



## ENCIRCLE

### European N Cbrn Innovation for the maRket CLustEr

## ENCIRCLE Human Factors Questionnaire - Analysis

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## Executive Summary

The Human Factors Questionnaire - Analysis presented herein provides an analysis of the ENCIRCLE HF questionnaire conducted by the Task 4.3 within the ENCIRCLE project.

**Table of Contents**

**Executive Summary..... 3**

**1 Introduction..... 5**

**2 PPE..... 5**

**3 Detectors ..... 7**

**4 UAV/UGV ..... 9**

    4.1 Drones:..... 9

    4.2 Robots:..... 10

**5 Conclusions..... 12**

## Introduction

The ENCIRCLE Human Factors Questionnaire was designed by the UCSC and PIAP teams within the activities of the Task 4.3 - Human Factors. The questionnaire was published on the EU survey platform (<https://ec.europa.eu/eusurvey/home/welcome>) for one year and received 17 answers.

All of the responders were really skilled, the average experience being 11,5 years (from 3 years to 25 years of experience in CBRN field). Most of the responders work in Police and Fire Services but there are also answers from academia, military and EMS as well as people from the civil society (Ministry of Internal Affairs, Research Organization).

The questionnaire was divided in three parts that is discussed accordingly: PPE, Detectors and UAV/UGV.

## PPE

7 Responders are used to Level C PPE while the others have equally chosen the PPE level A or B (according to NIOSH PPE classification).

The responders were asked to rank 13 items according to the priority given for the chosen PPE: Length in time while dressing PPE; Ergonomy; Thermal burden; Noise; Possibility to easily communicate with colleagues; Possibility to easily communicate with population; Use/integration with other devices (detectors, phone, touch screens, ...); Clear procedure for donning and doffing PPE; Intuitiveness of use; Longer shelf life; User level maintenance; Body monitoring; Versatility (use for chemical, biological, radiological protection). In addition, they were asked to point out any issue related to the items already indicated and to specify if they purchased a PPE based on the items.

Four main items were ranked as high priority through the calculation of the median: Ergonomy; Thermal burden; Possibility to easily communicate with colleagues; Versatility (use for chemical, biological, radiological protection). The last item was ranked as first priority by 10 responders. If we analyze the priorities according to PPE types few interesting considerations can be underlined:

- Versatility is the top priority for all kind of PPE;
- Longer shelf life is a main issue for PPE level A and B but not for the level C, this is probably due to the lower cost of the latter equipment;
- The use of PPE level B and C should be intuitive, while this seems not a top priority of the PPE level A, this could be explained because staff who use a high protection is often very expert;
- Integration with other devices, Communication with colleagues and Ergonomy represent a top priority for PPE level A and B while a not a real priority.

The table below summarizes the priorities according to PPE types and in general (blue line).

