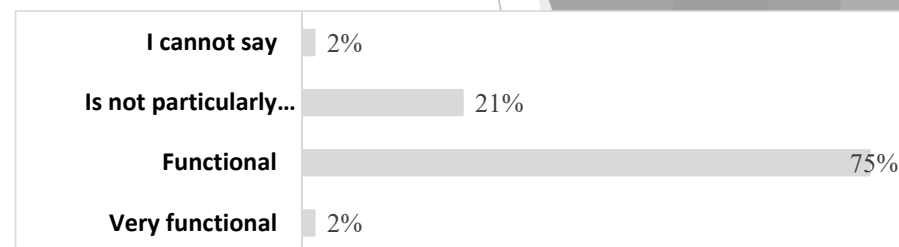
Functionality of current workwear Soldiers - Estonia



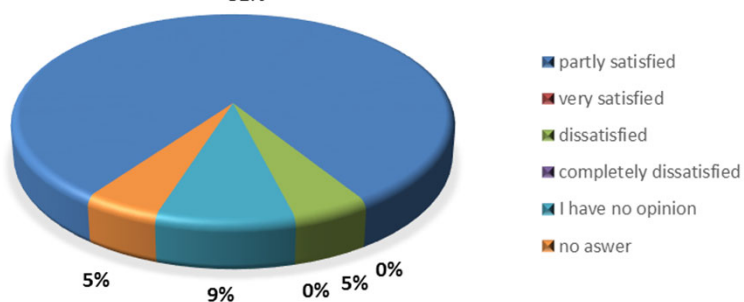
UNIFORM PATTERN-CONSTRUCTION SUITABILITY



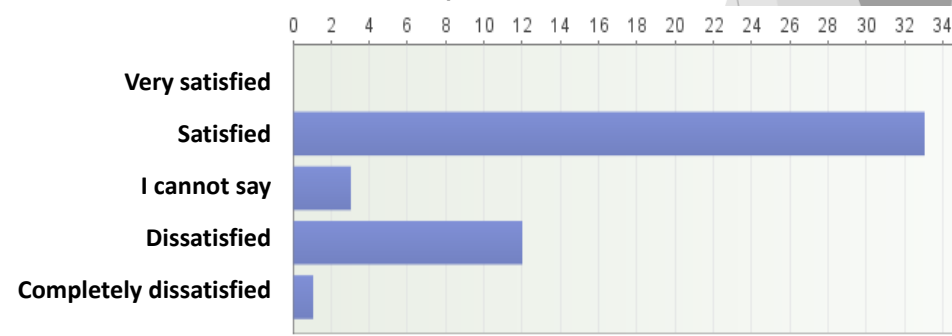
Soldiers- Latvia



Builders -Poland



Chemical industry workers - Finland



Analysis of questionnaires

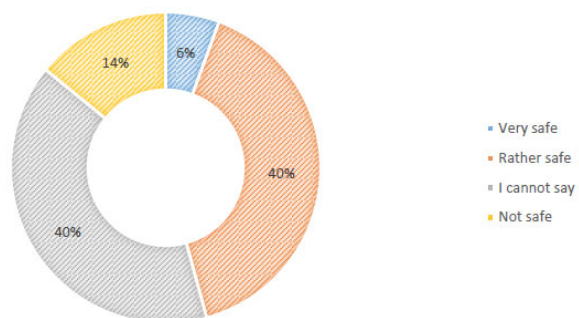
End users' suggestions to improve current workwear's functionality

FINLAND	POLAND	ESTONIA	LATVIA
<p>Materials:</p> <ul style="list-style-type: none"> the old model and material of the trousers were nicer, 1 the reflective tape deteriorates (in use as well as when washing), 3 the reflective tape come away from the garments, 1 the reflective materials dazzle when welding, 1 the material should withstand hot zinc, 2 the winter jacket is too dark, poor visibility, 1 materials could be more breathable, 6 woolen underwear material would absorb moisture, 1 acid and fire resistant, 1 <p>Fastenings:</p> <ul style="list-style-type: none"> Velcro is a "toy" zippers are weak, 1 no snap fasteners to the jacket, zippers instead, 1 <p>Pockets:</p> <ul style="list-style-type: none"> a pocket or a loop for the walkie-talkie, 3 the mobile pocket is too narrow thigh pocket: one would be is enough (1), tears off easily (1), are situated too low (1) a hammer loop could be on both legs, 1 a pocket for the pen instead of a loop, 1 	<p>Materials:</p> <ul style="list-style-type: none"> <i>more airy from natural fibres</i>, mainly in summer, with darker colours the use of more flexible, breathable, waterproof, winter warming, more colourful materials, more durable, reinforced fabrics, for example resistant to sparks, <p>Fastenings:</p> <ul style="list-style-type: none"> looser blouse, additional fastening under the neck in the shirt, use in blouse ZIP fasteners or snaps, cuts on the side with a zip (ventilation), <p>Pockets:</p> <ul style="list-style-type: none"> pockets at the wrong height, the cuts prevent insertion and extraction of things out of pocket, the phone pocket should be accessible from the outside larger cell phone pocket, additional pockets for keys, side pocket in the blouse in the side seam (too much behind) - suggested shift towards the front, phone pocket in the upper part (blouse), increasing the size of the pocket in a bib, pull-on cuffs, Velcro or rubber cuff two side pockets for carrying a measure and other instruments, instead of buttons, the slider in the fly, trousers fastenings with elastics gum remove the shirt, waist adjustment on both sides additional pockets in trousers on the side for tools, internal pocket for a mobile phone, 	<p>Materials:</p> <ul style="list-style-type: none"> Unsatisfactory quality of fabric used for manufacturing field uniforms (not strong, breathable, and stretchy enough, colour durability and friction resistance is insufficient). <p>Fastenings:</p> <ul style="list-style-type: none"> Button fastening should be replaced by zip fastener. <p>Pockets:</p> <p>Back pocket flaps should be removed; button fastener on pockets flaps or back pockets should be given up.</p>	<p>Materials:</p> <p>higher strengt of fabric, higher elasticity of fabric</p> <p>Fastenings</p> <p>Preferring Zipers and velcro</p> <p>Pockets:</p> <p>Change location of pockets, Change types of pockets</p> <p>Construction:</p> <p>Strengthen the elbow and knee areas Tightening options for sleeves and trousers Wearability comfort More openings, Loops for differents objects</p>

