The tactical board game UNI-KASS: Features and best practice

Summary

UNI-KASS is a tactical board game that enables participants to explore the impact of semi-autonomous systems on the command and control (C2) of mechanised warfare. UNI-KASS if flexible and can be used to investigate a wide range of C2 research questions by adapting the game board, scenarios, and game pieces using actual or expected vehicles and semi-autonomous systems as inspiration.

This memo describes the basic features of UNI-KASS, such as the game board, game pieces and their properties, as well as the game setup and rules for playing the game. UNI-KASS has been used at several workshops to stimulate discussions about how the introduction of semi-autonomous systems impacts C2 of mechanised warfare. The memo also describes the currently best practice for conducting such workshops.

1 Introduction

The use of semi-autonomous systems, such as Unmanned Aerial Vehicles (UAVs) and Unmanned Ground Vehicles (UGVs), on the battlefield raises many questions related to command and control (C2). For example, what mission roles are most suitable for semi-autonomous systems? What echelon levels are suitable for control of semi-autonomous systems? What is the expected impact of semi-autonomous systems on mission performance?

The tactical board game Universal Conflict game for Autonomous Combat Command and Control Studies (Swe. Universellt Konfliktspel för Autonom StridsledningsStudie, UNI-KASS) was developed to study the impact of semi-autonomous systems on C2 (Saleh et al., 2022). UNI-KASS is an experiential game that presents participants with typical tactical decision-making problems for mechanised warfare, which participants explore using combinations of semi-autonomous systems and conventional forces. Reasoning about the properties of semi-autonomous systems within a tactical context provides some initial experience of possible future warfare. UNI-KASS is often used during workshops where participants discuss their experiences of the semi-autonomous systems to reach some preliminary conclusions about their impact on C2.

This memo describes the basic features of UNI-KASS in terms of the game board for land warfare, game pieces and their properties that are inspired by actual or expected vehicles and semi-autonomous systems, game setup, and rules for playing the game. The memo also describes the currently best practice for conducting workshops with UNI-KASS to study the impact of semi-autonomous systems on C2. The best practice includes selection of C2 research question for a workshop, workshop participants, scenario design, adaptation of UNI-KASS to facilitate experiences that are important for the C2 research question, and the practical details of setting up a workshop with UNI-KASS to stimulate explorative discussions with relevant stakeholders, such as military commanders.

2 UNI-KASS features

UNI-KASS is a manual closed game that focuses on land warfare. Participants move their pieces on a game board and receive information about their opponent in a way that reflects typical tactical decision-making problems for mechanised warfare. UNI-KASS focuses on the impact of semi-autonomous systems on multiple echelon levels, from platoon to company. The UNI-KASS game board represents the general characteristics of typical terrain for land warfare in Sweden. A UNI-KASS game is played between own forces (blue side) and enemy forces (red side) with game pieces are that given properties that reflect the characteristics of existing military vehicles, as well as expected characteristics of future semi-autonomous systems. The game board, properties of game pieces, and scenarios are all adapted according to the needs of each C2 study. For example, the number and proportion of manned vehicles and semi-autonomous systems, echelon level for control of semi-autonomous systems, and the capabilities of semi-autonomous systems. For simplicity, one or two six-sided dice are used to determine detection of units and the outcome of engagements.

This chapter describes the game board, game pieces and their properties, game setup, and rules for playing the game.

2.1 Game board

The UNI-KASS game board consists of hexagonal tiles with side length 3 cm. Each tile is 6 x 5.2 cm and represent about 100 x 100 meters of terrain. For convenient transportation and assembly of game boards, a game board section consists of 5 x 5 tiles (500 x 500 meters) (Figure 1). The game board sections are combined into an arbitrarily large game board. Terrain patches on the tiles indicate the

type of terrain. There are seven types of terrain: open terrain, road (paved or unpaved), sparse forest, dense forest, rocks, water (river or lake), and urbanised (Figure 2). The type of terrain affects game pieces' line of sight and movability. Figure 3 shows an example of a UNI-KASS game board.