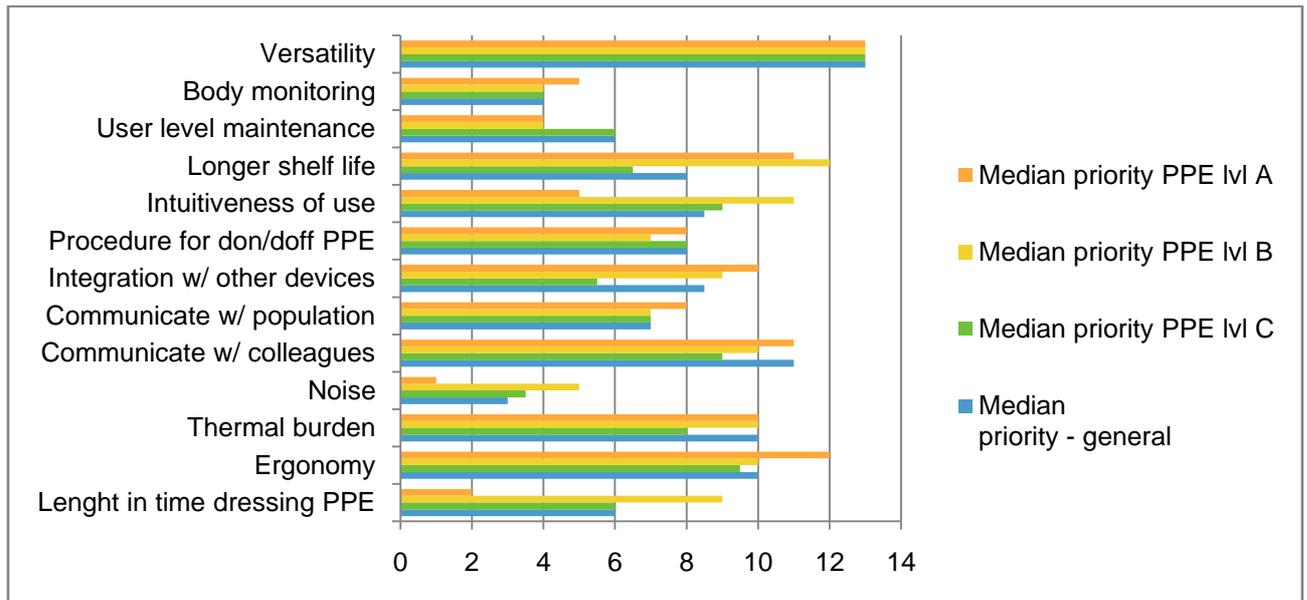


Table 1. PPE priorities

Most of the responders experienced issues related to communication with colleagues and thermal burden. Responders purchased PPE based on Versatility (use for chemical, biological, radiological protection), Longer shelf life and Ergonomy.

Some items, such as Length in time while dressing PPE, Possibility to easily communicate with colleagues and population, User level maintenance are indicated as priorities and are experienced by various responders but not so many people purchased a PPE considering these issues. On the other hand Ergonomy, Intuitiveness of Use, Longer Shelf Life and Versatility are really important while choosing a PPE even if few of the responders experienced these items.

Here below an histogram summarizes the answers.

