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INTEGRATION OF WARGAMING INTO PROFESSIONAL MILITARY EDUCATION: A DIAGNOSTIC STUDY

Background. The article examines the integration of wargaming into the system of Professional Military Education (PME) in Ukraine as a component of digital transformation in accordance with NATO standards. The problem addressed is the lack of scientific substantiation for the integration of wargaming into the PME system. The aim of the study is to justify the role of wargaming as a component of digital transformation and to develop a three-level integration framework.

Methods. Five research methods were applied: content analysis of 79 regulatory and legal acts with three-stage verifications; a comprehensive review of PME course catalogues (over 13,000 entries), comparison with the Bi-SC 075-007 benchmark (2025 edition); case study analysis, and comparative analysis of the models implemented in Lithuania, Finland, and the Scandinavian countries. The empirical basis was supplemented by a bibliometric dataset consisting of 151 Scopus publications (Score 7–14, 2019–2026).

Results. The diagnostic analysis revealed doctrinal recognition without operationalisation: wargaming is recognized as a type of educational activity (Ministry of Defence of Ukraine, 2024), and a dedicated simulation modelling unit has been established (Ministry of Defence of Ukraine, 2025); however, none of the course catalogues include wargaming as an educational product. Category D7 (AI/XR/Simulation) demonstrated only 11 % coverage. A three-level framework was proposed: tabletop wargaming; computer-assisted exercises (CAX); and AI-supported wargaming.

Conclusions. The proposed framework is based on the existing regulatory framework and the combat experience of the Armed Forces of Ukraine. The initial implementation steps include the adoption of Bi-SC 075-007 standards, the preparation of a cohort of facilitators through NATO DEEP and NATO School Oberammergau programmes, and the inclusion of wargaming modules in PME course catalogues.

Keywords: professional military education, digital transformation, NATO, Bi-SC 075-007, content analysis, simulation modelling, artificial intelligence, wargaming.

Background

This article employs two terms to denote the system of military personnel training: професійна військова освіта (PVO) and Professional Military Education (PME). This distinction is not merely linguistic. PVO is a term of current Ukrainian legislation, codified in the Law of Ukraine "On Education" (Verkhovna Rada of Ukraine, 2017, Art. 21) and the Concept for the Transformation of Military Education (Cabinet of Ministers of Ukraine [CMU], 1997/2022); it encompasses courses from the basic tactical level L-1A to the strategic level L-5 and operates within the national regulatory vertical: Ministry of Defence of Ukraine (MoD) – General Staff of the Armed Forces of Ukraine (GS AFU) – higher military educational institutions / military training units of higher education institutions (HMEI (MTU HEI)). The operational core of this vertical is the Regulation on Educational Process Organisation (MoD, 2024a), while the distribution of competences between the MoD and the GS AFU is codified by MoD (2024b). PME is an established concept within NATO doctrine that describes not so much a system of institutions as a model of continuous professional development of the officer corps: from cadet to senior command. The distinction is fundamental: PME under NATO standards presupposes a Systems Approach to Training (SAT), which incorporates an integrated cycle of analysis, design, implementation, and evaluation of educational solutions, whereas PVO is

normatively focused on level structure and ECTS credit volumes. This article examines precisely the zone of intersection between these two systems – and the zone of their disconnect.

The updated PVO system model (MoD, 2026), Directives of the Commander-in-Chief of the AFU (Commander-in-Chief, 2023; 2025a), and Euro-Atlantic commitments delineate the strategic framework for modernising the training process in HMEI (MTU HEI). Among the methods that NATO recognises as an integral component of PME, wargaming – learning through decision-making under conditions of simulated conflict – occupies a distinct place. The NATO Wargaming Handbook (NATO Allied Command Transformation [HQ SACT], 2023), the annual Wargaming Initiative for NATO conferences (NATO Allied Command Transformation, 2024), and courses at the NATO School Oberammergau constitute an institutional ecosystem of educational, analytical, and operational wargaming from the tactical to the strategic level. The Bi-Strategic Commands Joint Directive Bi-SC 075-007 "Education and Individual Training" (Bi-SC 075-007, 2025), translated by the Department of Military Education and Science of the Ministry of Defence of Ukraine (DMES MoD), recognises virtual reality, augmented reality, simulations, and e-learning as instruments for enhancing training quality

and establishes SAT as the mandatory methodology for course design across all NATO education institutions.

