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Soldier Individual Protection System Aprior Ranking of Functional Replies

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Abstract. **Researchers from National Armed Forces (NAF) Republic of Latvia in cooperation with researchers from Riga Technical university (RTU) based on analysis of NATO normative base and open source information of clothing and individual protection systems, have established massif of functions containing functions of protection, functions influent on combat ability and technical economic functions describing quality of the Soldier Individual Protection System. Researchers develop methodological approach of identifying priority group of functions. The basis of this approach is military expert evaluation with aprior ranking of functions. The results of aprior ranking with definition of priority functions can be used by government officials as a scientific basis in defining direction of further Soldier Individual Protection System improvement and optimization projects as well as set up requirements for the multi protection and multi layer type of the individual protection systems.**

Keywords: **clothing, soldier, protection, aprior ranking, functional replays, combat ability, requirements**

I. INTRODUCTION

National Armed Forces Republic of Latvia has developed Soldier Individual Protection System, providing protection against artificial and natural threats soldiers face on the operation areas worldwide. Researchers from National Armed Force Republic of Latvia in cooperation with researchers from Riga Technical University have started improvement program of Soldier Individual Protection System. In order to define directions of the further improvement researchers started analysis of the functional replays fully describing Soldier individual protection system from the functional replays of protection, influence on combat ability of the individual soldier as well as technical economy aspect of the NAF administrative financial system. The main information source for defining function replays is the base of the NATO Standardization agreements (STANAG), internal NAF and other allied nations information system and publications. Expert evaluation and mathematical proceeding for aprior ranking system provide scientific and legal basis of the decision making by officials about priorities in the functional replays on improvement of the individual protection systems.

II. SELECTION OF THE FUNCTIONAL REPLAYS

Within NATO STANAG system several agreements is published providing researchers with source of information on functional replays applying to the Soldier Individual Protection System. Within NATO there are NATO STANAGs developed for definition levels of CBRN protection and threats [1], associated protection for toxic industrial materials [2], influence of wearing CBRN suits on individuals [3]. State Defense Concept is basic political document for NAF in built up their capability in territorial Defense as well as participation in international military operation. Among different operational and strategic level requirements, CBRN protection is underlined in several clauses of State Defense Concept [4]. Importance of natural biological threat is proved by NAF procurement of duty gloves [5] with puncture resistance against needles as well as fabric for field uniform procurement with impregnation against insects [6]. Duty gloves providing cut resistance against bladed weapons until certain level [5], what makes threat from bladed weapons be considered as the threat. Multispectral individual camouflage systems are not making any barrier against threats, but role of camouflage is vital for soldier becoming not identified on environment background from enemy by multispectral surveillance devices. Requirements for camouflage for clothing systems [7] as well as for load bearing systems [8] and separately for snow camouflage system [9] are developed by NATO. On example of source [10] is shown tendency of visual, near-infrared, and infrared, radar and acoustic signature of individual soldier becoming significant in individual protection systems. NAF is operational worldwide [4] in different climates condition. Basic NATO requirements for clothing systems against extreme cold environment [11] and hot environment [12] set up basis for the development clothing system against mentioned threats. NATO ACCP-1 describing physical evaluation process of combat clothing systems. Main parameters of the clothing system influent on combat ability of the individual soldier can be found there [13] as well as prediction mathematical equitation on soldier fatigue depend on clothing parameters, level of activity and environmental conditions. NATO publication ATP-65 shows same technical parameters influencing on decreasing combat ability [3]. Not only clothing technical parameters influent on combat ability of individual soldier, but also training level of forces is significant part of the combat ability in classical definition of [14]. Different elements of the clothing systems and individual protection asking for specific training should be providing in order to maintain combat ability on required level. NATO STANAG on waterproof clothing [15] specifies different levels for water resistance and waterproofness. Windproofnes usually associated as adjustment for calculation of thermal insulation [16]. However, primary contractors NAF of clothing and fabric delivery putting windproofness as well as water resistance as protection function separately [17], [18],