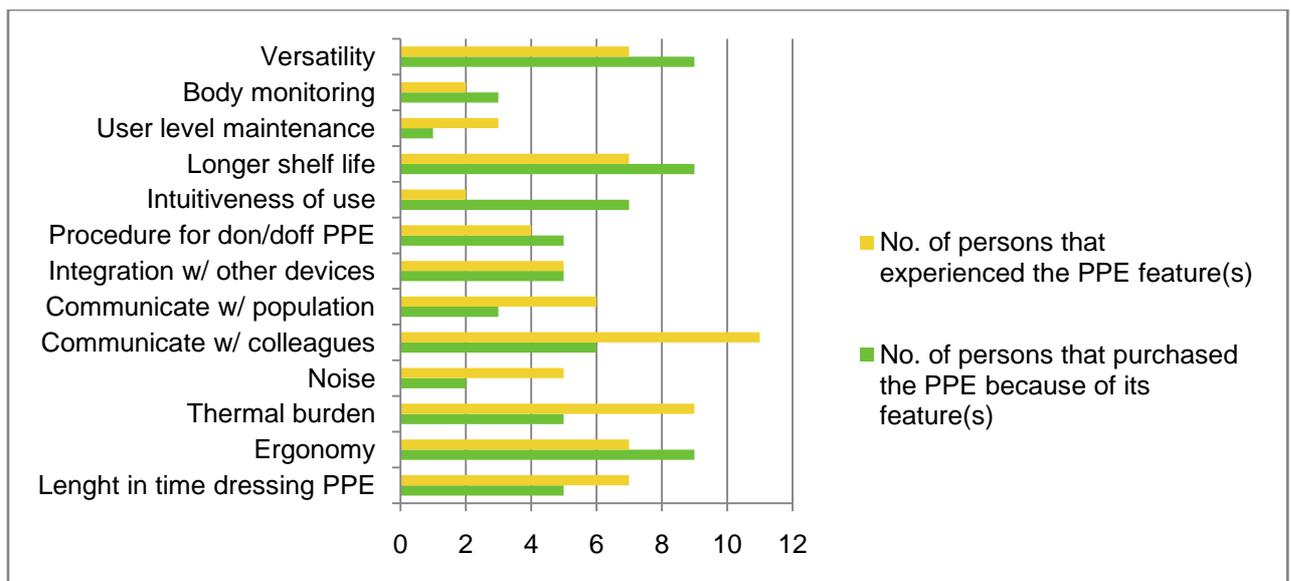


Table 2. Features related to PPE

8 responders are using PPE each month or more frequently, 5 responders every three months and the remaining responders less frequently. Responders who are using PPE frequently (more than 4 times per year) wear mostly PPE level C, while who use them twice a year or even less use to wear PPE level A; this is in line with the experience of the questionnaire designers.

Open comments regard the thickness of the gloves, the height difference between old and young soldiers and ballistic protection (suits and plates) for women.

## Detectors

13 responders use a hand-held detector, most of them for radiological and nuclear materials. Two responders did not indicate if they use a hand-held device or a standalone one.

For the detectors we have chosen 11 items, here listed: User-friendliness/intuitiveness of usage; Compactness (size and weight); Robustness; High screen visibility; Presence of alarms; Clear instructions/manuals; Stamp time and coordinates if the alarm is activated; Less maintenance required; Battery lifetime; Connectivity; Versatility (use for chemical, biological and radiological detection). The responders were asked to rank the items and to point out any encountered issue related to the items already indicated and if they purchased a PPE based on the items.

In general, user-friendliness/intuitiveness of usage and Presence of alarm items were ranked with high priority through the calculation of the median. Versatility, Clear instructions, Less maintenance required, Robustness and Compactness were ranked with a median priority of 7.5-8.

Taking into account just hand-held detectors for RN and C (14) we can draw some considerations: Versatility, battery lifetime and less maintenance required are top priorities for the hand-held chemical detectors while specific priorities for RN devices are compactness, robustness and clear instructions. Both detector types are required to be user friendly and to have alarms.

