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Human Factors Engineering - an Overlooked Aspect in Specifications for Radiation Detection Equipment's

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ABSTRACT

This study addresses some aspects of analysis about the **form factor** and **weight** in designing radiation detection equipment's. In overlooked aspect for design, the equipment's need to be assessed possibly in each component that can help design engineers to create a better product. The detection architecture must allow to detect radioactive materials out of regulatory control with acceptable probability of detection.

Since 2016 Albania has joined Coordinated Research Project (CRP) J02012 "*Advancing Radiation Detection Equipment for Detecting Nuclear and Other Radioactive Material out of Regulatory Control*" organized from International Atomic Energy Agency (IAEA). From May 2018 and till the end of March 2019 has been collected **3,948 measurements** with different form and weight equipment's in four holding positions. The experiments are performed in different weather conditions (winter/summer) and field conditions for determining optimal equipment specifications.

INTRODUCTION

The current state of fixed and handheld radiation detection instruments and systems used to detect a criminal or an unauthorized act with nuclear security implications involving nuclear or other radioactive material that is out of regulatory control is inadequate to meet the nuclear security needs.

This work gives the preliminary review for some factors in relation with holding time, angle, sex, and age depending on weight and form of instrument. In experiments are included mainly students with different age, height, weight and sex.

Experiments are conducted also in different weather conditions (winter/summer) and field conditions for determining optimal equipment specifications. The results has shown that holding position of instrument is very important in the timely and proper detection of Nuclear and Other Radioactive Material.

System is set of interrelated components that interact in an organized fashion to achieve a common goal:

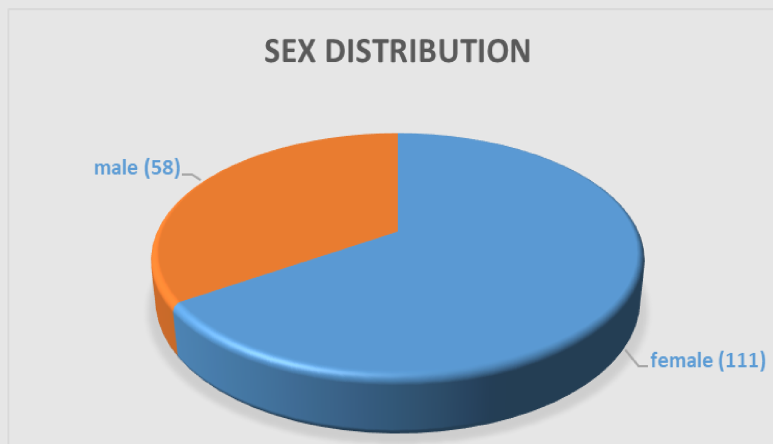
Equipment
Environment
People

Human factors is an important component:

- ✓ Focuses on the human element of the system
- ✓ Identifies human performance requirements for a successful system
- ✓ Identifies critical interactions between people and equipment
- ✓ Mitigates negative impacts of the environment on human performance (e.g., noise and glare)

MATERIALS & METHODS

Data in this report has been collected from May 2018 to March 2019.



Studied population consists of **169 persons** from ages of **18** to **61** years old.

There were **9 radiation detectors** with different weights and forms used in this experiment, which are:

- Fieldspec Identifinder
- Target Identifinder
- FLIR identifinder2
- Thermo Scientific Mikrosivert Dose Rate Meter
- Plexiglas model (mimicking one detector form)
- Contamat FHT115
- Inspector1000
- Dineutron
- KSAR1U.06

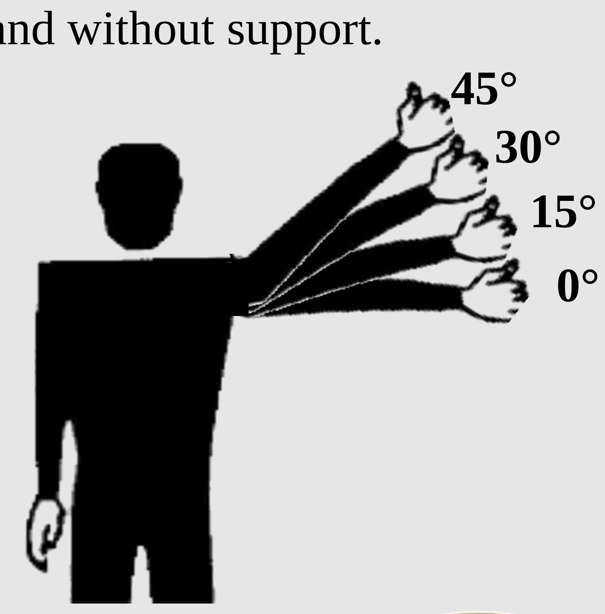
The equipment in this study could be categorized into 3 groups based on their forms and shapes.

