Identification and classification of tools and missions needing e-training of Humanitarian Demining staff with use of computer simulation

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ABSTRACT

Classification of computer-assisted training activities related to humanitarian demining are considered in the article. Two classification schemes postulated for e-training in the TIRAMISU project are presented, one of them for simulation-type training of unmanned ground vehicle operators, and second for game-type training of management staff. An assumption is made that these schemes can be treated as an example-pattern for classification on wider humanitarian demining field.

1. INTRODUCTION

During initial works on TIRAMISU humanitarian demining project [1] it turned out that some systematization and classification of information about training as a part of the project is helpful.

As an example-pattern, such classification related to computer-assisted training was considered and is presented in this article. Two classification schemes are particular subject of interest. One of them relates to simulation-type training of unmanned ground vehicle operators, and second to game-type training of management staff. Three-dimensional classification spaces are applied in both schemes. Dimensions, representing particular views of training, determine classification frameworks. Instances of views-dimensions determine crates of individual types of training, being atomic cells of classification, having individual addresses. In these crates detailed characteristics of training types can be placed.

The authors are of the opinion that similar approach to classification could be helpful also in wider field of humanitarian demining.

2. TERMS

Terminology used in the paper is mainly based on IMAS standards [2, 3, 4 ,5]. Humanitarian demining process is understood as a set of activities which lead to the removal of mine and ERW (Explosive Remnants of War) hazards, including survey, mapping, clearance, post-clearance documentation, and the handover of cleared land. The notion ERW covers mines and ordnance whether fuzzed, fired or otherwise, and all explosive devices whether mass-produced or improvised [6]. Demining mission (process) consists of 4 steps: planning, preparation, clearance and post-clearance. Typical demining action is performed by deminers and operators of demining machines, acting under supervision of section commander, which in turn is subordinated to team leader. Mine Action Centre (MAC) is an organisation that conducts reconnaissance of hazardous areas, collection and centralisation of mine data, coordinates local (mine action) plans with the activities of external agencies and carries out mine risk education training.

3. IDENTIFICATION AND CLASSIFICATION OF TOOLS NEEDING E-TRAINING

Unmanned ground vehicles (UGV) to be used in humanitarian demining are of rather narrow autonomy and need to be driven by skilled operators. Training of UGV operators should be conducted in accordance with the methodology of multi-level training with use of computer trainers (simulators) of different grade of perfection, taking advantages of technologies of virtual reality (VR) and augmented reality (AR) [7, 8, 9]. The following types of trainers are to be used:

- Trainers of the Level 1 – built with use of typical PCs. VR technology is applied. UGV, its environment and control console are simulated.
- Trainers of the Level 2 – built with use of PCs with real UGV control consoles connected. VR technology is applied. UGV and its environment are simulated.
- Trainers of the Level 3 – trainers of the Level 1 or 2 with application of AR technology – real UGV in the real environment with simulated elements added. A trainee uses special helmet.

In the case of use of trainers of the Level 1 and 2, the performance of training via Internet is possible (trainers of the Level 2 should be equipped with simplified control consoles, e.g. typical consoles for computer games). Training with use of computer trainers, both used locally and via Internet, is named as *e-training*. E-training is understood as an extension of e-learning: e-learning concerns obtaining of knowledge, whereas e-training concerns obtaining of operation skills.

E-training consists in realization by a trainee his/her individual *program of training.* Every program of training is a sequence of *training tasks*. An exemplary training task for UGV operator is lifting, with use of the UGV's gripper, of a certain object, and putting it in a certain container. At the beginning of the training session the trainee is informed on the task to perform, as well as on time limits, grading scale, and penalty points for causing wrong events (e.g. collisions of UGV with objects in its environment). The trainee, using virtual or real control console, performs training tasks of the character of a computer game, and after finishing them is informed about the score obtained. During execution of training tasks, the knowledge about trainee's progress is gathered, and on this basis a choice of the next task, or decision on the end of training is made. The detailed description of training methodology of RISE (Robotics for Risky Interventions and Environmental Surveillance) systems' operators is described in the paper [10].

With reference to TIRAMISU project a proposed classification of tools needing e-training is based on three parameters: type of a task do be performed by a UGV, type of an UGV, type of an environment. Dimensions-views of the framework and their instances are the following:
The dimension *Goal of a training* has instances: *Inspection (pre and post-removal), Close-in detection, Removal activities,* and *Mine transport*.
The dimension *Vehicle* has instances: *Semi-autonomous mobile robot, Unmanned ground vehicle adapted for demining tasks, Remote-controlled mine-clearer,* and *Mine transport trailer.*
The dimension *Environment* has instances: *Natural, Artificial,* and *Unknown.*
Graphical representation of the proposed classification is presented in Fig. 1.