[19]. Manual 1st edition of NAF Soldier individual protection system identify UV [6] as protection function on different layers of the clothing system. UV protection is important for eye protection. Military goggles and sun glasses utilized by NAF providing UV protection too [20]. Among NATO STANAGs for individual protection two STANAGs are referred to the specific area of the individual soldier – for eyes [21], [22] and ears [23] protection. Different types of ammunition fragments and bullets are common ballistics threats on modern operational area. According to source [24] every 60-90% human death in modern military conflict is due to small arms bullets. Connected to ballistics threats two standardization agreements [25], [26] for combat clothing systems and combat helmets were developed within NATO. Protection against flame becomes one of the important protection functions for dismounted soldier [27]. Two programs developed by US Army [28] and USMC [29] on improvement protection against flame threat on dismounted soldier showing importance of protection against these specific threats. Within NATO only flame retard STANAG requirement existing for the crew man clothing systems [30]. NAF Military Police participation in riot January 13, 2009 [31] recognize riot threat as one NAF face in modern full spectral operation concept as well as police type operation. In recent research made by researchers from NAF in cooperation with researchers from RTU mechanical protection of the fabric for the tailoring of the field uniforms was considered as very high level of priority in qualimetrical evaluation system [32] as well as protection against dust and small fraction particles. Mechanical protection of the skin as the basic level of the protection is underlined in source [5]. More than other above mentioned threats, wounds from explosion overpressure making long term negative influence on individual soldier health [33]. US Army recently started research on explosion overpressure influence on level of the brain trauma by incorporated measuring devices into combat helmet [34]. Mathematical models on prediction of lung trauma from explosion overpressure developed by researchers from US Army [33]. This showing importance of the overpressure as the type of threat soldiers face on modern operational areas. Budged limitations applied on every state agency within Republic of Latvia due to economic crisis worldwide. Ministry of Defense is not an exception even State Defense Concept specified certain budged for the Defense needs calculated from annual GDP [4]. Every material procured for Defense needs costs for budged, including elements of the soldier individual protection system. Costs effectiveness of the system is one of economy function should be optimized during improvement of the system. Supplying norms [6] for the NAF soldiers defines elements of the protection every soldier should be provided. Additionally analysis of mentioned norms showing complicity of the logistics system should be optimized during improvement program. Routine maintenance keeps material in readiness. Developed manual for system [6] providing soldier with full information about right maintenance and operational capabilities of the system. Depending on the architecture of the system maintenance procedures can be more complex or less complex making maintenance as one of the system function. Importance of the simple maintenance of the protection systems and clothing is underlined in source [35] as well as material not availability on the market may cause problems in system readiness. Elements of the system depending on some specific sources of the market should be avoided. Different protection systems can be less or more depending on some specific sources of the supplying, making market availability is one economic function of the system. Same source [35] has a requirements on disposal of the clothing. In order to keep environment not polluted disposability of the system elements should be considered as one of the economic function. Material disposal is one of the tasks NAF Logistics Command assigned for [36]. Based on above mentioned massif of twenty eight function describing soldier individual protection system is developed (1st table).

TABLE I
FUNCTIONAL REPLAYS AND EXPERT RANKING

Replays / No. of expert	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Flame resistance	8	3	8	1	1	4	10	3	3	2	15	1	2	3
Thermal insulation	9	21	9	4	1	2	3	1	1	1	19	2	2	2
Wind resistance	10	20	7	3	7	2	3	2	1	1	20	2	2	2
Waterproofness	13	16	13	4	4	2	2	1	2	1	24	3	2	2
Water resistance	13	22	12	3	4	2	2	1	2	1	25	2	2	2
Air permeability	11	18	5	3	5	2	6	1	1	3	16	3	2	3
Evaporation resistance	12	19	6	4	2	2	7	1	1	3	18	1	2	2
CBRN protection	24	5	19	3	1	6	3	2	4	3	14	3	1	4
Explosion shockwave	2	2	3	1	3	6	5	2	3	2	17	1	1	1
Natural Bio hazard	16	14	20	5	3	3	5	2	1	3	22	1	1	3
UV protection	25	13	21	4	7	2	4	2	1	3	23	3	3	4
Dust protection	14	15	22	5	8	2	4	2	4	3	6	2	3	3