Content analysis of 79 regulatory documents governing the PVO system – from laws of Ukraine to course catalogues – conducted with three-stage primary-source verification revealed a condition the authors define as doctrinal recognition without operationalisation: wargaming is normatively recognised yet absent from course catalogues as a training product. The problem this article investigates is the absence of a scientific basis for integrating wargaming into the PVO system as a component of digital transformation in accordance with NATO standards.

The paradox is that the PVO system of a country waging Europe's largest war since 1945 lacks the regulatory foundations for systematising its own combat experience through wargaming — a method recognised by AFU doctrines, NATO standards, and the practice of modern warfare. Since February 2022, the Armed Forces of Ukraine have accumulated combat experience unparalleled in any NATO army.

Literature review. The conceptual framework for wargaming in the PME context is shaped by three foundational sources. The NATO Wargaming Handbook (HQ SACT, 2023) standardises definitions, typology, and the four-stage wargaming process (design → development → execution → analysis and reporting). Perla's monograph (1990/2011) establishes wargaming as the art of decision-making, while Thieme et al. (2022) treat it as a craft with specific planning tools. Curry (2020) proposed the formula "a flawed but useful tool," which defines the dominant practitioner discourse.

Empirical evidence of the pedagogical potential of wargaming is concentrated in the special issue of the *Scandinavian Journal of Military Studies* (2022, Vol. 5, Iss. 1). Perla (2022) conceptualised the research-and-learning cycle. Enstad (2022) substantiated the concept of professional knowledge – a specific type of practical knowledge that is formed exclusively through the experience of acting under uncertainty. Vatne et al. (2022) examined wargaming as an instrument of knowledge development. Roennfeldt et al. (2022) demonstrated the effectiveness of matrix games for developing strategic thinking. Hagen (2022) explored the role of narrative and rhetoric, while Mouat (2022) cautioned against the risks of methodological misuse. Rosen and Kerr (2024) conducted the most extensive empirical study to date: wargaming was rated the most effective instrument among all PME teaching methods. Sjöblom and Lymer (2025) identified the mechanism of conceptual socialisation during debriefing. Cole (2021) proposed wargaming for real-time assessment of strategic thinking. Walters (2021a) systematised implementation challenges; Walters (2021b) demonstrated that wargaming develops confidence in decision-making. A fundamentally new line of research concerns the integration of artificial intelligence and large language models into wargaming. Davis and Bracken (2025) substantiated AI application for automating scenario generation, adversary modelling, and results analysis. Bae et al. (2026) proposed an architecture for LLM-based scenario generation. Bruzzzone et al. (2024) described a wargame simulation of critical infrastructure using LLMs. Saastamoinen and Nuutinen (2025) demonstrated how AI is integrated into military simulators in Finland.

The institutional dimension is analysed in the GAO report (U.S. Government Accountability Office [GAO], 2023), identifying three systemic problems: data fragmentation, absence of training standards, and opacity of scale.

Bekešienė and Vasiliauskas (2026) described the Lithuanian model. Domestic publications on wargaming are limited to isolated reviews without linkage to the PVO system (Bondarenko, & Hupalo, 2026).

The aim of the article is to substantiate the role of wargaming as a component of digital transformation in professional military education and to develop a three-tier framework for its integration into the PVO system based on NATO standards, empirical diagnosis of the current state, and comparison with resource-efficient models of NATO member states.

Methods

The article combines five methods. Content analysis of the regulatory framework was conducted on a corpus of 79 regulatory documents governing the PVO system. Coding was performed across seven analytical categories (D1–D7), of which D7 (AI/XR/Simulation) is central to the wargaming problematic. Results were verified against primary sources in three stages: automated full-text search across 50 .docx files, visual inspection of 7 scanned documents, and cross-referencing with a prior registry. Exhaustive verified review of PVO course catalogues covered four planning documents – collectively exceeding 13,000 entries. Benchmarking against the NATO standard was conducted using Bi-SC 075-007 (2025). Case study analysis (Yin, 2018) was conducted using an embedded multiple-case design on six critical situations. Comparative analysis involved the Lithuanian (Bekešienė, & Vasiliauskas, 2026), Finnish (Saastamoinen, & Nuutinen, 2025), and Nordic (Roennfeldt et al., 2022; Sjöblom, & Lymer, 2025) models. The empirical base consists of three blocks: Block 1 – regulatory corpus (79 documents); Block 2 – NATO benchmark and institutional documents; Block 3 – 151 Scopus publications (Score ≥ 7, 2019–2026) selected through a relevance scoring model (Table 1).

