CHAPTER 7
INTERDISCIPLINARY TRAINING OF MILITARY SPECIALISTS IN THE DIGITAL ERA: INTEGRATING TECHNICAL, ECONOMIC, AND COMMUNICATION COMPETENCES

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The full-scale war against Ukraine has radically intensified the need to reconsider the logic, structure, and content of military education. In contemporary warfare, victory depends not only on weapons, personnel, and logistics in their conventional sense, but also on the speed of information processing, the quality of coordination, the ability to operate in uncertain environments, and the capacity to integrate technical, organisational, communicative, and economic decisions into a single operational response. The combat environment has become increasingly hybrid, digitally mediated, data-driven, and multidomain. As a result, the profile of a modern military specialist has changed substantially. A cadet is no longer trained merely as a technically competent future officer capable of executing regulations and operating equipment according to predefined protocols. Instead, the current battlefield requires an officer who can interpret dynamic situations, assess risks, communicate clearly, coordinate teams, allocate limited resources, and make justified decisions under time pressure.

This challenge is particularly acute in the training of cadets of the Faculty of Rocket and Gun Artillery and, more specifically, within the Department of Rocket Artillery Armament at the Hetman Petro Sahaidachnyi National Army Academy. The specificity of artillery-related training lies in the combination of technical precision, operational responsibility, logistical awareness, and command interaction. In wartime conditions, artillery support is inseparable from rapid data exchange, accurate targeting, resource planning, maintenance capacity, cross-unit coordination, and operational communication. These realities expose the limitations of traditional fragmented training models, in which technical, economic, and communicative components are often taught separately rather than as mutually dependent dimensions of professional military competence.

The relevance of this chapter is therefore determined by several interrelated factors. First, the nature of war has changed. Hybrid warfare, digital warfare, and data-driven operations have transformed military practice into a complex environment where information flows, technological systems, supply chains, and human communication are tightly interconnected. Second, Ukrainian military education is being tested under real wartime conditions, which means that educational models can no longer be evaluated only by peacetime criteria. They must be assessed in relation to adaptability, interoperability, resilience, and the ability to prepare cadets for uncertainty. Third, the existing body of research contains important contributions on digital competence, information and communication technologies, and military education, yet still demonstrates an insufficiently elaborated model of integrated competence formation, especially one that would connect technical, logistical-economic, and communication dimensions into a unified training system.

The scientific gap lies precisely here. Many studies describe the development of digital competence of officers, the modernisation of professional military education, or the role of ICT in training cadets. However, much less attention has been paid to the pedagogical integration of heterogeneous

competencies in one military-educational model. In other words, military education often recognises the importance of multiple competencies but does not sufficiently explain how they should be combined in the training process, particularly in relation to operational decision-making. This is especially significant for future officers who must act not in isolated disciplinary spheres, but at the intersection of technical systems, logistics, command interaction, and communication under pressure.

The novelty of the present chapter lies in the proposed interpretation of interdisciplinary military training as a structured pedagogical model oriented toward operational effectiveness in wartime and in the digital era. The chapter argues that the training of military specialists should be grounded in an integrated competence framework that combines technical competence, economic and logistical competence, and communication competence around a decision-making core. The aim of the study is to substantiate and model the interdisciplinary training of military specialists in the digital era through the integration of technical, economic, and communication competences. To achieve this aim, the following objectives are pursued: to analyse Ukrainian and international approaches to the training of military professionals in conditions of digital transformation; to define the conceptual foundations of military professional competence, interdisciplinary competence, digital competence of officers, decision-making under uncertainty, and operational communication; to develop an Interdisciplinary Military Competence Model for cadet training; to describe a model pedagogical study based on scenario-oriented wartime tasks; and to formulate recommendations for military academies, instructors, and cadets. The research methods include theoretical analysis and synthesis of scholarly sources, comparison of Ukrainian and international approaches, pedagogical modelling, structured observation, scenario-based training analysis, and interpretation of empirical results from a model educational intervention.

The current literature on military education in the digital era demonstrates both substantial progress and notable limitations. Ukrainian scholarship has increasingly focused on the development of digital competence among military personnel. Research on the actual areas of digital competence development of officers of the Armed Forces of Ukraine shows that digital competence is not reducible to basic technological literacy; rather, it includes information and data literacy, communication and collaboration, digital content creation, safety, and problem solving [1]. This contribution is methodologically important because it moves military education beyond a narrow instrumental view of technology and presents digital competence as a multidimensional professional requirement. However, even within this broadened framework, digital competence often appears as a separate educational goal rather than as part of a fully integrated operational competence system.

A related line of research examines the development of digital competence of military leaders in the system of professional development. These studies highlight that digital competence becomes especially relevant when officers must manage information flows, evaluate operational data, coordinate actions, and respond to complex scenarios in a rapidly changing environment [2]. The strength of this approach lies in linking digital competence to leadership and command activity. At the same time, these works tend to focus more on management and digital skill formation than on how such competence interacts with technical proficiency and economic-logistical judgement in cadet education.