Blade weapons protection	26	4	18	3	2	1	7	2	3	3	11	3	1	3
Camouflage multispectral	7	6	2	1	1	2	3	3	2	2	8	4	4	4
Weight	5	7	11	1	2	4	3	1	1	1	4	1	2	1
Volume, bulkiness	15	13	14	3	5	6	3	1	2	2	5	1	2	2
Odor resistance	21	17	15	3	5	2	6	2	2	3	21	1	3	3
Mechanical protection	20	12	4	2	4	2	4	2	2	3	7	1	2	1
Riot protection	22	9	17	5	6	5	3	3	3	3	12	2	1	3
Eyes protection	3	8	1	2	2	2	4	2	1	3	1	1	1	2
Hearing protection	4	10	10	2	2	2	4	3	1	3	2	1	2	2
Ballistics protection	1	1	1	1	1	1	3	1	2	2	3	1	1	1
Costs	17	16	26	8	9	5	9	2	3	4	9	2	4	3
Logistics	19	25	24	2	5	5	5	1	3	3	13	2	3	4
Training	6	23	23	5	10	4	4	3	2	3	10	2	3	2
Market availability	23	24	25	3	11	6	9	2	3	3	28	4	4	3
Disposal	27	27	27	7	10	6	4	3	4	3	26	2	5	5
Maintenance	18	11	16	5	4	4	1	1	1	3	27	3	3	2

III. EXPERT EVALUATION OF FUNCTIONAL REPLAYS

Fourteen military officials (experts) were selected in order to apply expert evaluation and make ranking of selected functional replays (see 1st table) of the Soldier Individual Protection System as well as make further mathematical proceedings. Each expert evaluate (rank) particular functional replay in his own way and his own priority ranking. There is also possibility for every expert of applying equal rank for group of functional replays. In the following proceedings it is necessary to transform initiate expert ranking (see 1st table) into transformed ranking (see 2nd table) by methodology [37] and make ranking to equal scale.

TABLE II

FUNCTIONAL REPLAYS AND TRANSFORMED EXPERT RANKING

Replays / No. of expert	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Flame resistance	8	3	9	3	3	18,5	28	25,5	22	8	15	6	13	19
Thermal insulation	9	23	10	19,5	3	9	7,5	5,5	5,5	3	19	16	13	9,5
Wind resistance	10	22	8	13,5	22,5	9	7,5	16,5	5,5	3	20	16	13	9,5
Waterproofness	13,5	17,5	14	19,5	14,5	9	2,5	5,5	14,5	3	24	23,5	13	9,5
Water resistance	13,5	24	13	13,5	14,5	9	2,5	5,5	14,5	3	25	16	13	9,5
Air permeability	11	20	6	13,5	18,5	9	22,5	5,5	5,5	19	16	23,5	13	19
Evaporation resistance	12	21	7	19,5	8	9	24,5	5,5	5,5	19	18	6	13	9,5
CBRN protection	25	5	20	13,5	3	26	7,5	16,5	27	19	14	23,5	4	25,5
Explosion shockwave	2	2	4	3	11,5	26	20	16,5	22	8	17	6	4	2,5
Natural Bio hazard	17	15	21	23,5	11,5	16	20	16,5	5,5	19	22	6	4	19
UV protection	26	13,5	22	19,5	22,5	9	15	16,5	5,5	19	23	23,5	21,5	25,5
Dust protection	15	16	23	23,5	24	9	15	16,5	27	19	6	16	21,5	19
Blade weapons protection	27	4	19	13,5	8	1,5	24,5	16,5	22	19	11	23,5	4	19
Camouflage multispectral	7	6	3	3	3	9	7,5	25,5	14,5	8	8	27,5	26	25,5
Weight	5	7	12	3	8	18,5	7,5	5,5	5,5	3	4	6	13	2,5
Volume, bulkiness	16	13,5	15	13,5	18,5	26	7,5	5,5	14,5	8	5	6	13	9,5
Odor resistance	22	19	16	13,5	18,5	9	22,5	16,5	14,5	19	21	6	21,5	19
Mechanical protection	21	12	5	7,5	14,5	9	15	16,5	14,5	19	7	6	13	2,5
Riot protection	23	9	18	23,5	21	22	7,5	25,5	22	19	12	16	4	19