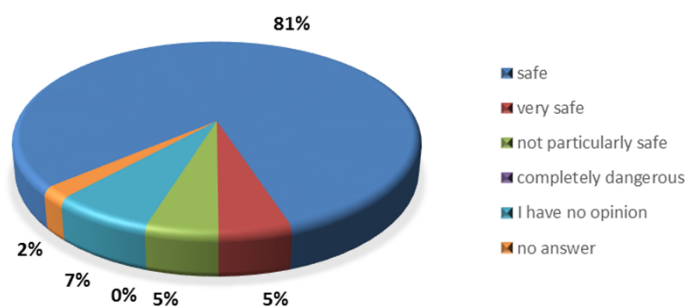
Analysis of questionnaires

Safety of current workwear

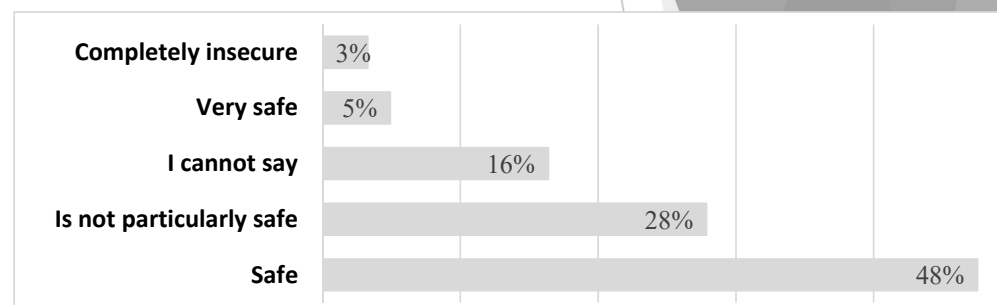
Soldiers - Estonia



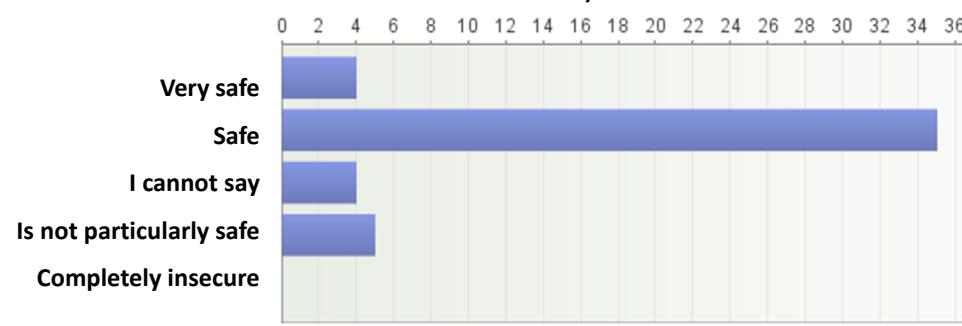
Builders –Poland



Soldiers- Latvia



Chemical industry workers - Finland



Analysis of questionnaires

Materials

- ▶ There was no direct question about the materials of work clothes. However, the sentiments expressed concerning materials became known in many of the answers; in comfort, functionality, security.
- ▶ Finding, testing and choosing new materials is one of the issues in developing new workwear.

Integrating RFID and textronic into workwear

- ▶ RFID/sensors to locate person (in case of emergency) or to inform of the arrival of a person to working area ,
- ▶ technology that alerts person of occupational hygiene, air purity, noise level or gas.

Conclusions from questionnaire

The general conclusions for the assessed clothing products, among others:

- ▶ there is a need to design and produce garments for women and men,
- ▶ users report that the clothing are too loose,
- ▶ user expectations are focused on clothing for the summer and winter season,
- ▶ low strength of the base material (for example too fast rubbing of trousers in the crotch),
- ▶ quality of used additives (buttons, zippers, rubber bands) ,
- ▶ length of the sleeves, trouser legs not always consistent with the need,
- ▶ changes in the location of the pockets, flaps,
- ▶ increase the size of the pockets and change of cuffs fastening.

Body measurements in relation to workwear dimensions

Most users expect more fitting clothes and functionality in terms of design and usage – comfort.

In the case of some group of users there was too much discrepancy between body dimensions and ranges of growth and circumferences included in the manufacturer's size tables.

Measurements for workers has shown wrong adjusting garment sizes regarding:

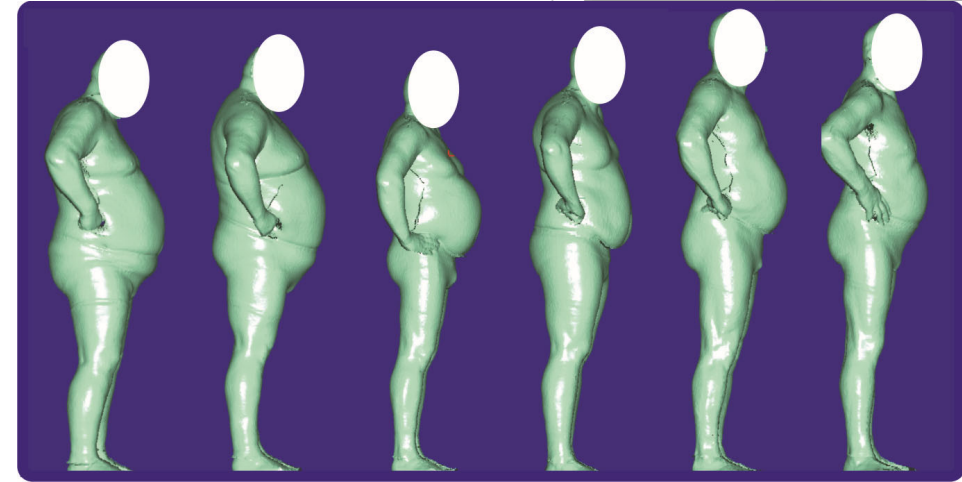
- chest girth (men as well as women),
- lenght of sleeve,
- lenght and width of legs,
- buttock girth,

Body measurements in relation to workwear dimensions

Problematic was adjusting blouse sizes for workers **with unusual waist girth.**

The information from the surveys showed low awareness of the respondents regarding the selection of appropriate workwear clothing for the type of work performed.