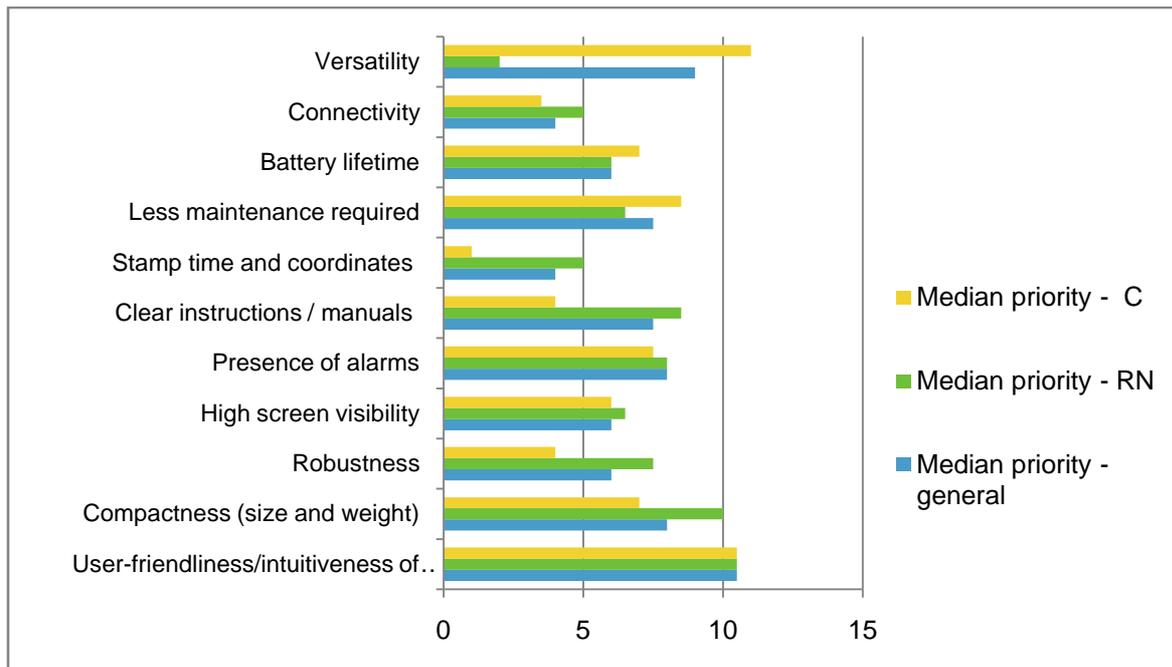


Table 3. Hand-held detector priorities

10 responders bought detectors because of intuitiveness of usage while most of the responders did it also because of less maintenance required and compactness. 9 responders experienced issues related to battery lifetime but, together with the clear instructions/manuals, these are not items that are usually taken into consideration while buying a detector.

Here below an histogram summarizes the answers.

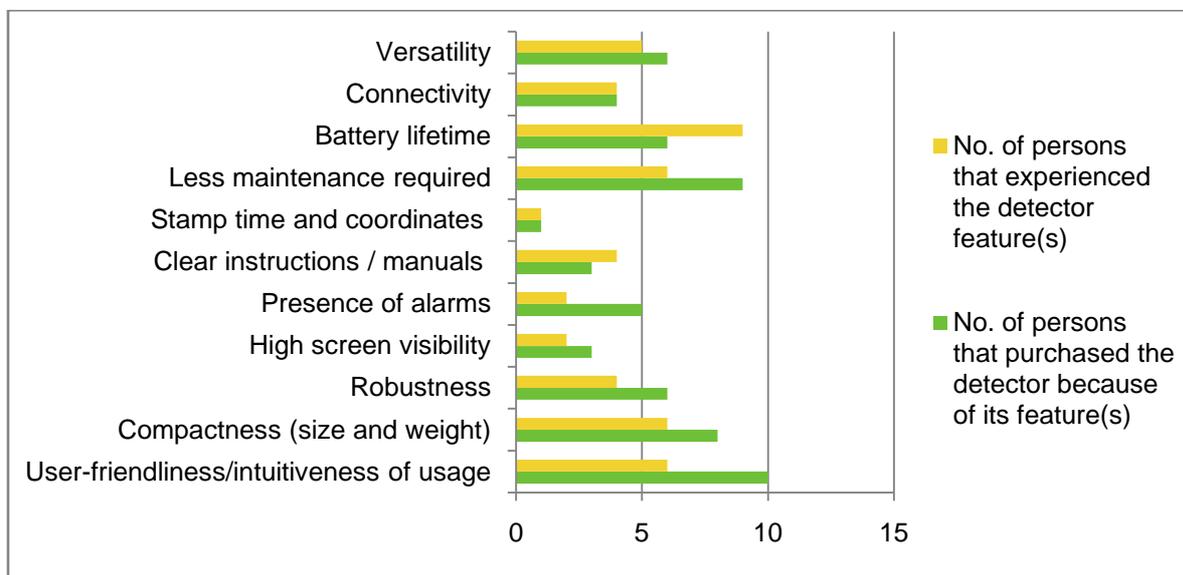


Table 4. Features related to hand-held detector

Most of the responders use the detectors every week (9), the majority of these are detector for chemicals. The remaining responders use the detectors at least once per month.

Responders were asked to indicate the alarm types that they wish to have on their detector (multiple responses allowed). Display information, Flashing light and Vibration were all selected by 10 responders while Audio signal from the detector speaker was selected 8 times. Fixed light and Audio signal through earphone were selected respectively 1 and 2 times.