Eyes protection	3	8	1,5	7,5	8	9	15	16,5	5,5	19	1	6	4	9,5
Hearing protection	4	10	11	7,5	8	9	15	25,5	5,5	19	2	6	13	9,5
Ballistics protection	1	1	1,5	3	3	1,5	7,5	5,5	14,5	8	3	6	4	2,5
Costs	18	17,5	27	28	25	22	26	16,5	22	28	9	16	26	19
Logistics	20	27	25	7,5	18,5	22	20	5,5	22	19	13	16	21,5	25,5
Training	6	25	24	23,5	26,5	18,5	15	25,5	14,5	19	10	16	21,5	9,5
Market availability	24	26	26	13,5	28	26	27	16,5	22	19	28	27,5	26	19
Disposal	28	28	28	27	26,5	26	15	25,5	27	19	26	16	28	28
Maintenance	19	11	17	26	14,5	18,5	1	5,5	5,5	19	27	23,5	21,5	9,5
Total score of scale:	406	406	406	406	406	406	406	406	406	406	406	406	406	406

IV. MATHEMATICAL PROCEEDING ON EXPERT RANKING

There are several mathematical criteria should be applied in order to check experts work and aprior ranking results. The first of the criteria is Spearman's correlation coefficient of the rank (1).

$$r_s = 1 - \frac{6}{k^3 - k} \sum_{j=1}^{k} \left[\Theta_j(1) - \Theta_j(2)\right]^2 \quad (1)$$

In equitation (1) k – is number of replays, Θj(1) – rank of the j-factor in initial table, Θj(2) – rank of j-factor in transformed table. If $r_s = 1$, both rankings are equal, if $r_s = -1$ both rankings are opposed, if $r_s = 0$ there is no any compliance between rankings. When applying equitation (1) to the 1st table and 2nd table $r_s = 0{,}9505$ – both rankings are in very strong correlation. Additionally in order to check statistical significance of the correlation coefficient Student's criteria should be calculated (2).

$$t_{nov} = \frac{r_s}{\sqrt{\frac{1 - r_s}{k - 2}}} \quad (2)$$

Student's criteria can be applied if number of expert at least on one more than number of functional replays. In this particular research number of functional replays is more than number of experts. In the following mathematical proceedings concordance of expert opinions is checking out by Kendel's coefficient (3).

$$W = 12 \sum_{j=1}^{k} \frac{\Delta_j^2}{\left[m^2(k^3 - k) - m\sum_{i=1}^{m} T_j\right]} \quad (3)$$

In equitation (3) there are m – number of experts, Δ_j - deviation of the rank sum calculated by equitation (4)

$$\Delta_j = \left| \sum_{i=1}^{m} a_{ij} - \frac{1}{k} \sum_{j=1}^{k} \sum_{i=1}^{m} a_{ij} \right| \quad (4)$$

In equitation (4) a_{ij} - rank applied by expert i to functional replay j

$$T_j = \sum_{j=1}^{k} (t_j^3 - t_j) \quad (5)$$

In equitation (5) t_j - number of equal ranks in i – ranking

Coefficient W can be within 0 (not concordance) until 1 (total concordance). When applying equitation (3) W=0,4053. Statistical significant of concordance coefficient define by Pierson's coefficient in equitation (6). If $\chi^2_{nov} \geq \chi^2_k$ where χ^2_k - is critical value defined by [37], means expert opinions are in concordance. If $\chi^2_{nov} \leq \chi^2_k$ this mean ranking of the functional replies is too complicated for selected experts and expert evaluation should be done one more time.

$$\chi^2_{nov} = m(k-1)W \quad (6)$$

When applying equitation (6) χ^2_{nov} = 142,268, when critical value [37] is χ^2_k = 40,133 (when f = 27). Pirson's coefficient shows concordance of the expert opinions.

VII. RESULTS OF RANKING AND INTERPRETATION

When mathematical proceedings are finished, significance of every functional reply is defined by equitation (7).

$$M_j = \frac{\sum_{i=1}^{m} a_{ij}}{\sum_{i=1}^{m} \sum_{j=1}^{k} a_{ij}} \quad (7)$$

The results of equitation (7) shown in 3rd table. Functional replies are placed in the line of priorities from highest – ballistics protection to the lowest priority – disposal.