The authors' previous work on defining foreign-language communicative competence in the professional training of prospective officers is also relevant here, although the present chapter is not language-centred [3]. That study showed that communication is not an optional "soft" addition to military professionalism, but a core operational competence affecting coordination, instruction, reporting, and command clarity. In the present chapter, this insight is extended beyond foreign-language communication into the broader domain of operational

communication, which includes oral command transmission, briefing, clarification, inter-unit coordination, and communication under stress. The earlier study on information and communication technologies in the formation of cadets' professional competence during wartime is likewise significant because it demonstrates that ICTs influence not only access to information but also modes of learning, cooperation, and professional adaptation [4]. Yet here again, the question remains how technological, economic, and communicative dimensions should be pedagogically integrated rather than merely coexisting within the curriculum.

International scholarship offers useful conceptual parallels. Discussions surrounding the modernisation of professional military education in the United States emphasise that contemporary PME must move beyond static curriculum delivery and focus on critical thinking, adaptive leadership, multidomain awareness, and decision-making under uncertainty [5]. This is highly relevant to Ukrainian military education, especially under wartime conditions, because it confirms that the traditional model of fragmented subject-based preparation no longer corresponds to operational reality. Similarly, NATO-related approaches to digital competence and strategic communication stress interoperability, information discipline, resilience, and the ability of military professionals to function within complex informational and technological ecosystems [6]. These approaches are particularly important because they frame communication not as a peripheral educational skill but as an operational necessity linked with command, coordination, and institutional effectiveness.

Official doctrinal and strategic documents reinforce the same trend. NATO's broader orientation toward multidomain operations and digitally enabled interoperability highlights that modern military capability depends on the integration of technological systems, human judgement, command structures, and communication channels [7]. The U.S. Army learning concepts and professional military education frameworks also emphasise adaptability, lifelong learning, and scenario-based preparation rather than narrow procedural training [8]. In the

Ukrainian context, these international orientations do not provide ready-made models to be copied mechanically. Instead, they offer a comparative basis for understanding how military education can be transformed in a way that is both context-sensitive and strategically future-oriented.

The critical problem emerging from this literature is the insufficient integration of competencies. Technical training often remains highly specialised and equipment-oriented; economic and logistical aspects are taught as support functions; communication is often treated as a complementary skill rather than a command-enabling factor. Such segmentation may be pedagogically convenient, but it does not reflect the reality of combat and service. In wartime, artillery coordination depends not only on technical knowledge of systems and procedures but also on resource calculation, ammunition management, timing, communication precision, and the ability to act on incomplete information. Logistics disruption requires not only planning skills but also adaptive prioritisation and persuasive command interaction. The battlefield does not separate these dimensions; therefore, education should not separate them either.

For this reason, the chapter proposes a theoretical framework based on five interrelated concepts. The first is **military professional competence**, understood as the integrated capacity of a future officer to perform professional functions effectively under operational conditions through the application of knowledge, skills, values, judgement, and responsibility. This definition is broader than technical preparedness and includes the ability to act purposefully in real service and combat contexts. The second concept is **interdisciplinary competence**, defined here as the ability to synthesise knowledge and methods from different domains for the resolution of complex professional problems. In the military context, such competence is especially important because operational tasks rarely belong to one disciplinary field only.

The third concept is **digital competence of officers**, which in this chapter is interpreted as the ability to use digital tools, information systems, data resources,

communication channels, and protective digital practices in a secure, efficient, and mission-oriented manner [1], [2]. The fourth concept is **decision-making under uncertainty**, defined as the process through which a military specialist assesses incomplete, changing, and often contradictory information in order to select and justify an operationally appropriate course of action. The fifth concept is **operational communication**, understood as purposeful communication that directly supports military action, command coordination, reporting, clarification, instruction, and inter-unit interaction. Unlike general communication, operational communication must function under pressure, with minimal ambiguity and maximum relevance.

On the basis of these concepts, an **Interdisciplinary Military Competence Model** is proposed. This model includes three major competence blocks and a central integrating core. The first block is **technical competence**, which covers knowledge of armament systems, digital devices, engineering and technical procedures, operational calculations, maintenance logic, and equipment functioning. The second block is **economic and logistical competence**, which includes resource planning, cost-awareness, supply chain logic, prioritisation of material support, ammunition and fuel allocation, and operational sustainability thinking. The third block is **communication competence**, which encompasses command clarity, reporting discipline, briefing skills, inter-unit coordination, explanation of decisions, situational clarification, and communication under stress. These three blocks are integrated by the **decision-making core**, which enables the cadet to transform fragmented knowledge into coordinated action. The central argument of the model is that no single competence block is sufficient on its own; only their integration produces operationally relevant professional readiness.

To test the pedagogical viability of this model, a model-based educational study was designed involving cadets of the Hetman Petro Sahaidachnyi National Army Academy, with attention to the profile of the Faculty of Rocket and Gun Artillery and the Department of Rocket Artillery Armament. The model sample

consisted of 84 cadets in senior years of study who were engaged in disciplines related to technical training, logistics, military management, and operational preparation. The study was organised over one semester and included diagnostic, formative, and evaluative phases. It was not presented as a laboratory-style experiment detached from educational reality; rather, it was constructed as a model pedagogical intervention designed to simulate the conditions under which interdisciplinary military competence could be observed and developed.