The next question was about controls on the detectors while wearing PPE (multiple responses allowed). 13 responders would like to have buttons or switches. Very few would like to use a touch screen with finger, 3 a vocal control and just 1 the touch screen with stylus.

Responders were asked to indicate which kind of information the ideal detector should display:

- biological detector: ATP Luminometer; Toxin, protein and strain detector (Ricin/Enterotoxin/Abrine/Botulin etc.); Specific Bio Agent detector or immunochromatography.
- chemical detector: class of agent/compound family/name of the agent, concentration, percentage with respect to alert level, GHS pictogram, specific alarms depending on nature of the agent.
- radiological detector: radiation type, dose-rate, radioisotope(s) identification.

## UAV/UGV

9 responders filled the questionnaire for the drones, while 8 took into consideration robots. No one has chosen the UAV with fixed wing.

For both options the questions were the same, but due to the differences the answers will be presented and discussed separately. Items: User-friendliness/intuitiveness of usage; Modularity; Interoperability; Fast deployment; Possibility of decontamination; Long time operation; Autonomy of operation in navigation; Autonomy of operation in manipulation/data acquisition; Payload capacity; Controller's usability; Robustness; Ability to operate in various weather conditions; Use with other devices (controllers, displays, audio, ...).

### 1.1 DRONES

5 high priorities were identified for the dronesthrough the calculation of the median: User-friendliness/intuitiveness of usage; Modularity; Interoperability; Fast deployment; Ability to operate in various weather conditions. Use with other devices (controllers, displays, audio, ...) and Robustness were perceived as low priorities (median priority of 2 and 5 respectively).

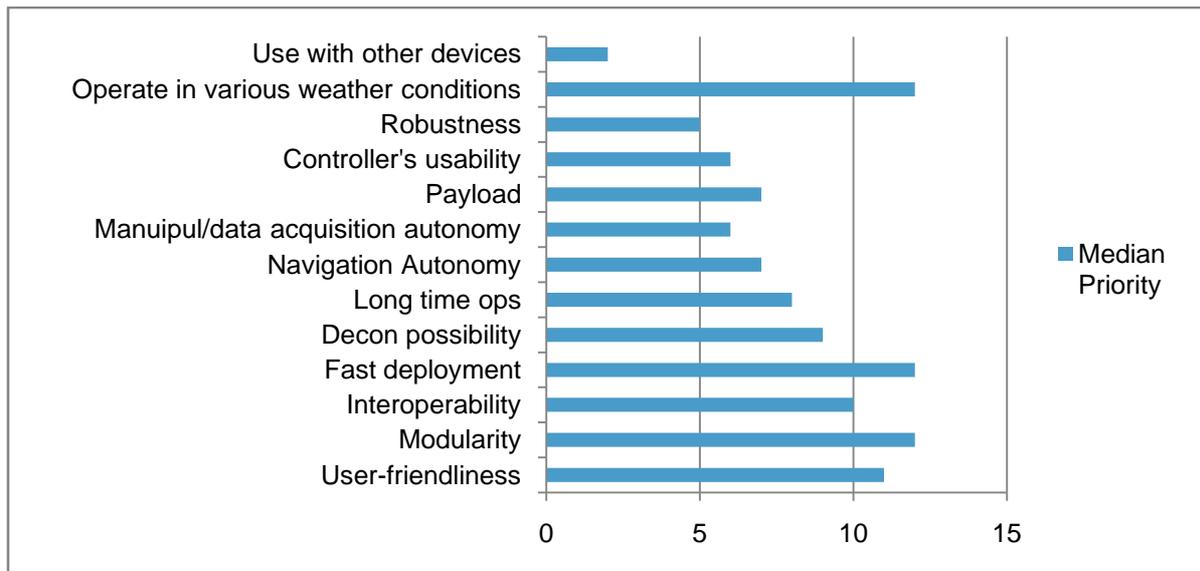


Table 5. Drone priorities

The indications on purchase or experiences on the items were not relevant due to very few answers. This is associated to the fact that most of the responders never used a drone or used it just for training purposes, while only 3 used it once a year or more frequently.