The respondents did not know their own size of workwear clothing!!!



It seemed to be difficult for the users to choose right size of clothing.

For this purpose there are standards:

13402-1 Terms, definitions and body measurement procedure

13402-2 Size designation of clothes. Primary and secondary dimensions

13402 -3 defines a new pictogram that can be used in language-neutral labels to indicate body dimensions.

New prototypes

Each of the project partners has modified the workwear clothing in the selected, specific assortment, which was the subject of works in the full task program. A number of construction and technological changes have been introduced in clothing, which in general terms related to:

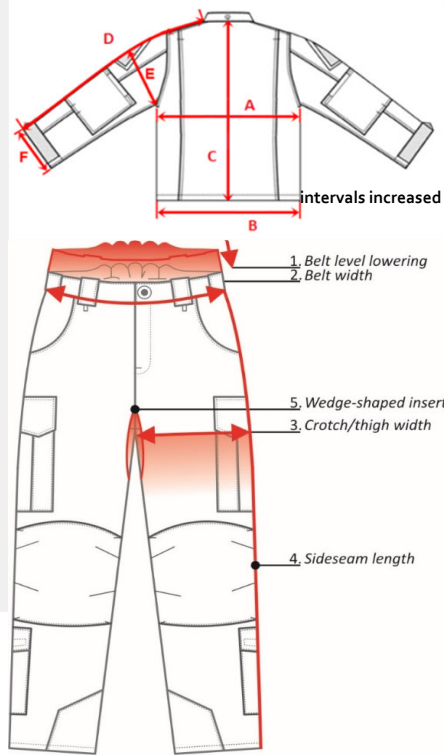
- product construction,
- applied basic materials,
- used additives,
- adjusting the size and location of the pocket.

The completed product modification includes compliance with the principles of ergonomics and comfort of use in accordance with the type of workwear clothing.