Group A consists of 3 equipment that are Fieldspec Identifinder (1.12 kg), Target Identifinder (1.14 kg), and FLIR identifinder2 (1.22 kg).

Group B consists of 3 equipment and one Plexiglas model, that are from Thermo Scientific Mikrosivert Dose Rate Meter (1.51 kg), Plexiglas model (1.73 kg), Contamat FHT115 (1.96 kg), and KSAR1U.06 (4.14 kg).

Group C and D are other two equipment with distinctive forms which are different from any others; Inspector1000 (2.52 kg) and Dineutron (3.71 kg).

The persons withstanding to hold handheld radiation detectors at four different positions at different angles, with and without support.



With different angle

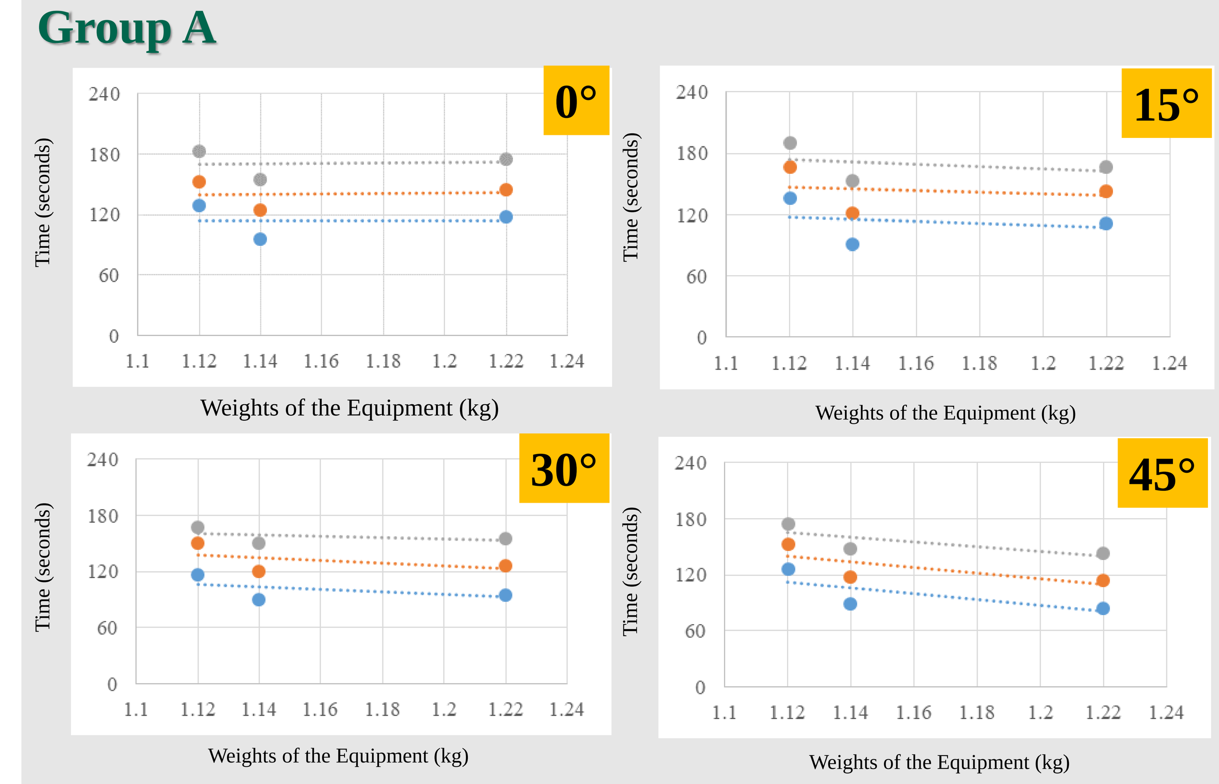
With or without support

Experiments under the field conditions

RESULTS & DISCUSSIONS

The data collected, at every positions or angles in this study, show that people can still be comfortable to hold the equipment up to the average of **2 minutes** (Fieldspec Identifinder).