Responders were asked to rank on a scale from 1 to 3 (where 1 is the most and 3 is the least) the words that would be associated with the attitude towards the use of drones. Trust was the most indicated while Simplicity, Efficiency, Satisfaction and Comfort follow in the order indicated by the average of responses.

1 responder indicated the 'suitability for sampling only and scarce versatility of on-board C detection' as an operational problem of the drones, even if the same responder declared that he/she used the drone just during training sessions.

### 1.2 ROBOTS

Through the calculation of the median four high priorities can be recognized: Ability to operate in various weather conditions; Use with other devices (controllers, displays, audio, ...); Controller's usability; Possibility of decontamination. Three low priorities were identified: Modularity; Payload capacity; Autonomy of operation in navigation (median priority of 4).

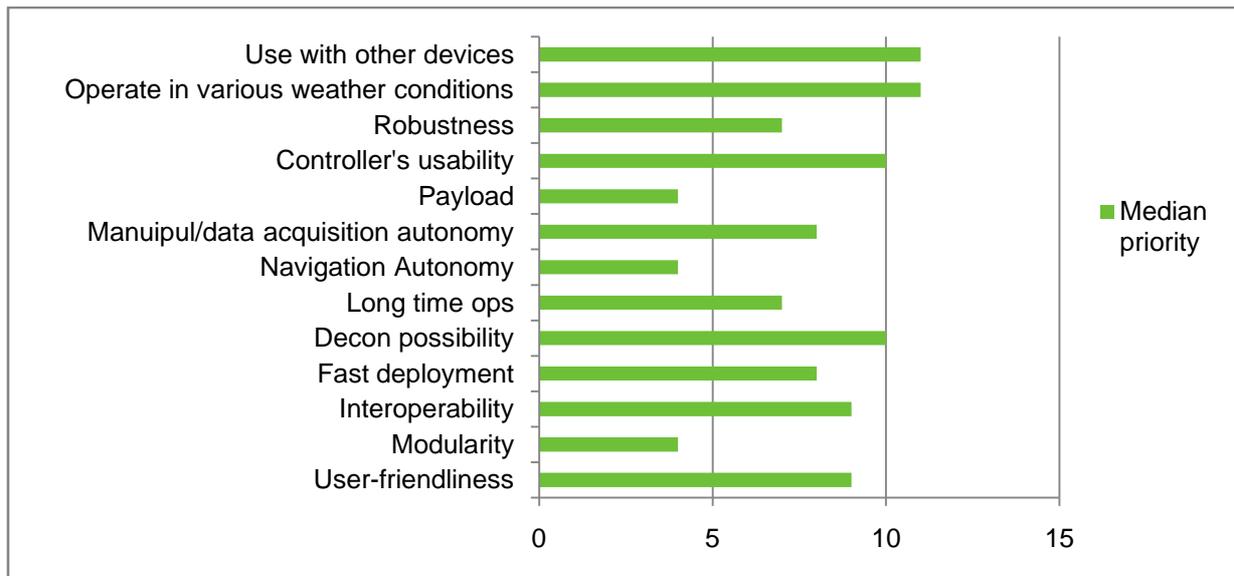


Table 6. UGV priorities

Responders use to experience various issues while using a UGV but few of them bought a UGV because of that items. Fast deployment, Long time operation, Controller's usability and robustness are some of those items.