Changes

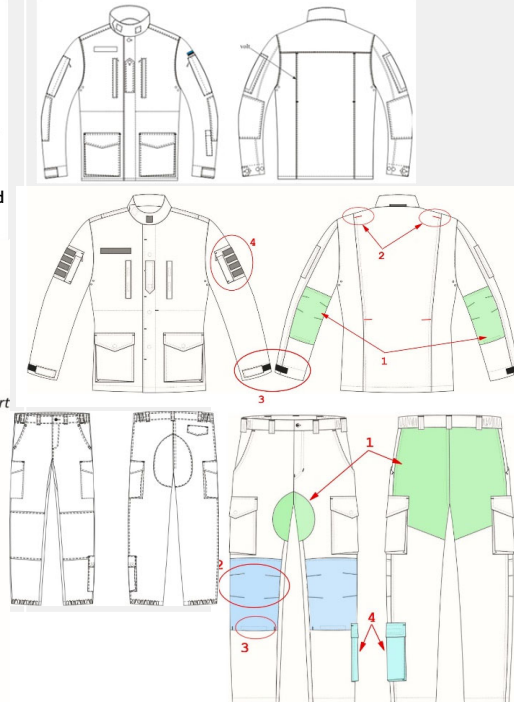
Latvia

CHANGES IN JACKET AND TROUSERS



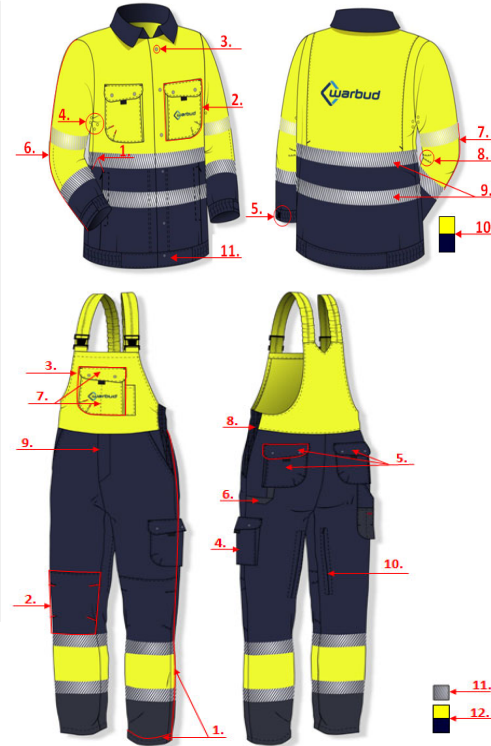
Estonia

CHANGES IN TROUSERS



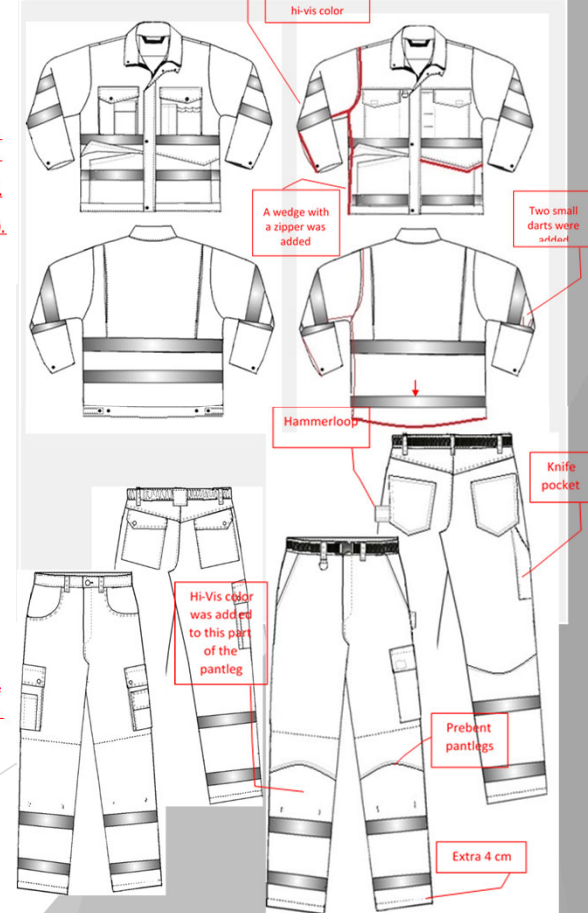
Poland

CHANGES IN SWEATSHIRT AND DUNGAREES



Finlandia

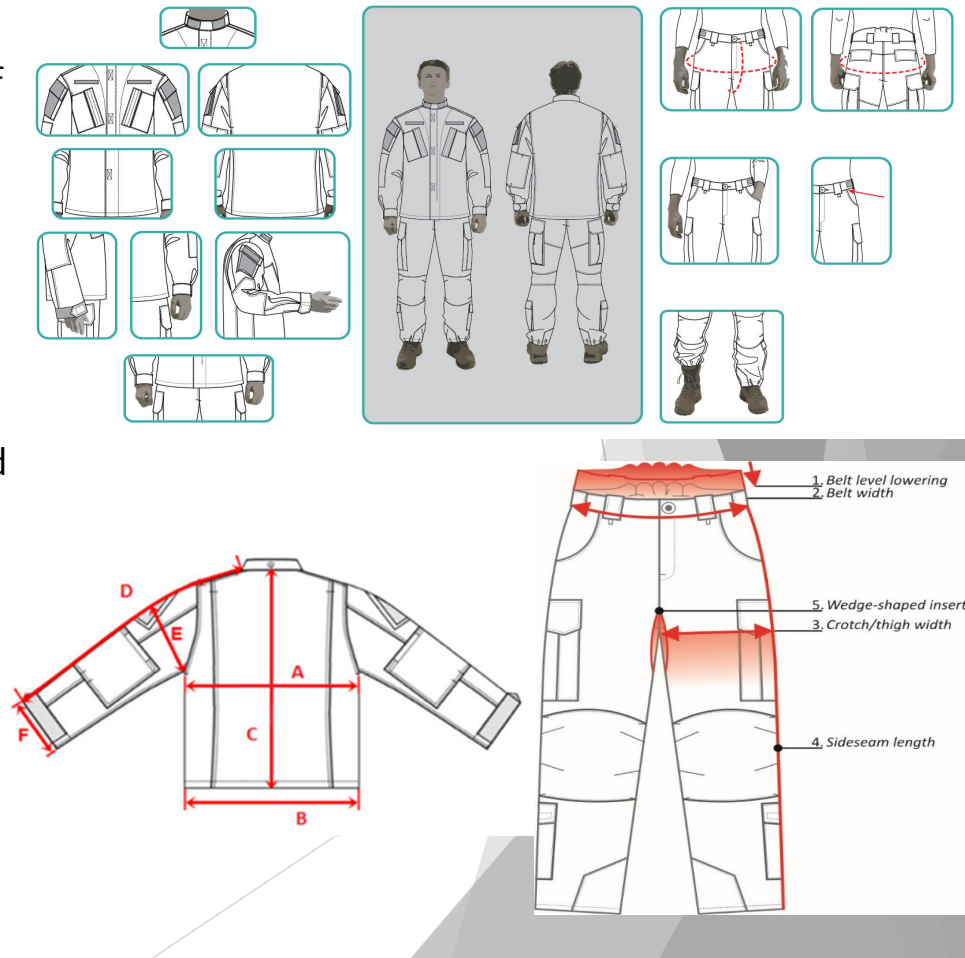
CHANGES IN JACKET AND TROUSERS



Changes in clothing for soldiers - Latvia

1. lowered the belt level by 6 cm.
2. changes in tape width (stretching) measurements were introduced
3. increase the width of the interval of crotch width (linked with thigh girth) from 2 cm to 2.5 cm, which could increase freedom of movement as an additional solution to prevent the tear in the crotch area of trousers.
4. as a result of changes in the belt level, the control measures of the side-seam length in the control measurement tables were adjusted, without changing the previous interval widths.
5. in the trouser model a wedge-shaped insert was introduced, improving the functionality of the crotch area. The rhombus-shaped wedge is 8 cm (± 0.5 cm) wide and 41 cm (± 1 cm) long and consists of two basic layers of fabric. Inseam, seams connecting the front part from the zipper to the wedge and wedge stitching are reinforced with parallel seams and a choice of more durable threads (PES were replaced with PA - 23% stronger than required in the specifications).
6. In order to protect the pocket against tearing, we recommend extending the pocket opening in the shape of a curve by 1 cm.