Table 1

Dataset structure by Score

Score range	Number of publications	Characterisation
0	6,079	Non-relevant (search periphery)
1–2	1,557	Tangentially related
3–6	4,719	Partially relevant
7–14	151	Curated — core of the literature analysis

Source: compiled by the authors.

In the fourth stage, 151 publications with Score ≥ 7 (range 2019–2026) were selected as the core of the literature analysis. Thematic profiling revealed the dominance of wargaming (73 publications – 48 % of the dataset), AI/ML/GenAI (43 publications), simulation (36 publications), and PME/military education (34 publications).

Research boundaries. This study focuses on the PVO system in the segment delivered through HMEI (MTU HEI): courses at levels L-1B, L-2, L-3, L-4, and professional development courses. Outside the scope are L-1A, L-5, and training centres.

Results

1. Conceptual foundations of wargaming in the PME system

1.1. Definitions and typology. The NATO Wargaming Handbook (HQ SACT, 2023) defines wargaming as the depiction of conflict or competition in a safe-to-fail environment in which humans make decisions and respond to the consequences of those decisions. The

definition contains three constitutive elements: player decisions as the central mechanism; friction – artificially imposed constraints that replicate the cognitive load of actual combat; and adjudication – a mechanism for determining the consequences of decisions. Without player decisions, it is a simulation; without friction, an academic discussion; without adjudication, unconstrained

speculation. The Handbook distinguishes educational wargames and analytical wargames. Gorla (2025) additionally identifies operational wargaming.

1.2. The format continuum. Wargaming formats form a continuum along the degree of rule formalisation (Table 2). The position on the continuum determines resource requirements, facilitator qualifications, and pedagogical effect.

Table 2

Wargaming format continuum by degree of rule formalisation

Format	Rule rigidity	Adjudication method	Application in PME
Seminar	Minimal	Structured discussion	Strategic level (L-4)
Matrix game	Low	Consensus + probability	Operational level (L-3) (Roennfeldt et al., 2022)
Free Kriegsspiel	Medium	Expert judgement of the umpire	Tactical (L-2B) / operational (L-3)
Rigid Kriegsspiel	High	Deterministic tables and rules	Tactical level (L-1B, L-2A)
CAX	Maximum	Digital model (JCATS, JTLS-GO)	Operational-level CAX; staff exercises
AI-assisted	Adaptive	LLM-generated scenarios	All levels (Davis, & Bracken, 2025; Bae et al., 2026)

Source: compiled by the authors based on HQ SACT (2023), Curry (2020), Roennfeldt et al. (2022), Davis and Bracken (2025).

A matrix game requires a trained facilitator, a scenario, and 3–4 hours – no specialised IT infrastructure. AI-assisted wargaming does not replace any preceding format but extends their capabilities: LLMs can generate adaptive scenarios (Bae et al., 2026), model adversaries (Davis, & Bracken, 2025), and provide automated adjudication (Bruzzzone et al., 2024).

1.3. Demarcation from adjacent instruments. Wargaming is not an exercise: an exercise rehearses predetermined procedures, whereas wargaming confronts the participant with an open-ended problem. Wargaming is not Modeling

and Simulation (M&S): M&S can function without human decisions. Mouat (2022) warns of a systemic risk: when an exercise is labelled a "wargame" yet lacks player decisions or adjudication, it fails to generate the expected pedagogical effect. These demarcations explain why "command-staff exercises," present in the PVO catalogues as a level designation, do not constitute wargaming as defined by the NATO Wargaming Handbook.

1.4. Empirical evidence of pedagogical potential. The argument for wargaming in PME rests on a growing body of empirical data (Table 3).