Figure 1

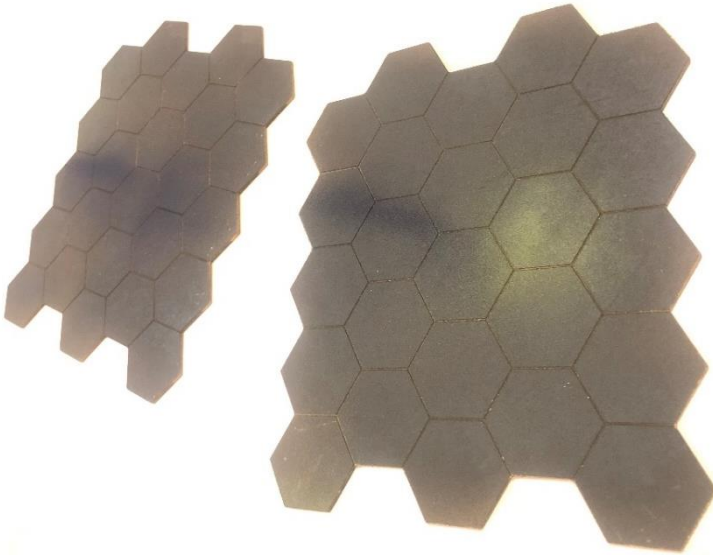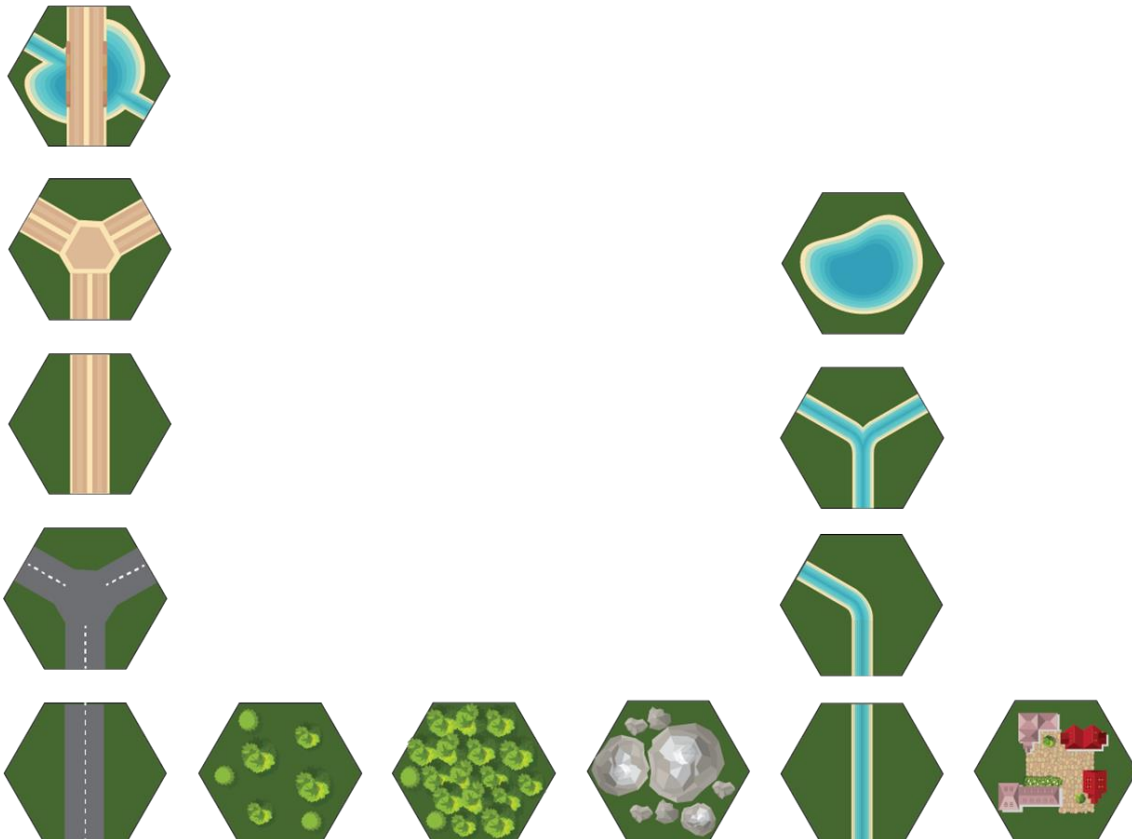*UNI-KASS tile module (24.7 x 29.5 cm).*