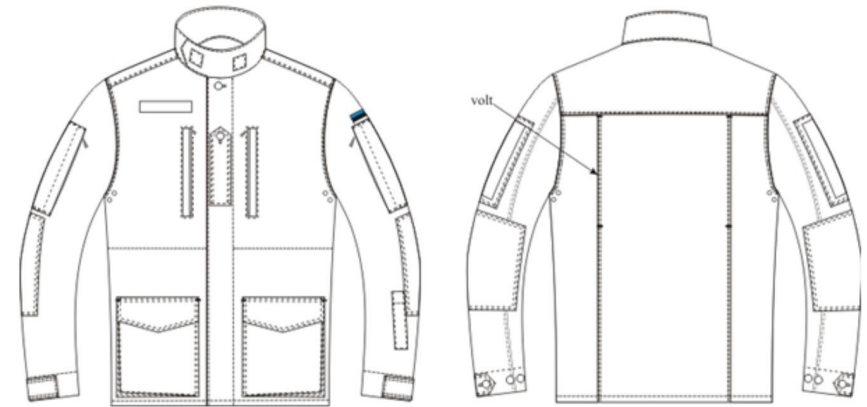
SWW Seminar, 05th.02.2019, Rovaniemi, Finland



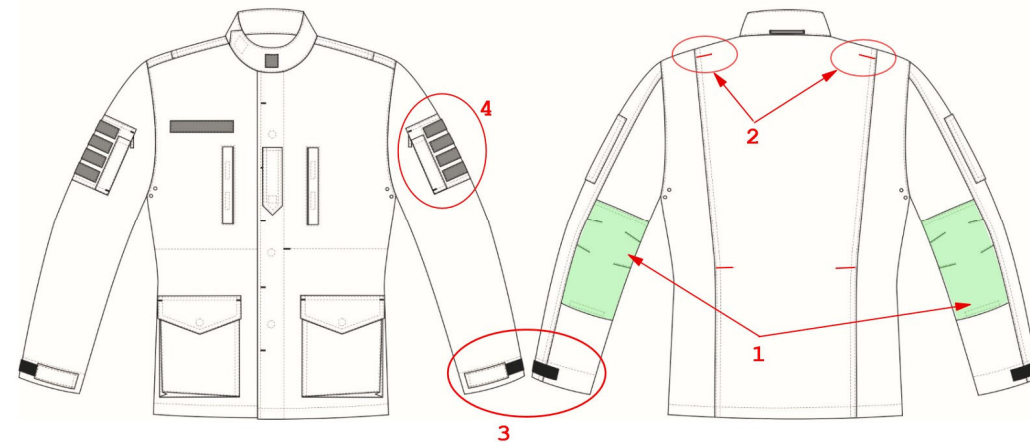
Changes in clothing for soldiers - Estonia

ESTONIAN DEFENCE FORCE AND MARINE UNIFORM CHANGES IN JACKET DESIGN

1. Darts were added to elbow details for more ergonomic shape. Openings for reinforcement were added for more comfort and protection.
2. Jackets back detail yoke was uncomfortable and didn't allow needed movements, it was redesigned into pleated vertical seams with bar tackers for pleats near shoulders and waistline.
3. Velcro fasteners were added to sleeves for better adjustment
4. Velcro fasteners were added to sleeves for military emblems.

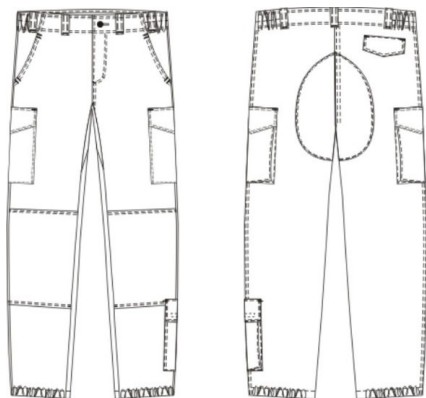


Picture 1. Old version of Estonian Defense Force and Marine uniform jacket

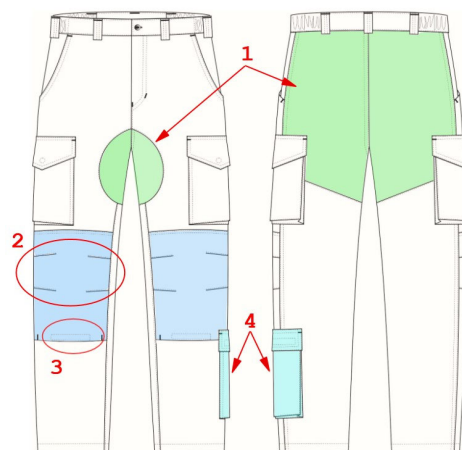


Picture 2. New and improved version of Estonian Defense Force and Marine uniform jacket

ESTONIAN DEFENSE FORCE AND MARINE UNIFORM CHANGES IN TROUSER DESIGN



Picture 1. Old version of Estonian Defense Force and marine uniform trousers

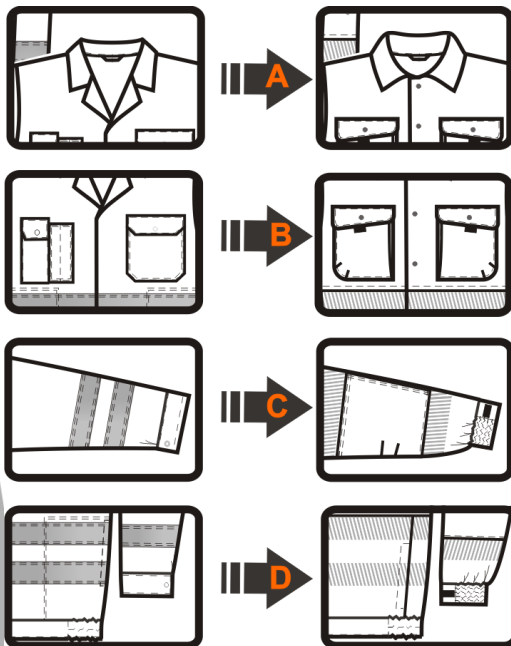


Picture 2. New improved version of Estonian Defense Force and Marine uniform trousers

1. Trouser front and back details were changed to the shape that helps to reduce tension in crotch and buttock area while performing different movements.
2. Knee details were elongated and location was changed to cover all kneeling positions. Also darts were added for more ergonomic shape.
3. Knee reinforcement openings were added for more comfort and protection.
4. Pocket on the left lower outer seam is redesigned to fit med-pack comfortably.