Table 3

Empirical evidence of the pedagogical potential of wargaming in PME (2020–2026)

Author(s), year	Method / context	Finding
Sjöblom and Lymer (2025)	Video analysis, Swedish Defence Univ.	"Conceptual socialisation": collective construction of tactical concepts
Enstad (2022)	Professional knowledge concept	Knowledge formed only through acting under uncertainty
Vatne et al. (2022)	Allied courses of action analysis	Wargaming as knowledge development instrument
Rosen and Kerr (2024)	Student survey, Naval War College	Most effective method among all PME formats
Walters (2021a)	Systematisation of challenges	Facilitator shortage; instructor resistance
Walters (2021b)	Decision-making confidence	Quality demanded in high-tempo combat
Davis and Bracken (2025)	AI for wargaming	Scenario generation, adversary modelling automation
Perla (2022)	Research-and-learning cycle	Thinking adversary as unique element
Roennfeldt et al. (2022)	Matrix games, Norwegian DUC	Open structure compels justified decisions
Mouat (2022)	Methodological misuse	Label without mechanics = no effect
Cole (2021)	Tabletop game Hegemony	Real-time assessment of strategic thinking
Bae et al. (2026)	LLM-based scenario generation	Adaptive scenarios without large teams

Source: compiled by the authors based on 151 Scopus publications (Score 7–14, 2019–2026).

Rosen and Kerr (2024) provide the most extensive empirical evidence: wargaming was rated the most effective instrument among all teaching methods, with its pedagogical effect extending to critical thinking, strategic planning, and the ability to justify decisions under pressure.

Sjöblom and Lymer (2025) show that during debriefing, participants jointly construct tactical concepts as knowledge objects. The 2024–2026 AI integration wave allows Level 3 (AI-enabled wargaming) to be treated as a technologically accessible horizon. Effectiveness is critically dependent on the quality of design and facilitation – making institutionalisation a necessary prerequisite for scaling.

2. Diagnosis: wargaming in Ukraine's PVO system

2.1. Content analysis of the regulatory framework. Content analysis covered 79 regulatory documents across

all levels of PVO system regulation. Results by hierarchical level are presented in Table 4.

Verification identified eight documents containing wargaming terminology (10 % of the corpus). Confirmed data include: the Doctrine of Organisation of Joint Defence Force Training (GS AFU, 2020a) with 37 verified WG/SIM entries, supplemented by the parallel Doctrine of Organisation of Training in the AFU (GS AFU, 2020b); the Regulation on Educational Process Organisation (MoD, 2024a, Art. 14) with WG=11 and SIM=10 matches. New findings: Joint Order (MoD, & MES, 2015) contains WG=4; the earlier Joint Order (MoD, & MES, 2002) records WG=0; MoD Order (2025a) establishes a simulation and modelling unit. Refuted attributions: Commander-in-Chief Directive (2025a) contained only reporting forms, WG/SIM=0.

None of the eight documents provides a complete wargaming methodology – quality standards, facilitator qualifications, and reporting procedures are absent.

2.2. PVO course catalogues. The verified review covered four core planning documents (MoD, 2024c; 2024d; 2024f; 2025b) and two supplementary ones (MoD, 2024e; 2025c), summarised in Table 5.

Table 4

Content analysis results for 79 regulatory documents: wargaming terminology and simulation technologies

Hierarchical level	Docs	WG>0	WG %	SIM>0	SIM %	Verification
I. Laws of Ukraine	9	0	0 %	0	0 %	9 files
I. CMU Resolutions / Pres. Decrees	10	0	0 %	2	20 %	10 files
II. MES Orders	5	0	0 %	0	0 %	4 files, 1 scan
II. CMU Resolutions (civilian)	5	0	0 %	1	20 %	5 files
II. Joint MES/MoD Orders	5	2	40 %	2	40 %	4 files, 1 scan
III. MoD Orders	17	3	18 %	4	24 %	14 files, 3 scans
III. GS AFU Acts	12	1	8 %	0	0 %	2 files, 10 scans
III. Doctrines / C-in-C Directives	10	2	20 %	2	20 %	3 files, 7 scans
III. Course catalogues	5	0*	0 %	0	0 %	5 files
Benchmark: Bi-SC 075-007	1	+	–	+	–	PDF
Total (excl. benchmark)	79	8	10 %	11	14 %	54 files, 7 vis., 18 scans

Note: WG — wargaming terminology; SIM — simulation technologies. * The term "command-staff" appears ~30 times as a level designation, not a method descriptor.