Figure 2

UNI-KASS terrain patches. A tile without any terrain patch indicates open terrain.
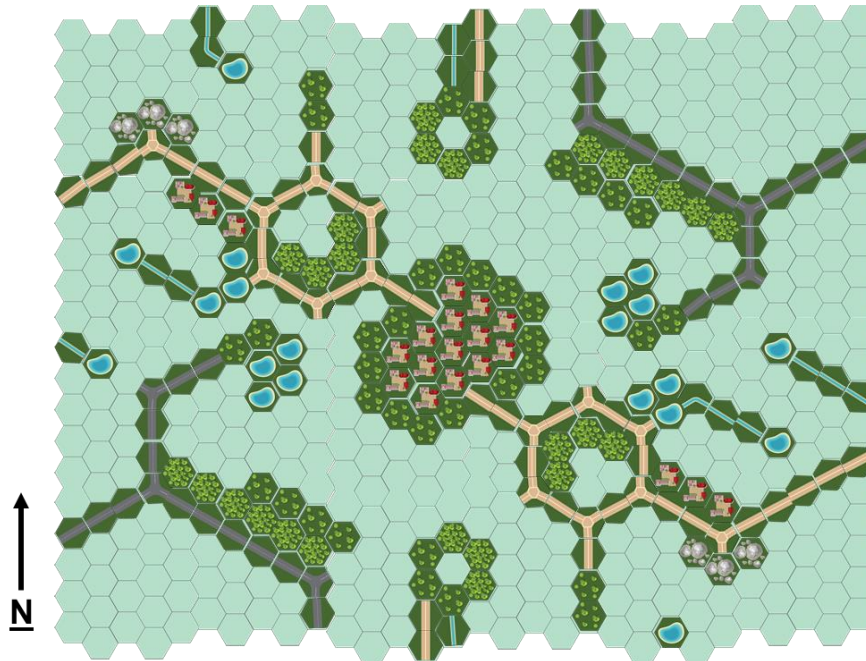
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Figure 3

Example of UNI-KASS game board (3.0 x 2.0 km).

2.2 Game pieces and game cards

The UNI-KASS game pieces are 3D printed and represent existing military vehicles, as well as future semi-autonomous systems. The game pieces are not to scale, but rather of a size that is convenient for participants to move on the game board. Currently, there are eight types of game pieces in UNI-KASS. Four game pieces represent conventional ground forces: an infantry fighting vehicle (IFV), a main battle tank (MBT), an infantry squad, and a mortar for indirect fire (Figure 4). Four game pieces represent semi-autonomous systems: UGV, Unmanned Combat Ground Vehicle (UCGV), quadcopter UAV, and fixed-wing UAV (Figure 5). The UGV is inspired by Milrem Robotics TheMIS (Tracked Hybrid-electric Modular Infantry System)[1] and has one anti-tank robot. The UCGV is inspired by Milrem Type-X Combat[2] with similar characteristics as an IFV. The quadcopter UAV is inspired by Parrot ANAFI[3] and does not have a weapon system. The fixed-wing UAV is inspired by Aerovironment RQ-20 Puma[4] and does not have a weapon system.

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[1] https://milremrobotics.com/defence/

[2] https://milremrobotics.com/product/type-x-combat/

[3] https://www.parrot.com/en/drones/anafi

[4] https://www.militaryfactory.com/aircraft/detail.php?aircraft_id=1043

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Figure 4

UNI-KASS game pieces for conventional ground forces (on the left IFV and dismounted infantry squad and on the right MBT and mortar).

Figure 5

UNI-KASS game pieces for semi-autonomous systems (on the left UGV and quadcopter UAV and on the right fixed-wing UAV and UCGV).

The game pieces properties are inspired by the actual or expected characteristics of vehicles and semi-autonomous systems. However, the pieces' properties do not direct reflect the actual characteristics in reality. The pieces' properties are instead adapted to the constraints of the board game format that UNI-KASS uses, tactically relevant differences that may impact C2, as well as the focus of each study. The game pieces' properties do not reflect the actual characteristics in reality. The purpose of UNI-KASS is to facilitate explorative discussion about C2 of semi-autonomous systems, not detailed realism.