Changes in workwear clothing of builder - Poland

Technological details



- Moving the inlet to the bottom pocket closer to the front centre edge to facilitate the use of pockets and adding zippers (spiral type).
- ✓ Changing the collar construction to a buttoned at the neck (A)
 - ✓ Changing the shape of the upper pockets (B)
 - ✓ Execution of embroidered ventilation holes on the line of armpits (8 items)
 - ✓ Cuffs with sewn rubber and additional regulation of wrist circumference in the form of sewn-up trap fastened with self-splice tape (Velcro or "Velcro" type) (C)
 - ✓ Extension of the sleeves by 2.0 cm (D)
 - ✓ Reinforcements on the elbows in the form of an additional layer of fabric (C)
 - ✓ Adding profiled sutures to the elbows, forming the convexity (C)
 - ✓ Application of a reflective panel tape (D)
 - ✓ Changing the fabric, the use of a material with a cotton dominance.
 - ✓ Resignation of the clasped fastening of the sweatshirt, the use of durable, metal latches suitable for clothing used in the work environment.

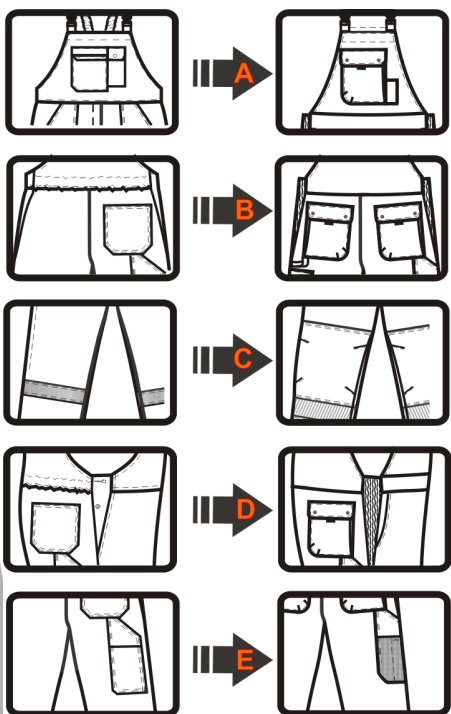


Before changes



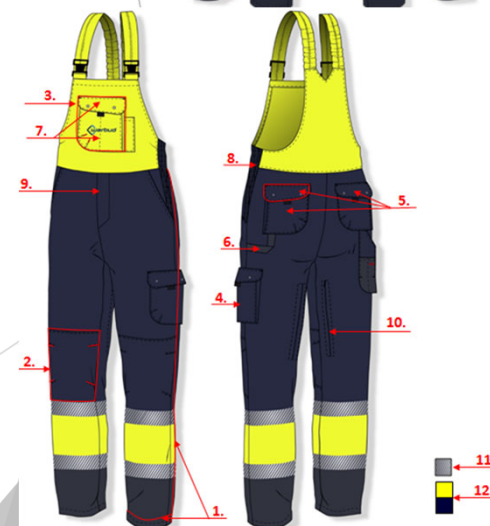
After changes

Technological details



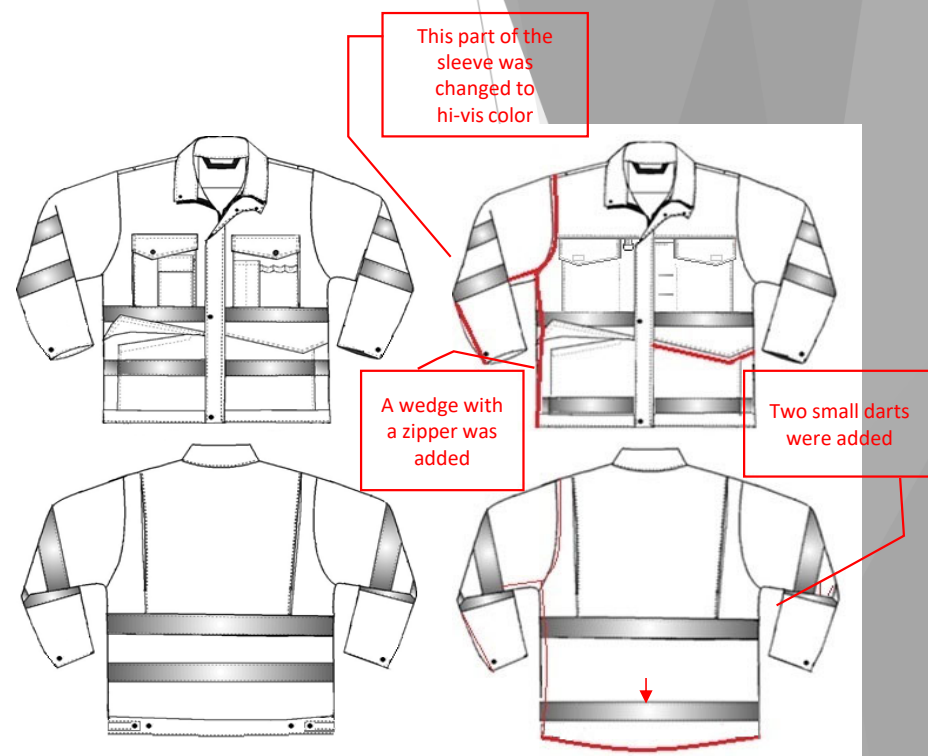
In the new prototype the complete change in the construction of **dungarees** has been made, the applied fashion / cut gives greater comfort and freedom of movement while working.

- ✓ Narrowing and shortening of the legs.
- ✓ Reinforcements on the knees and tucks modelling the leg on the knee (C)
- ✓ Changing the fashion of the side pockets.
- ✓ Adding a pocket to the left thigh and a spatial inch pocket (E)
- ✓ Additional rear pocket. Pockets covered with straps.
- ✓ Hammer holder (B)
- ✓ A pocket on a gore zippered with a stitching created a pocket for a mobile phone (A)
- ✓ Side strip made of elastic fabric (D)
- ✓ Dungarees at the front zippered.
- ✓ Moving the ventilation holes from the side seam to the back of the leg.
- ✓ Panel tape.
- ✓ Changing the fabric, the use of a material with a cotton dominance.