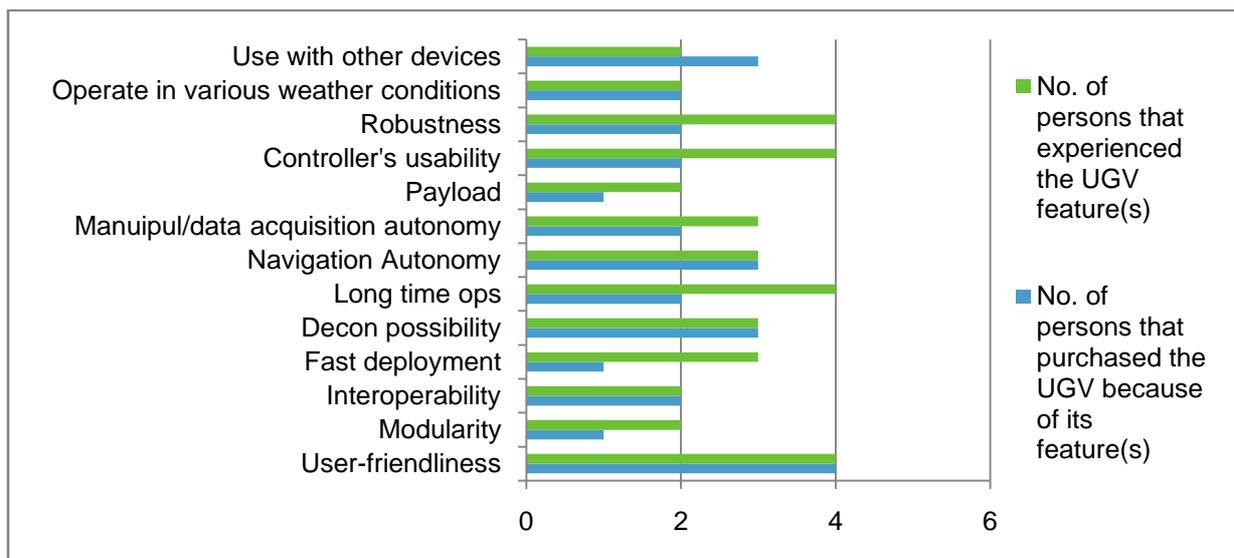


Table 7. Features related to UGV

Most of the responders use robots even if not frequently, only 3 responders use them every three months or more frequently.

Responders were asked to rank on a scale from 1 to 3 (where 1 is the most and 3 is the least) the words that would be associated with the attitude towards the use of robots. Trust, Efficiency, Simplicity received a high ranking on a similar average, while Comfort and Satisfaction received a lower ranking.

In the space for comments the responders highlighted as problems the maintenance cost, reliability of the equipment, operating distances, the use in closed spaces, obstacle capacity, load capacity, autonomy and the use of UGV while dressing PPE.

## Conclusions

The questionnaire was answered by few, but very skilled responders. CBRN is considered a niche and not many people are experienced in the sector. The length of the questionnaire can be another possible reason of few answers.

Most of questionnaire users utilize the technologies they were asked about, excluding UAVs.

Regarding PPEs, without taking into account the various level of protection, responders have suggested the following areas as a priority: Ergonomy; Thermal burden; Possibility to easily communicate with colleagues; Versatility (use for chemical, biological, radiological protection). Responders expressed their concerns on gloves thickness, the height difference between old and young soldiers and ballistic protection (suits and plates) for women.

With regards of detectors, they assigned a high priority to the User-friendliness/intuitiveness of usage and Presence of alarm items. For this last item they would appreciate to have a detector that, when the alarm is on displays information, has a flashing light and vibrates. Buttons or switches represent the best control they wish to have when using a detector in PPE.

Taking into account UAVs or drones, responders have suggested the following areas as a priority: User-friendliness/intuitiveness of usage; Modularity; Interoperability; Fast deployment; Ability to operate in various weather conditions. The word most associated by responders with their attitude towards the UAV is Trust. In this case the answer are not very relevant due to the fact that most of the responders use UAVs rarely.

Regarding UGVs, responders assigned a high priority to the following areas: Ability to operate in various weather conditions; Use with other devices (controllers, displays, audio, ...); Controller's usability; Possibility of decontamination. The words most associated by responders with their attitude towards the UGV are Trust, Efficiency, Simplicity.