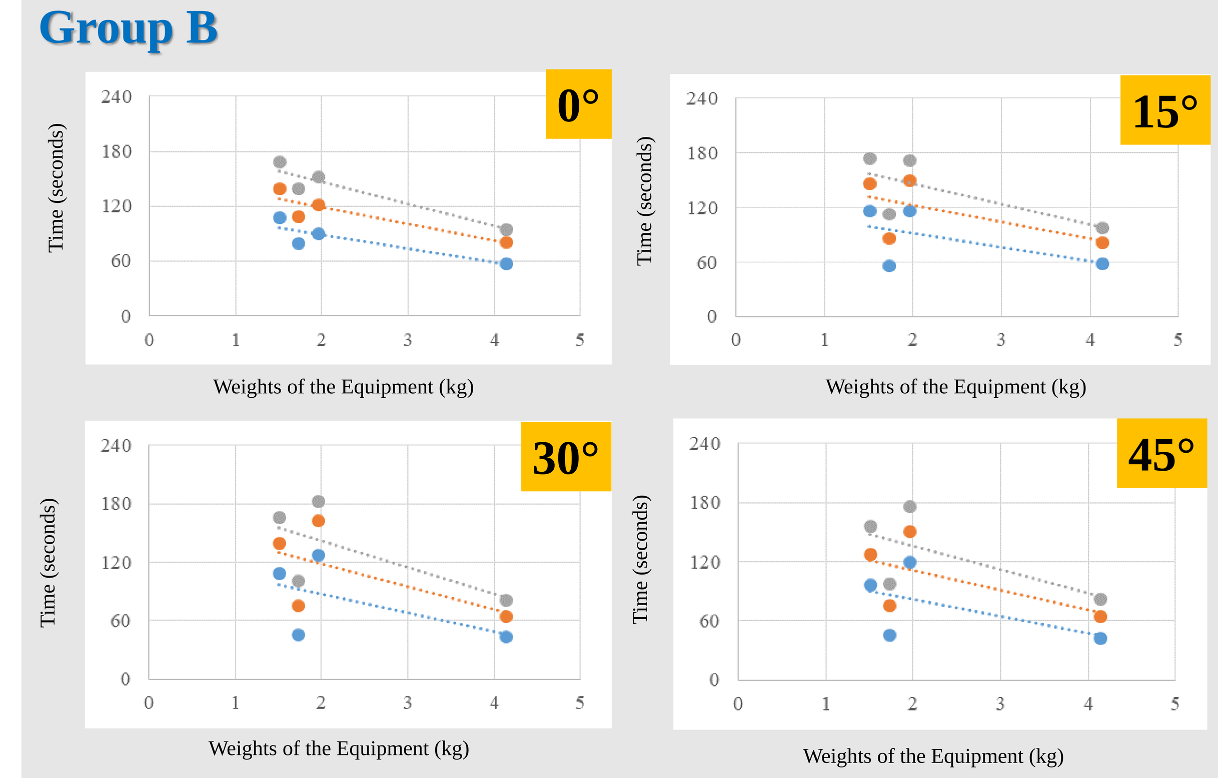
Group A



Time that persons feel: **comfortable to hold the equipment** (blue); **uncomfortable to hold the equipment** (orange); and **cannot stand holding the equipment** (grey) are shown. The dotted lines represent correlation trend lines between weights and time.

As shown for Group A equipment (Fieldspec, Target, and FLIR identifinder2), correlation trend lines between weights and time at the angle of 0° are neutral. Negative correlation trend lines can be observed in other 3 higher positions. Notably, data shown that the higher the position, the more negative the correlation between weights and time.

Group B



As shown for Group B equipment (Thermo Scientific Mikrosivert Dose Rate Meter, Plexiglas model, Contamat FHT115, and KSAR1U.06), the correlation trend lines between weights and time at all 4 angles suggest negative correlation.

CONCLUSIONS

- ❑ This work is thoroughly supported by IAEA, chiefly from Division of Nuclear Security, Department of Nuclear Safety and Security.
- ❑ In these paper are presented preliminary results from the experiments.
- ❑ More data on weight distribution for each group might also provide more evidence/ reasons for the out-group data points.
- ❑ Mitigating human error for an established system is more difficult than factoring in human capabilities and limitations in initial design.

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