The properties of each game piece are printed on game cards that are handed out to participants. Figure 6 shows an example of a game card with the following information:

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1. Type of piece.
2. Number of *movement points* (MP). More movement points means that the piece can move a longer distance in a round of the game.
3. A picture of the relevant military unit.
4. Main characteristics or the relevant military unit for contextual information.
5. *Movement cost*: How many movement points it costs to move the game piece over different terrain tiles. A higher cost means that it is more difficult to move through that type of terrain. For example, an IFV can move four tiles of open terrain during a game round, but only one tile of dense forest. Armoured vehicles cannot move over rocks.
6. *Detection range*: Maximum range in tiles for detection of enemy pieces within line of sight. The minimum roll of the dice required for detection of enemy pieces within detection range depends on the type of terrain (Table 1). A higher minimum roll of the dice means that it is more difficult to detect enemy units in that type of terrain.
7. *Weapon range*: Maximum range in terms of number of tiles required to fire at enemy pieces within line of sight.
8. Weapon properties in terms of the minimum roll of the dice required to firstly hit and secondly to destroy an enemy piece. Different minimum roll of the dice are required to hit and destroy armoured units (MBT, IFV, UGV, and UCGV), UAVs, and dismounted infantry squads. A higher minimum roll of the dice means that it is more difficult to hit and destroy that type of unit.

Figure 6

Example of UNI-KASS game card (8 x 14 cm). See text for explanation.

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Table 1

Roll of the dice required for detection of enemy units.

Type of tile/ game piece	Minimum roll of the dice
Open terrain/Road	Always detect
Sparse Forest	3
Dense Forest	5
Urbanised – Infantry squad	6
Urbanised – Any game piece except infantry squad	3
UAV	3

2.3 Other game components

Round markers (3 cm diameter) are used to indicate the location of indirect fire. Further, a tile shaped disc may be placed under IFV pieces to indicate when it does not have any infantry squad on-board. Coloured post-it notes may indicate associations between units. For example, when a UAV is controlled by a specific IFV and therefore needs to be within communication range. Additionally, paper stripes may be used to indicate decreasing UAV battery levels as a representation of limitations on UAV battery time and that it needs to fly back to recharge.

Other useful material are a ruler or stick to estimate line of sight and a physical or digital six-sided dice to determine whether units are detected or destroyed by enemy fire. Alternatively, the roll of the dice may be generated in advance to avoid sequences of high or low numbers that give advantages to one side in a way that is undesirable for the study.

2.4 Game setup

UNI-KASS is usually played as a one-sided game, participants with military expertise play the blue side, while a game administrator with military expertise plays the red side. However, UNI-KASS may also be played as a two-sided game with two opposing teams of players. Each of the two sides have their own game board and their view is blocked so that they cannot see where the other side places their units (Figure 7). The physical size of the game boards are adapted to the number of people that will use them. Since there are often several participants that play the blue side in one-sided games, they typically use a larger game board with game board sections. The red side, on the other hand, is often only one person who can therefore use a smaller game board that is printed on laminated paper. This makes it easy to mark the position of the player's own units and the blue units they have detected.
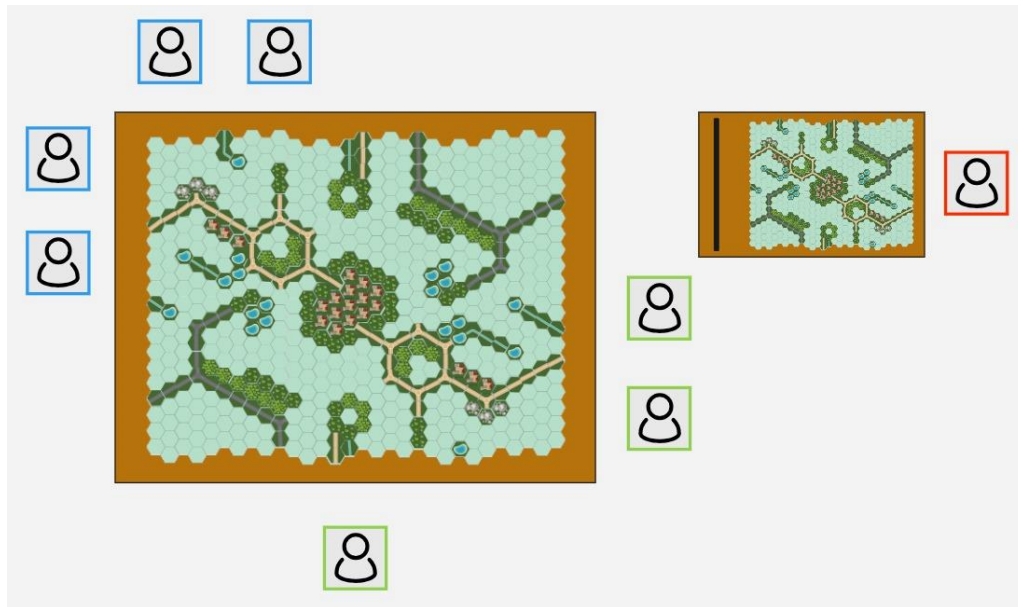
Video cameras may be used for recording and laptops for taking notes.