Changes in clothing for chemical industry workers - Finland

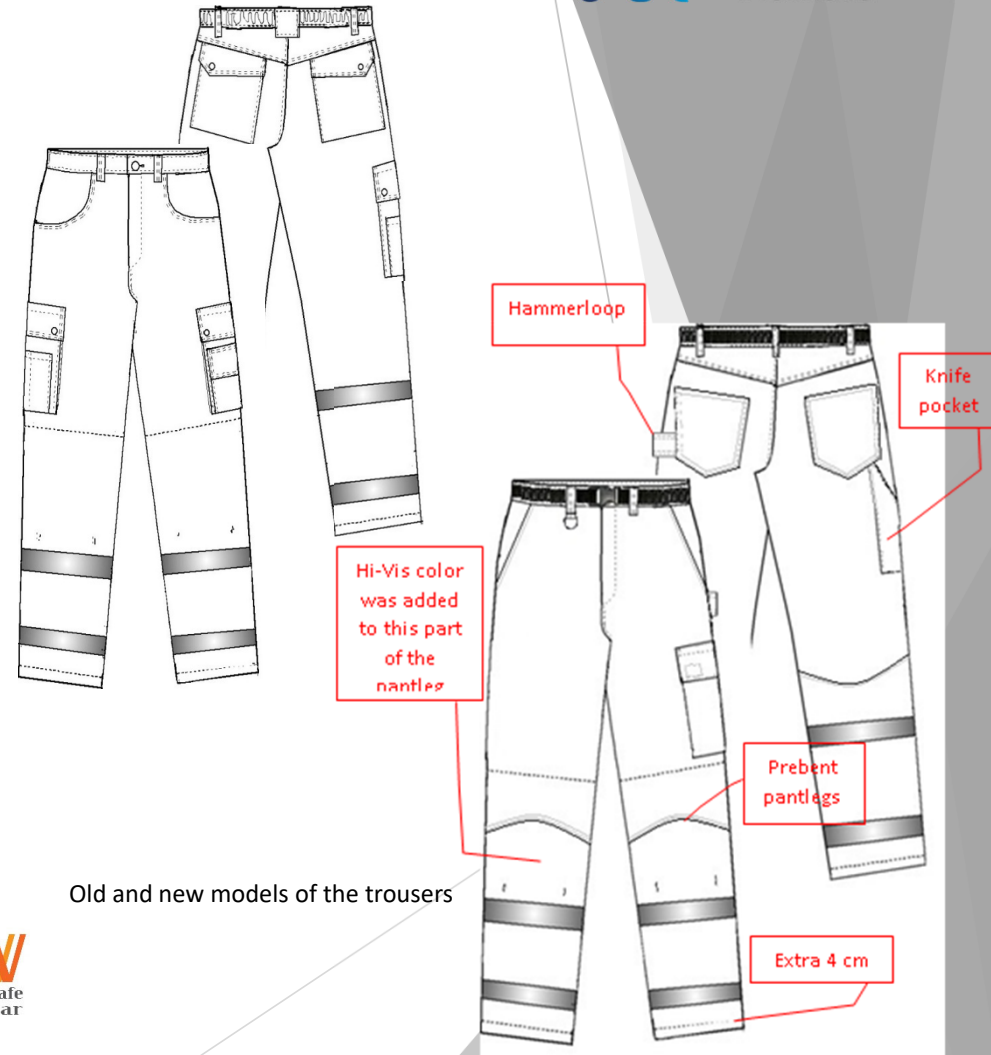
1. New measurement table based on the body scanning study was created and sized with letter codes from XS – XXXL (the size range can be expanded from both ends)
2. The very masculine form of the jacket was made narrower on the waist. The hip circumference was kept unchanged, but the side seams were fitted with a wedge and a zipper to get more ease to the hip.
3. The straight sleeve was shaped to be narrower and the side seam was raised from the armpit.
4. Two small darts were put to the sleeve to make it slightly pre-bent.
5. The sleeve cap was raised and the shoulder seam was shortened.
6. The surface of the high visibility color was added on the sleeve.
7. The hem was lengthened in the middle back.
8. The lower reflector strip was moved next to the waistband.
9. New, more spacious breast pockets



Old and new models of the jacket

Changes in clothing for chemical industry workers - Finland

1. New measurement tables based on the bodyscanning study were created differently for men and women: 2 length groups for men, 1 for women.
2. 4 cm extra hem at leg opening to be opened if needed.
3. Hi-Vis fabric added.
4. A hammer loop was added to the left.
5. Slightly pre-bent pantlegs.
6. A knife pocket was added.
7. The other thigh pocket was removed. The pleat was removed from the front of the other thigh pocket and the snap fastener was changed to Velcro.
8. The rubber band back on the waist was removed and replaced with a belt and a plastic snap buckle.



Body measurements in relation to workwear dimensions

In connection to the analysis of the fitability of workwear clothing, it was necessary to carry out own simulation of choosing the optimal size of clothing for the user with specific dimensions.

Dimensions have been assigned on the basis:

- body dimensions,
- clothing producers size table,
- clothing designs,
- table of dimensions of ready-made clothing products

Finland

Changes between women's old and new trousers' measurements

	N 32	N 34	N 36	N 38	N 40-42	N 40-42	N 44	N 46	N 48	N 50	(N 52)	(N 54)	(N 56)
PD-Size New size	(32)	34	36	38	40	42	44	46	48	50	52	54	56
Measurement													
Waistband/New	76	80	84	88	92	96	100	106	112	118	124	130	136
Waistband/PD-Service	84,5	88,5	92,5	96,5	100,5	100,5	104,5	109,5	114,5	119,5	124,5	129,5	134,5
Change	-8,5	-8,5	-8,5	-8,5	-8,5	-4,5	-4,5	-3,5	-2,5	-1,5	-0,5	0,5	1,5
Hip/New	96	100	104	108	112	116	120	125	130	136	142	148	154
Hip/PD-Service	94	98	102	106	110	110	114	118,5	123	127,5	132	136,5	141,5
Change	2	2	2	2	2	4	6	6,5	7	8,5	10	10,5	12,5

Changes/improvements in size tables (trousers and jackets) with short descriptions shown below.