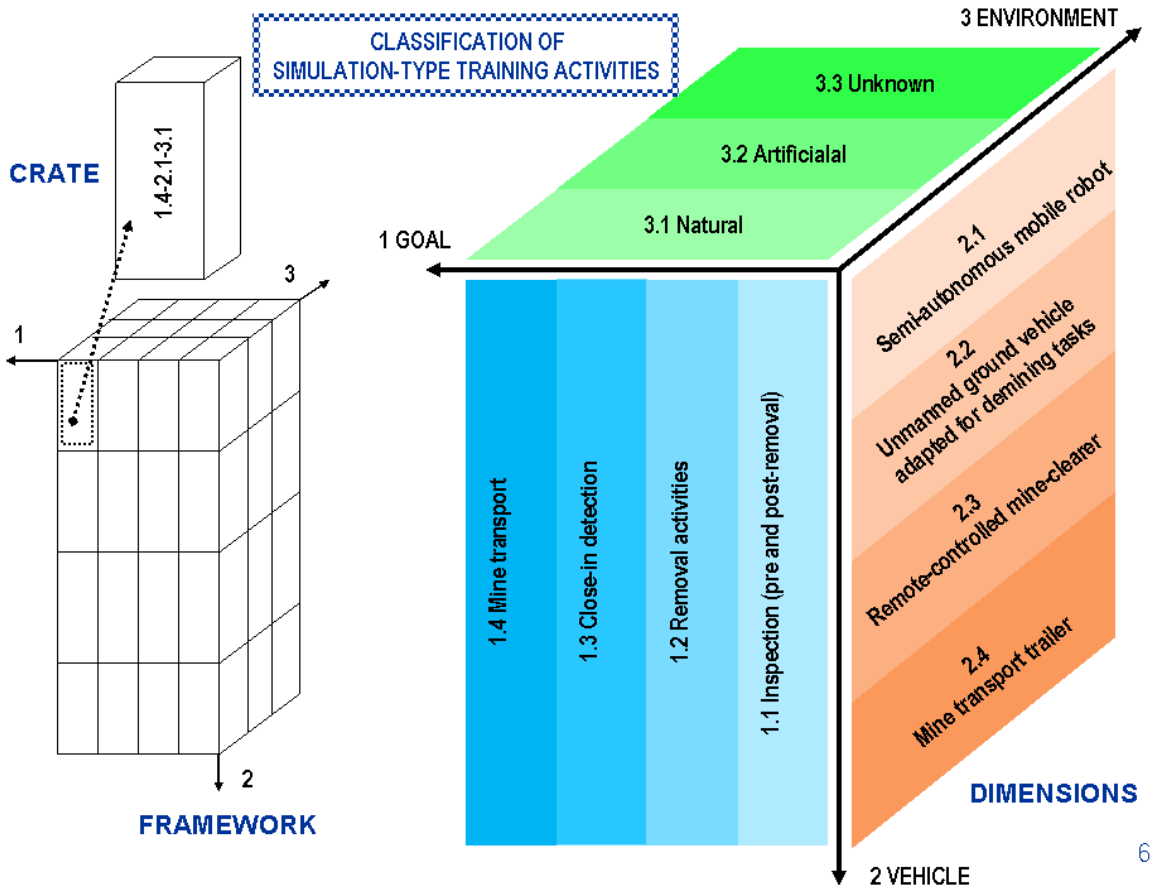

Fig. 1. Classification of tools needing e-training

An example of a crate content that is supposed to be considered within TIRAMISU project is:
CRATE 1.4-2.1-3.1
Training mission No XXX
Mine transport – Semi-autonomous mobile robot – Natural environment
Description: Operation of transporting of previously pulled ERW into defined place of disposal.

4. IDENTIFICATION AND CLASSIFICATION OF MISSIONS NEEDING E-TRAINING

In a case when a given demining mission is performed by more then one human and when activities of the people involved should be coordinated somehow, then a *collective computer trainer* should be applied for training. (This is in contrast to *an individual computer trainer* described in point 3, which may be applied to the training of only one operator at a given point of time).

The simplest implementation of a collective computer trainer it is a set of computers connected via local area network. Nodes of the network may be individual computer trainers accustomed to needs of training both of operators of UGV used and members of managing staff as well. Through the network any kind of data may be transmitted, including voice and video.

Training based on collective computer trainers has a form of network computer game. Depending on the need different type games may be applied: simple simulation games, adventure games with interactive scenarios, role-playing games (with use of avatars). Strategy games with management of resources (of MONOPOLY-type) seems to be out of the scope of TIRAMISU, but purposefulness of modelling of some functions performed by MAC (associations with police, medical services, fire department, local authorities, among others) is to be considered.

Specific methodology of training is to be elaborated for training with use of collective computer trainers.