Source: compiled by the authors, verified against primary sources.

Table 5

PVO course catalogues: verified review for the presence of wargaming / simulation / CAX

Catalogue / document	Level	Entries	WG/SIM/CAX
PVO Course Catalogue (MoD, 2024d)	L-1B–L-4	~3,200	0
PDC Catalogue (MoD, 2024c)	PDC	~718	0
PVO Volume Calc. 2025 (MoD, 2025b)	Organisational	~4,800	0
PDC Volume Calc. 2025 (MoD, 2024f)	PDC	~4,300	0
List of Training Clients (MoD, 2025c)	Organisational	30 pp.	0
Org. and Method. Guidelines (MoD, 2024e)	Organisational	~120 pp.	0
Total		over 13,000	0

Source: compiled by the authors. All documents verified through full-text search. Restricted-access documents.

Of over 13,000 verified entries, none contains a course or module with an explicit wargaming, simulation, or CAX component. The absence at the L-1B level carries particular consequences: Rosen and Kerr (2024) found that early exposure produces a career-long method acceptance effect.

2.3. Benchmarking against Bi-SC 075-007. Content analysis under category D7 (AI/XR/Simulation) recorded 11 % coverage – the lowest among all seven categories, while the Bi-SC benchmark demonstrates full coverage. In Ukraine's PVO system, catalogues are maintained in .docx and Excel formats; no MoD order defines LMS requirements; the term SCORM does not appear. Cross-referencing with the NATO C3 Taxonomy Baseline 6 (NATO ACT, 2022) reveals an absent mapping between Ukrainian CIS classifications and the NATO reference vocabulary for IT capabilities. The terms VR and AR are entirely absent from departmental regulatory documents. SAT is not implemented. The term "artificial intelligence" does not appear across the 50 verified .docx files.

2.4. Combat experience as an untapped resource. Since February 2022, the Armed Forces of Ukraine have accumulated Europe's largest body of contemporary combat experience. External partners draw on this experience more actively than the PVO system: the U.S. Marine Corps University, WIN conferences, and Finland (Saastamoinen, & Nuutinen, 2025) integrate Ukrainian scenarios. Officers returning from the front line are potential scenario

developers and facilitators, yet the PVO system has no "wargaming facilitator" role, no preparatory course, and no regulatory requirement codifying wargaming as a method for processing combat experience.

2.5. Synthesis: the "doctrine → catalogue" cascade. The diagnosis revealed a four-link cascade: doctrine recognises (GS AFU, 2020a: 37 verified entries) → regulation codifies (MoD, 2024a: WG=11, SIM=10) → establishment creates capacity (MoD, 2025a: simulation and modelling unit) → the catalogue ignores (0 WG courses out of over 13,000 entries). The problem is not technological: a matrix game requires a facilitator, a scenario, and three to four hours (Roennfeldt et al., 2022; Bekešienė, & Vasiliauskas, 2026). The problem is institutional.

Discussion and conclusions

The framework is built on a synthesis of diagnostic findings and comparison with resource-efficient NATO models. The Lithuanian experience (Bekešienė, & Vasiliauskas, 2026) demonstrated that a small state can integrate wargaming through a centralised platform. The Finnish experience (Saastamoinen, & Nuutinen, 2025) showed how a new NATO member integrates AI into simulators. The Nordic experience (Roennfeldt et al., 2022; Sjöblom, & Lymer, 2025) confirmed that tabletop formats precede digital ones and deliver a full learning effect without IT infrastructure. The framework builds on the existing regulatory base and envisages a progressive increase in complexity (Table 6).

Table 6

Three-tier framework for integrating wargaming into the PVO system

Parameter	Level 1: Tabletop	Level 2: CAX	Level 3: AI-enabled
Horizon	2026–2027	2027–2028	2028+
Format	Matrix games, free Kriegsspiel, seminar wargames	CAX with JCATS/JTLS-GO or analogues	LLM scenarios, AI adversary modelling
PVO level	L-1B, L-2A/L-2B (priority)	L-2A/L-2B, PDC	L-2B, L-3A, L-3B
Adjudication	Expert judgement / player consensus	Computer model + umpire	LLM + human oversight
Scenarios	Real AFU combat episodes	Complex operational scenarios	AI-generated adaptive scenarios
Prerequisites	Facilitator + scenario + 3–4 hours	IT infrastructure + licences	Edge AI / open-source LLM
Existing regulatory base	MoD (2024a): WG as training activity; MoD (2025a): simulation unit	GS AFU (2020a); Bi-SC 075-007 (SAT/ADDIE)	MoD CIS Classifier (UA-1227)
Required regulatory action	WG modules in PVO Catalogue L-2	Amendment to PVO Model (MoD, 2026)	Regulation on AI/XR in HMEI