Table - Garment control measurement table – trousers (cm)

SIZE GROUP			LABEL	XS	S	M	L	XL	2XL	3XL	4XL	
			Bust/chest girth	76-80	84-88	92-96	100-104	108-112	116-120	124-128	132-136	
			NEW Bust/chest girth intervals - full	74-82	82-90	90-98	98-106	106-114	114-122	122-130	130-138	← Full intervals according to EN 13402-3
			Waist girth	64-68	72-76	80-84	88-92	96-100	104-108	112-116	120-124	
			NEW Waist girth intervals - full	62-70	70-78	78-86	86-94	94-102	102-110	110-118	118-126	← Full intervals according to EN 13402-3
B	1/2 Belt, stretched	+/-1,0		37	41	45	49	53	57	61	65	← Changes as a result of lowering the belt level

Changes on measurements A, C, D and E made as a result of lowering the belt (waistband) level

Table - Garment control measurement table – jackets (cm)

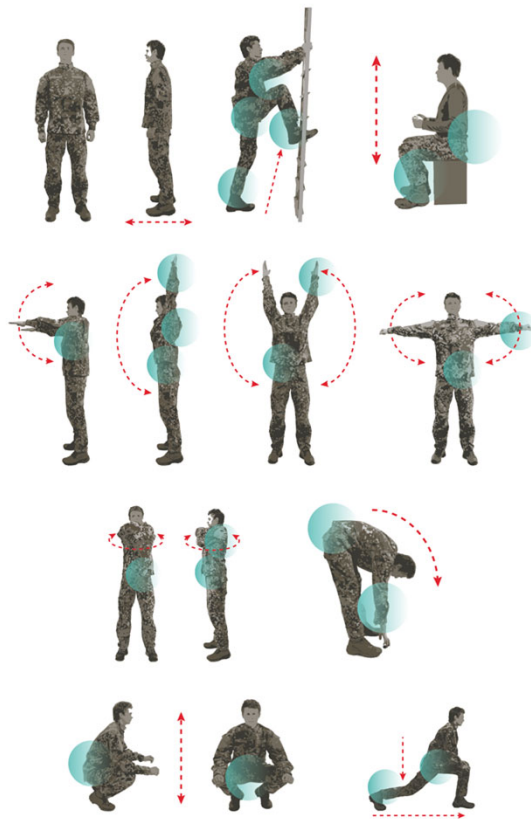
SIZE GROUP			LABEL	XS	S	M	L	XL	2XL	3XL	4XL	
			Bust/chest girth	76-80	84-88	92-96	100-104	108-112	116-120	124-128	132-136	
			NEW Bust/chest girth intervals - full	74-82	82-90	90-98	98-106	106-114	114-122	122-130	130-138	Full intervals according to EN 13402-3
			Waist girth	64-68	72-76	80-84	88-92	96-100	104-108	112-116	120-124	
			NEW Waist girth intervals - full	62-70	70-78	78-86	86-94	94-102	102-110	110-118	118-126	Full intervals according to EN 13402-3

Changes on measurements A, B, C, D, E and F made as a result of full interval involvement

The summary of the Krystian size table for typical and modified silhouettes.

rozmiary męskie					
rozmiar uproszczony	rozmiar odzieży	wzrost	obwód klatki piersiowej	obwód pasa	kołnierzyk
2XS	42	158-164	80-84	72-76	36-37
XS	44	158-164	84-88	76-80	37-38
S	46	164-170	88-92	80-84	38-39
M	48	170-176	92-96	84-88	39-40
	50	170-176	96-100	88-92	40-41
L	52	176-182	100-104	92-96	41-42
	54	176-182	104-108	96-100	42-43
XL	56	182-188	108-112	100-104	43-44
	58	182-188	112-116	104-108	44-45
2XL	60	188-194	116-120	108-112	45-46
	62	188-194	120-124	112-116	46-47
3XL	64	194	124-128	116-120	47-48
	66	194	128-132	120-124	48-49
*4XL	68	194	132-136	124-128	49-50
	70	194	136-140	128-132	50-51
*5XL	72	194	140-144	132-136	51-52
	74	194	144-148	136-140	52-53

Verification of the new prototype of workwear clothing under environmental conditions



The conducted research confirmed the benefits resulting from the introduced changes, increasing the fit of clothing to the figure, improving the comfort of using the clothing and its functionality.

Verification of the new prototype of workwear clothing under environmental conditions

Developed new prototypes of workwear clothing were verified in environmental conditions by the end users. Users tried new clothes in sizes dedicated to each of them, they were asked to simulate movements and activities performed during work. In addition, prototype assessments were also made in the form of questionnaire surveys.



Photo 1 a-f. Photos of Warbud employees presenting modified clothing in dedicated sizes selected in the table after measuring the silhouettes.

Summary

The main objective of this project task was to modify existing workwear clothing for designated end user groups.

It was possible through:

- ▶ acquisition of sets of body measurements of target groups, application of new measurement methods using a contact-less method of body scanning,
- ▶ obtaining by analysing current problems in the area of workwear clothing fitting for selected pilot groups,
- ▶ indication of changes in the dimensions of the human body in relation to existing measurement tables in partner countries and product size tables for each producer
- ▶ increased awareness among target groups aimed at modifying the construction of worn workwear clothing.

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Conclusion

The knowledge gained during the project will allow manufacturers to obtain tailor-made or **individual designs** and to **optimize existing sizes** on the workwear market.

The conducted **work indicates the proper cooperation of the industry with research units**, which allowed to **focus on the special needs of end users**.

The completed **research gives the opportunity** to determine the directions of modification of the construction of workwear clothing in all partner countries, and **in the future to implement modified prototypes of workwear for production**.

Thank You For Your Attention!