In TIRAMISU project a proposed classification of missions needing e-training is based on three parameters: goal of a training, action type performed, structure of managed forces.
Dimensions-views of the framework of missions needing game-type training of the HD staff, and their instances are the following:
The dimension *Goal of training* has instances: *Action planning,* and *Operation Management.*
The dimension *Action type performed* has instances: *Non-technical survey, Technical survey, Ground-based close-in detection, Stand-off detection, Removal action,* and *Combined.*
The dimension *Managed forces structure* has instances: *Uniform group, Joint task force,* and *Aggregate with vertical and horizontal connectivity.*
Graphical representation of the proposed classification is presented in Fig. 2.

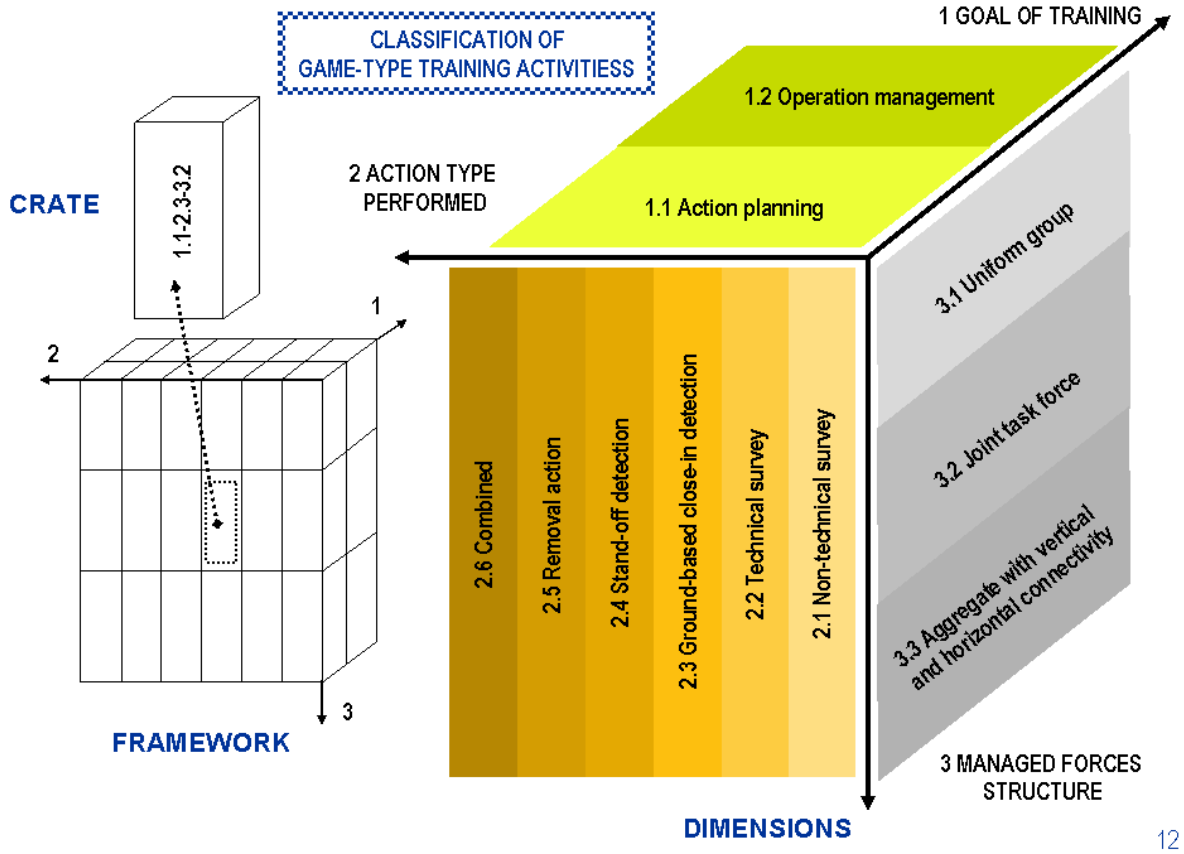

Fig. 2. Classification of missions needing e-training
An example of a crate content that is supposed to be considered within TIRAMISU project is:

CRATE 1.2-2.3-3.2
Training mission No YYY
Operation management – Ground-based close-in detection – Joint task force
Description: Manual and mechanical demining combined operation in confirmed hazardous area.
Use of the following TIRAMISU tools:

- Ground penetrating radar array
- Chemical sensor
- Remotely controlled platforms for inspection
- Low-cost agricultural derived assistance
- Intelligent prodder
- Innovative metal detector array
- Real-time location and communication system

5. CONCLUSION

Computer-assisted training, both in the form of trainers-simulators and computer games, becomes more and more popular in many sectors of human activity. Demining in general, and humanitarian demining particularly, seem to belong to the sector of very high demand for such training. So, many computer training tools and applications will appear here. Therefore their identification and classification can be an important problem. An approach to this problem presented in connection with TIRAMISU matter maybe will turn to be useful on the whole HD field, and of course more-than-three dimensional classification space can be applied for this. **REFERENCES**

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