Source: developed by the authors based on HQ SACT (2023), GAO (2023), Bekešienė and Vasiliauskas (2026), Saastamoinen and Nuutinen (2025), Davis and Bracken (2025).

Level 1 creates the institutional foundation: training 10–15 facilitators through DEEP or NSO, building scenarios on AFU combat experience, and augmenting PVO course catalogues with WG modules. Without codification in the catalogues, wargaming will remain an initiative of individual instructors – a risk identified by Walters (2021a). Curry's (2020) framing of wargaming as a "flawed but useful tool" captures the pragmatic stance underpinning the proposed framework: institutional adoption need not await methodological perfection. Level 2 integrates CAX simulations requiring IT infrastructure and licences. Level 3 – AI-enabled wargaming – is prospective but technically accessible (Davis, & Bracken, 2025; Bae et al., 2026; Saastamoinen, & Nuutinen, 2025). The simulation and modelling unit established by the staffing norms for HMEI (MoD, 2025a) provides the institutional carrier for Levels 2 and 3.

Recommended initial steps: endorsement of Bi-SC 075-007 by MoD order; training a facilitator cohort through DEEP or NSO; augmentation of PVO course catalogues with specific WG modules. These steps align with the priorities of the updated PVO system model (MoD, 2026).

Limitations. The study focuses on courses at levels L-1B, L-2, L-3, L-4, and PDC delivered through HMEI (MTU HEI) and does not cover training at training centres and unit training centres. The comparison with Bi-SC 075-007 is limited to the D1–D7 categories.

Prospects for further research encompass pilot implementation at two HMEI of different profiles, development of a methodology for converting AFU combat experience into wargaming scenarios, integration with generative AI under wartime information security constraints, and a comparative study of student competencies before and after wargaming implementation.

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ІНТЕГРАЦІЯ WARGAMING У ПРОФЕСІЙНУ ВІЙСЬКОВУ ОСВІТУ: ДІАГНОСТИЧНЕ ДОСЛІДЖЕННЯ

Вступ. Стаття досліджує інтеграцію wargaming у систему професійної військової освіти (ПВО) України як складову цифрової трансформації відповідно до стандартів НАТО. Проблема – відсутність наукового обґрунтування інтеграції wargaming у систему ПВО. Мета – обґрунтувати роль wargaming як складника цифрової трансформації та розробити трирівневу рамку інтеграції.

Методи. Застосовано п'ять методів: контент-аналіз 79 нормативно-правових актів із тристадійною верифікацією, суцільний перегляд каталогів курсів ПВО (понад 13000 рядків), порівняння з еталоном Bi-SC 075-007 (ред. 2025), кейс-стаді-аналіз і порівняльний аналіз моделей Литви, Фінляндії та скандинавських держав. Емпіричну основу доповнює бібліометричний масив – 151 публікація Scopus (Score 7–14, 2019–2026).

Результати. Діагностика виявила доктринальне визнання без операціоналізації: wargaming визнано видом навчального заняття (МОУ, 2024), забезпечено штатним підрозділом імітаційного моделювання (МОУ, 2025), проте жоден каталог курсів не містить wargaming як навчальний продукт. Категорія Д7 (ШІ / XR / Симуляція) зафіксувала охоплення 11 %. Запропоновано трирівневу рамку: настільне wargaming, САХ, wargaming із ШІ підтримкою.

Висновки. Рамка спирається на наявну нормативну базу та бойовий досвід ЗСУ. Першими кроками визначено імплементацію Bi-SC 075-007, підготовку когорти фасилітаторів через НАТО (DEEP, NSO) і доповнення каталогів курсів wargaming-модулями.

Ключові слова: професійна військова освіта, цифрова трансформація, НАТО, Bi-SC 075-007, контент-аналіз, імітаційне моделювання, штучний інтелект, wargaming.

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