TABLE III

SIGNIFICANCE OF FUNCTIONAL REPLIES AND CALCULATION OF LINK-WOLLES CRITERIA

	$100\times M_j$	$\sum_{i=1}^{m} a_{ij}$	$\bar{a}_j = \frac{1}{m}\sum_{i=1}^{m} a_{ij}$	$vR(\bar{a}_j)$	K_{nov}	K_{tab}	$\sum_{j=1}^{v} R_j$	
Ballistics protection	1,091	62,0	4,429	23,5714	0,274	1,240	86,00	25,00
Weight	1,768	100,5	7,179					20,00
Eyes protection	1,997	113,5	8,107					19,50
Explosion shockwave	2,542	144,5	10,321					21,50
Hearing protection	2,551	145,0	10,357	15,75	0,114	0,810	138,00	22,00
Thermal insulation	2,683	152,5	10,893					18,00
Mechanical protection	2,859	162,5	11,607					19,00
Volume, bulkiness	3,017	171,5	12,250					22,50
Camouflage multispectral	3,052	173,5	12,393					20,00
Wind resistance	3,096	176,0	12,571					19,50
Water resistance	3,105	176,5	12,607					17,00
Evaporative resistance	3,123	177,5	12,679	12,5	0,128	0,910	98,00	21,00
Flame resistance	3,184	181,0	12,929					23,00
Waterproofness	3,228	183,5	13,107					24,50
Air permeability	3,554	202,0	14,429					16,00
Blade weapons protection	3,739	212,5	15,179					13,50
Natural Bio hazard	3,800	216,0	15,429	14,7857	0,133	0,910	111,50	16,50
Maintenance	3,844	218,5	15,607					18,50
CBRN protection	4,038	229,5	16,393					21,50
Odor resistance	4,187	238,0	17,000					18,00
Riot protection	4,249	241,5	17,250					23,50
Dust protection	4,407	250,5	17,893					13,50
Training	4,477	254,5	18,179	13	0,252	1,240	51,50	17,00
UV protection	4,609	262,0	18,714					19,50
Logistics	4,618	262,5	18,750					20,50
Costs	5,278	300,0	21,429					14,50
Market availability	5,779	328,5	23,464	2,78571	0,073	1,920	38,00	13,00
Disposal	6,122	348,0	24,857					25,00

In order to define groups of prioritized functional replays Criteria of Link-Wolles K_{nov} is calculated by equitation (8) and compared with critical value [37] K_k taking into consideration confidence level on 0,95.

$$K_{nov} = \frac{vR(\bar{a}_j)}{\sum_{j=1}^{v} R_j} \quad (8)$$

In equitation (8) v – number of ranks to be compared, $R(\bar{a}_j)$ - deviation diapason of average to be compared, calculated by equitation (9), R_j – j deviation diapason of average, calculated by equitation (10).

$$R(\bar{a}_j) = \bar{a}_{\max} - \bar{a}_{\min} \quad (9)$$

$$R_j = a_{ij\max} - a_{ij\min} \quad (10)$$

If $K_{nov} \le K_k$ it is considered that there is no big deviation in average values to be compared.

Figure 1 shows final diagram of aprior ranking.