Figure 7

Setup of UNI-KASS game boards for blue and red side. Blue icons indicate participants. The red icon indicates one person playing the red side. The black line indicates that their view is blocked so that they can only see their own game board. Green icons indicate game administrators.

2.5 Playing the game – start positions, game rounds and rules

The blue and red side are usually free to choose the initial placement of their pieces within the constraints of the scenario. For example, when one side is attacking, the direction of the attack is known to the other side. The attacking side therefore place their pieces on the side of the game board that corresponds to the direction of attack. Thereafter, UNI-KASS is played in rounds where the blue and red side take turns moving their game pieces and choosing whether to fire at enemy units. Each round consists of several steps where the players can move or use a particular type of unit (Table 2). The order of unit types in each round is designed to provide a good game experience which reflects mechanised warfare.

The game pieces can fire on enemy pieces directly before or after finishing their movement. Only the infantry squad piece may occupy the same tile as another game piece. Game administrators continuously adjudicate to update the game board based on which enemy units are visible to participants depending on their line of sight and units' detection range. Participants then indicate with which of their units they want to fire, as well as which enemy units they are targeting. Participants can only fire at detected units that are within weapon range of the units that engage the enemy. Several units may fire on the same target. Game administrators then adjudicate to determine the outcome of engagements given the game piece's weapon properties relative to the type of enemy unit. The game administrators first use one roll of the dice to determine whether the enemy unit is hit or missed. If the enemy unit is hit, the game administrators use another roll of the dice to determine whether the unit is destroyed by the hit or survives. Destroyed game pieces are indicated by turning the game piece upside down.

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Table 2

Steps in a UNI-KASS round. In this case, the red side does not have any UAVs or UGVs.

Step	Blue side	Red side
1	Indirect fire – launch	
2		Indirect fire – launch
3	UAV – move	
4	MBT/IFV – move/fire	
5		MBT/IFV – move/fire
6	UGV – move/fire	
7	Infantry squads – move/fire	
8		Infantry squads – move/fire
9	Indirect fire – hit/miss	
10		Indirect fire – hit/miss

The effect of indirect fire is calculated at the end of each round to capture the time delay of indirect fire. Participants therefore have to estimate where the enemy's units will move next to hit a moving target. Additionally, due to the inaccuracy of indirect fire, it may also hit adjacent tiles rather than the targeted tile. The minimum roll of the dice to hit the targeted tile is 3. If the indirect fire misses, it will instead hit one of the adjacent tiles. Then another roll of the dice is used to determine which tile is hit, where 1 corresponds to the tile above and then continues clockwise for each roll of the dice (Figure 8). The outcome of the indirect fire for a tile that is hit is determined in the same way as for direct fire. The minimum roll of the dice to destroy any unit is 3. Indirect fire may also hit own units that are nearby.

Figure 8

Hit on adjacent tiles from indirect fire.
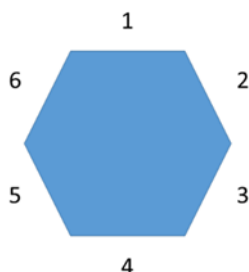
3 Best practice for UNI-KASS workshops

The Swedish Defence Research Agency (FOI) has used UNI-KASS at several workshops to stimulate discussions about how the introduction of semi-autonomous systems impacts C2 of mechanised warfare. This chapter describes the currently best practice for conducting such workshops including selection of the C2 research question, workshop participants, scenario design, adaptation of UNI-KASS, and how to setup a workshop.

3.1 C2 research question

UNI-KASS can be used to investigate a wide range of C2 research questions regarding the impact of semi-autonomous systems. For example:

- What mission roles are most suitable for semi-autonomous systems?
- What echelon levels are suitable for control of semi-autonomous systems?

- How can control of semi-autonomous systems be organised?
- What is the expected impact of semi-autonomous systems on mission performance?
- What are the advantages and disadvantages with using UAVs and UGVs in mechanised warfare?
- How do different types of autonomy impact C2?
- How do different types of semi-autonomous systems impact C2? For example, large UCGVs compared to medium-sized UGVs? Large UCGVs may have similar characteristics to IFVs.