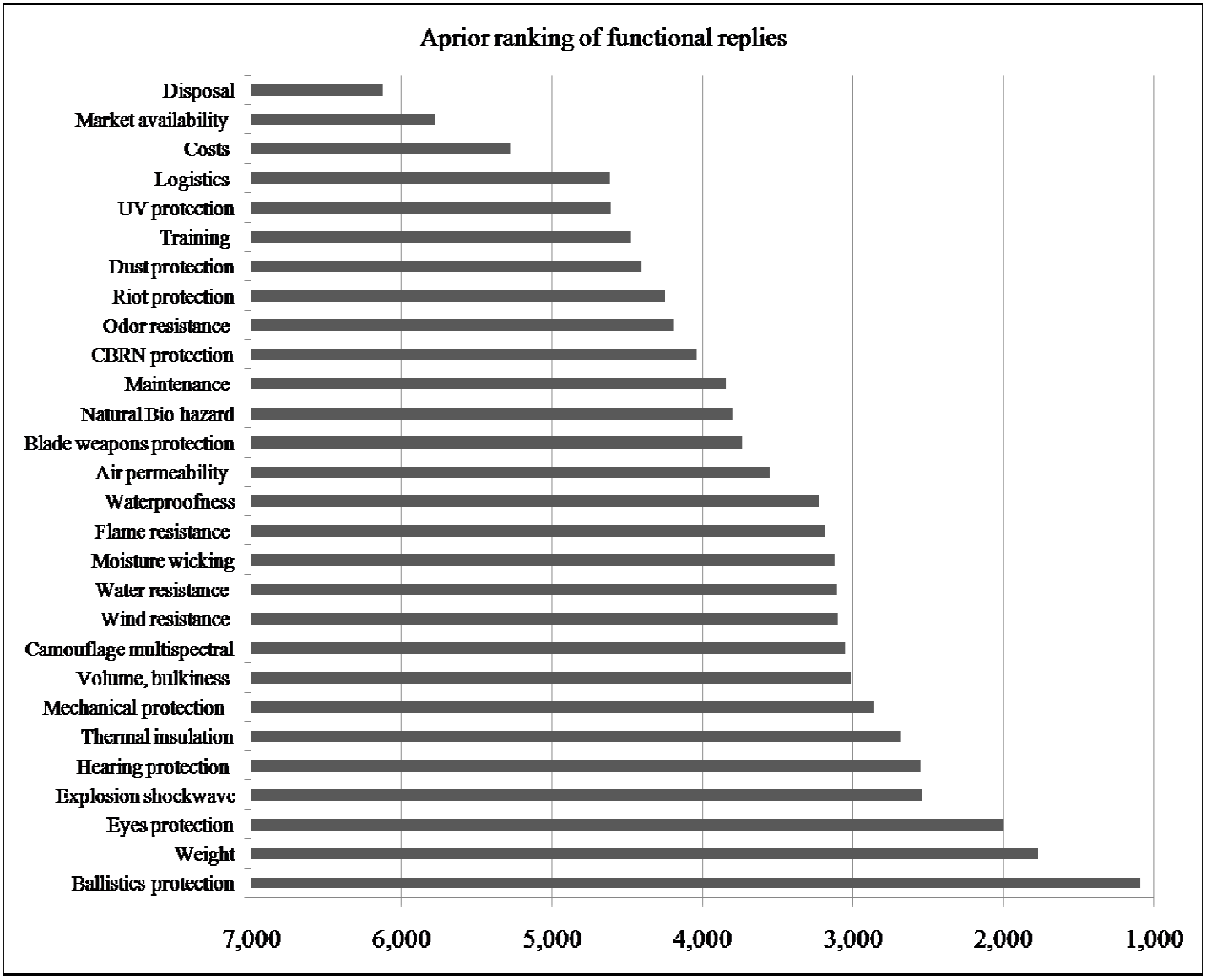

Fig 1. Final diagram aprior ranking of functional replies

VIII. CONCLUSIONS

As the result of aprior ranking following groups of priorities were defined within twenty eight functional replies: Ballistics protection, Weight, Eye protection, Explosion shockwave → Hearing protection, Thermal insulation, Mechanical protection, Volume, bulkiness, Camouflage multispectral, Wind resistance, Water resistance → Evaporation resistance, Flame resistance, Waterproofness, Air permeability, Blade weapons protection → Natural Bio hazard, Maintenance, CBRN protection, Odor resistance, Riot protection, Dust protection → Training, UV protection, Logistics, Costs, Market availability, Disposal. Mathematical proceedings of the aprior ranking confirm adequate expert's evaluation and opinions concordance. Applied criteria of mathematical proceedings are within critical.

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Igors Šitvjenkins, Ausma Viļumsone, Inese Ziemele, Una Zariņa, Kristine Piņķe. Karavīra individuālās aizsardzības sistēmas funkcionālo atsauču apriorais ranžējums.