A workshop with UNI-KASS is usually designed to investigate one such C2 research question since each question may require a specific adaption of the game board, scenario, and game pieces.

3.2 Participants

Participants usually have military expertise since tactical knowledge is required to develop mission plans that are representative for actual operations and to use available game pieces in tactically appropriate ways. Such tactical knowledge is important for valid conclusions about the impact of semi-autonomous units on C2.

3.3 Game administrators

A UNI-KASS game usually requires at least three game administrators: two for managing and updating the game boards and one for notetaking. The game administrators need in depth knowledge of the UNI-KASS rules and the properties of game pieces so that they can respond to questions from participants. UNI-KASS is a complex game to learn in a short period of time so questions are expected. Even if participants are recruited from the same organisational unit for successive workshops, it has to be expected that most participants are new to UNI-KASS due to rotations of military personnel.

3.4 Scenario

The scenario is designed to provide tactical decision-making problems enabling the exploration of the C2 research question. The scenario should also be relevant for the participants' military expertise. It is therefore important to consult personnel with a relevant military background for development of suitable scenarios. For example, the scenario and mission goals may be for the blue or red side to attack or defend an area of terrain or urban area, or to delay the advance of enemy forces in an area of terrain. Additionally, the scenarios should describe the overall mission contexts and the commander's intent since this affects how military personnel plan and execute missions.

Since UNI-KASS uses game rounds where the blue and red side take turns moving their pieces, the game does not reflect realistic warfare. UNI-KASS only attempts to represent valid tactical decision-making problems that will likely occur for C2 when introducing semi-autonomous systems.

3.5 Adaptation of game board, game pieces, and game cards

The C2 research question and scenario affect the design of the game board. For example, the size of the game board depends on which echelon levels are being investigated since higher echelon levels operate over larger areas. Appendix A shows some examples of UNI-KASS game boards that range from the size 2.0 x2.0 km for a platoon size scenario to 3.5 x 3.0 km for a scenario with several mechanised companies. The layout and placement of terrain tiles depends on the C2 research question, scenario, and mission goals. For example, an urban area may be placed in the middle of the

game board for missions to attack and defend the urban area. Forest and rocks are placed to restrict line of sight and limit freedom of movement while also enabling several tactical opportunities that makes the game partly unpredictable.

The number and type of game pieces for the blue and red side also depends on the C2 research question and the scenario. It is often important that the number of game pieces is the same as the actual number of vehicles and infantry squads as in existing units at the investigated echelon levels. Military personnel are familiar with reasoning about the actual organisational structure and the workshop should facilitate such reasoning. For mechanised warfare in the Swedish Armed Forces, this means that an IFV-platoon consists of three vehicles where each vehicle has an infantry squad on-board. The platoon commander commands one of the vehicles. An IFV-company typically consists of fifteen IFV-vehicles: three IFV-platoons (nine IFV-vehicles), a company commander IFV-vehicle, a deputy company commander IFV-vehicle, a C2 support IFV-vehicle, a logistical support group IFV-vehicle, a fire support IFV-vehicle for coordination of indirect fire, and an armoured recovery IFV-vehicle. The company C2 vehicles do not have an infantry squad.

The game cards for existing vehicles are usually same for many workshops since they form a baseline for introduction of semi-autonomous systems. The game cards for semi-autonomous systems, on then other hand, are typically adapted for each game to facilitate experiences of the systems that are relevant for the C2 research question. Movement points, movement cost, detection and weapon range, and weapon properties may therefore be adjusted up or down for investigation of the C2 research question in the best way possible.

3.6 Setup

Larger game boards can be placed on a few tables that are put together. However, it is important that participants and game administrators can reach all tiles from at least one side of the game boards. It is advisable to have the blue and red game boards on nearby tables, but with a screen between the game boards so that the blue and red side cannot see the positions of the other side's units. This makes it easier for game administrators to switch between the game boards and update them as the game progresses.

Video cameras may be mounted both above for a top-down view of the blue side's game board and from the side for an overall view to record the game.

3.7 Procedure

A full day is usually required for a UNI-KASS workshop with one game in the morning and one in the afternoon. Typically, a different scenario is used for each game. Although about one hour is often enough for playing one game, additional time is required for discussions, breaks, and to setup and pack up the game (Table 3). Each game consists of describing the scenario, planning the course of action, selecting starting positions, and several rounds of game playing. The game ends when one side can be considered to have achieved their objective or when the time is up.

It is advisable to allocate plenty of time for discussions since the aim of UNI-KASS is to facilitate explorative discussions about the introduction of semi-autonomous systems. Discussion topics regarding the C2 research question may also be prepared in advance. For example:

- How did you experience the scenario?
- Did you succeed with the mission?
- How did you use the semi-autonomous systems?
- Which tasks are suitable for semi-autonomous systems?
- What are the advantages and disadvantages of semi-autonomous systems?
- Which echelon level is suitable for control of semi-autonomous systems?

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- How does semi-autonomous systems affect C2?

Table 3

Example of schedule for a UNI-KASS workshop.

Time	Topic
08:00-08:45	Setup
08:45-09:15	Introduction to workshop and UNI-KASS
09:15-09:30	Break
09:30-11:00	Game 1: scenario, starting position, planning, game playing
11:00-11:30	Discussion game 1
11:30-12:30	Lunch
12:30-14:00	Game 2: scenario, starting position, planning, game playing
14:00-14:15	Break
14:15-16:00	Discussion game 2 Concluding discussion
16:00	End

4 Conclusions

UNI-KASS is a tactical board game that can be adapted to a wide range scenarios where semi-autonomous systems may be used for mechanised warfare. The flexibility of UNI-KASS enable studies of relevant research questions for how semi-autonomous systems impact C2. Researchers and participants can thereby explore the advantages and disadvantages of semi-autonomous systems and how C2 may be adapted to utilise such systems. Semi-autonomous systems will be increasingly common in future conflicts and UNI-KASS enables military C2 to prepare for this transformation of warfare.

5 References

Saleh, D., Pestrea, A., & Johansson, B. J. E. (2022). Exploring Command and Control of Semi-Autonomous Units: Co-constructing the future battlefield using a tactical board game. In *Proceedings of 27th International Command and Control Research & Technology Symposium* (pp. 1-15), 25-27 October 2022, Quebec City, Canada: International C2 Institute.

# Appendix A — Examples of UNI-KASS game boards

Figure 9

Example of game board 2.0 x 2.0 km. The area is suitable for platoon combat. An urban area is placed in the middle of the game board for scenarios to attack and defend the urban area.

Figure 10

Example of game board 3.0 x 2.0 km. The area is suitable for company combat. An urban area is placed in the middle of the game board for scenarios to attack and defend the urban area.

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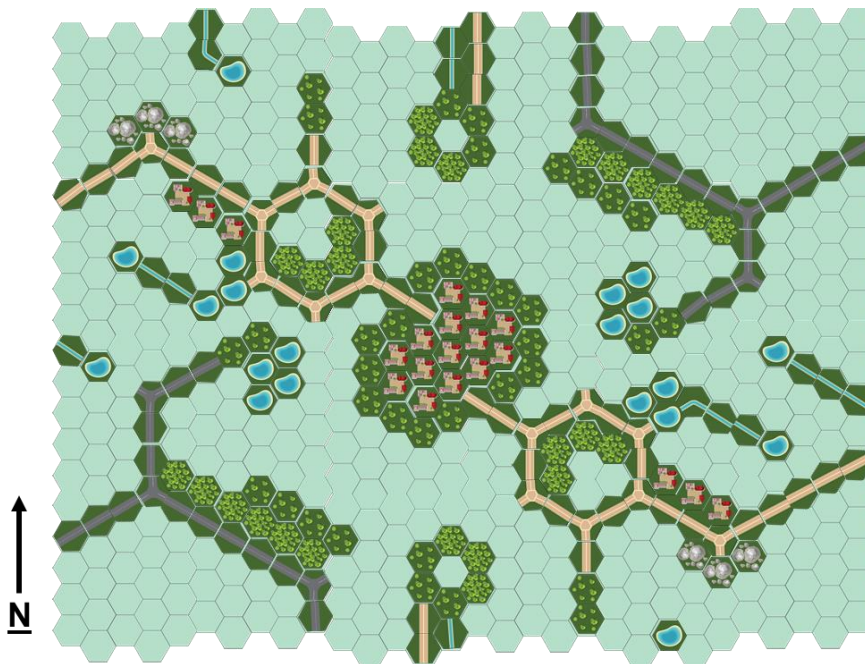
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Figure 11

Example of game board 3.5 x 3.0 km. The area is suitable for combat with several companies. The trees along the sides channels the combat to this area. An urban area is placed on the side of the game board since it is not central for the scenarios.