Latvijas Republikas Nacionālie Bruņotie Spēki ir izveidojuši Karavīra Individuālās Aizsardzības Sistēmu, kura nodrošina aizsardzību pret mākslīgo un dabīgo apdraudējumu, ar ko karavīrs sastopas militāro operāciju rajonos visā pasaulē. Pētnieki no Nacionālajiem Bruņotajiem Spēkiem sadarbībā ar pētniekiem no Rīgas Tehniskās universitātes ir uzsākuši pilnveidošanas programmu Karavīra Individuālās Aizsardzības Sistēmai. Lai definētu pilnveidošanas virzienus, pētnieki veica pastāvošās NATO normatīvās bāzes analīzi, kā arī izskatīja pieejamo informāciju individuālās aizsardzības un apģērbu sistēmu jomā. Rezultātā ir izveidots Karavīra Individuālās Aizsardzības Sistēmu raksturojušo funkciju masīvs, kas ietver aizsardzības funkcijas, karavīra kaujas spēju ietekmējošas funkcijas un tehniski ekonomiskās funkcijas. Ir izstrādāta metodoloģiskā sistēma, ar kuras palīdzību noteiktas prioritārās funkciju grupas. Metodoloģiskā sistēma balstās uz militāro ekspertu aptaujas un funkciju apriorās ranžēšanas metodi. Apriorās ranžēšanas rezultāti ar prioritāro funkciju noteikšanu var tikt izmantoti zinātniski pamatotai Karavīra Individuālās Aizsardzības Sistēmas pilnveidošanas virzienu definēšanai, kā arī vairāku slāņu un dažādu aizsardzības veidu un līmeņu kompleksam izvirzāmo prasību noteikšanai. Pētījuma rezultātā šādas prioritārās karavīra individuālās aizsardzības sistēmas divdesmit astoņas funkcionālās atsauces tika sagrupētas secībā no visaugstākās prioritātes līdz viszemākajai prioritātei: Ballistiskā aizsardzība, masa, redzes orgānu aizsardzība, sprādziena pārspiediens, dzirdes orgānu aizsardzība, siltumizolācija, mehāniskā aizsardzība, apjoms, masīvums, plaša spektra maskēšanas, vēja noturība, ūdens noturība, pretestība ūdens tvaiku izvadei, uguns aizsardzība, ūdens necaurlaidība, gaisa caurlaidība, aizsardzības pret aukstiem ieročiem, dabīgais bioloģiskais apdraudējums, lauka apkope, CBRN aizsardzība, pretestība negatīvo mikrofloru rašanai, pūļa kontroles apdraudējums, aizsardzība pret dubļiem, putekļiem, apmācība, aizsardzība pret UV, loģistika, izmaksas, pieejamība tirgū, utilizācija. Ekspertu novērtējuma matemātiskā apstrāde ir apstiprinājusi hipotēzes par adekvātu novērtējumu.

Игорь Шитвёнкин, Аусма Вилюмсоне, Инесе Зиемеле, Уна Зарина, Кристине Пинке. Априорное ранжирование функциональных откликов системы индивидуальной зашиты солдата.

Национальные вооруженные силы Латвийской Республики создали Систему Индивидуальной Защиты Солдата, которая обеспечивает защиту от искуственных и естественных угроз с которыми солдат сталкивается в районах провидения операций по всему миру. Исследователи из Национальных Вооруженных сил совместно с исследователями из Рижского технического университета начали програму по улучшению Системы Индивидуальной Защиты Солдата. Чтобы определить возможные направления улучшения ислледователи, проанализировав существующую нормативную базу НАТО и открытых источников в военной области индивидуальной защиты и систем одежды, создали массив из функций характеризующих Систему Индивидуальной Защиты Солдата и включающих в себя защитные функции, функции, влияющие на боеспособность а также технико-экономические функции. Исследователи разработали методологическую систему по определению групп приоритетных функций. Основой разработанной методологии является априорное ранжирование массива функций военными экспертами. Результаты априорного ранжирования с определением групп приоритетных функций могут быть использованны как научное обоснование для определения направления дальнейшего улучшения Системы Индивидуальной Защиты Солдата в конкретных приоритетных функциях, а также в определении базовых требований к многослойным, различного вида и уровня защиты системам. В результате проведенных исследований группы приоритетных функций защиты были сведены в следующие позиции по уровню важности от важных до мало значимых: баллистическая защита, масса, защита органов зрения, избыточное давление при взрыве → защита органов слуха, теплоизоляция, механическая защита, объем, массивность, маскировка в широком диапазоне спектра, защита от ветра, влаго устойчивость, испарение с поверхности тела, защита от огня, водонепроницаемость, воздухопроницаемость, защита от холодного оружия → защита от естественных био угроз, обслуживание в полевых условиях, защита от оружия масового поражения, образование негативной микрофлоры, защита от угроз при массовых беспорядках, защита от грязи и пыли → обучение, защита от UV, логистика, затраты, доступность на рынке, утилизация. Математическая обработка результатов продтвердила достоверность гипотез об адекватности оценок экспертов.