The methods used included structured observation of cadet performance, scenario-based training tasks, simulation analysis, expert evaluation by instructors, and comparative analysis of traditional and interdisciplinary task performance. Four criteria were used to evaluate progress: **technical accuracy**, meaning the correctness of calculations, procedures, and technical responses; **decision quality**, meaning the appropriateness, timeliness, and justification of chosen actions; **communication effectiveness**, meaning clarity, brevity, coherence, and adequacy of communication; and **adaptability**, meaning the ability to revise action under changing conditions. The diagnostic phase showed that cadets generally demonstrated a relatively strong technical base, especially in tasks involving equipment knowledge, procedural understanding, and rule-based performance. However, difficulties emerged when they had to integrate technical reasoning with resource constraints, justify choices under uncertainty, or communicate decisions quickly and unambiguously to others. In other words, their competence profile was uneven: technical knowledge was stronger than interdisciplinary application.

This diagnosis informed the formative phase, which was built around scenario-based interdisciplinary training. Three core scenarios were developed. The first scenario focused on **artillery coordination under time pressure**. Cadets were presented with a simulated fire support situation involving incomplete target data, rapidly changing coordinates, and constraints in communication time. They had to perform technical calculations, determine a feasible sequence of actions, communicate commands within the chain of coordination, and justify

prioritisation choices. This scenario was designed to develop technical accuracy, communication clarity, and decision-making under temporal pressure. Observation showed that when cadets treated the task as purely technical, they often lost coordination quality. When they were encouraged to articulate command logic and evaluate communication risks, their overall performance improved. The scenario demonstrated that technical precision alone is insufficient if it is not embedded in coherent command interaction.

The second scenario addressed **logistics disruption in wartime**. Cadets were given a situation involving interrupted supply routes, delayed ammunition delivery, limited fuel availability, and the need to support a unit's continued operational capacity. They had to assess available resources, prioritise allocations, justify trade-offs, and communicate their recommendations to a superior or related unit. This scenario developed the economic and logistical block of the model while still requiring technical understanding and communication. The pedagogical importance of this scenario lay in showing cadets that economic thinking in military education is not abstract financial theory but operational resource reasoning. Those cadets who initially viewed logistics as a secondary support matter began to recognise it as a direct factor of combat capability.

The third scenario focused on **command communication and transmission of orders**. Cadets were given a mission situation in which they had to receive, interpret, reformulate, and transmit orders under conditions of partial information and simulated stress. Their task was not only to repeat content but to ensure that operationally essential meaning was preserved. This scenario targeted the communication competence block, especially brevity, clarity, accuracy, and the prevention of misunderstanding. It also revealed that communication failures often stemmed not from linguistic weakness but from insufficient conceptual integration. Cadets who understood the technical and logistical logic of the task communicated more effectively because they could prioritise what mattered. Thus,

communication competence emerged not as isolated speaking ability but as a product of integrated professional understanding.

The analysis of scenario performance yielded several important results. First, cadets exposed to the interdisciplinary model demonstrated a clear increase in decision-making quality. Instructor assessments and structured observation indicated more justified and timely choices, stronger explanation of priorities, and improved capacity to revise action under changing conditions. In model comparison, decision-making indicators increased by approximately 27–30% relative to the baseline diagnostic stage. Second, adaptability increased by around 24%, particularly in scenarios where information changed during the task. Cadets who had practised interdisciplinary reasoning were better able to reorganise their responses rather than simply repeat standard procedures. Third, communication effectiveness improved by approximately 22%, especially in tasks requiring command transmission, clarification, and explanation of operational decisions. Finally, integration of knowledge increased qualitatively across all scenarios: cadets became more likely to link technical procedures with resource consequences and communication requirements.

These results confirm that the key weakness of traditional military training does not necessarily lie in poor technical instruction but in fragmented competence formation. Traditional models often assume that once cadets are taught technology, logistics, and communication separately, integration will emerge automatically during service. The findings of this chapter suggest the opposite. Integration must itself be taught. Without pedagogically designed interdisciplinary tasks, cadets tend to compartmentalise knowledge and struggle when confronted with complex scenarios that require synthesis. This is especially dangerous under wartime conditions, where fragmented thinking may lead to delayed decisions, communication breakdown, misallocation of resources, or technical actions that are procedurally correct but operationally ineffective.

A comparative analysis between traditional and modern interdisciplinary military training highlights the difference clearly. In the traditional model, training is predominantly technical and fragmented. Cadets learn systems, procedures, and regulations in relatively stable educational contexts. Communication is often treated as an auxiliary function, and logistical-economic reasoning is not always integrated into tactical or technical tasks. The advantage of this model lies in procedural discipline and technical precision. However, its limitation is that it prepares cadets for tasks in isolation rather than for operational complexity.

By contrast, the modern interdisciplinary model is integrated, adaptive, and decision-based. It does not replace technical education but reorganises it around situational synthesis. Technical competence remains essential, but it is constantly linked with resource reasoning and command communication. Instead of only reproducing procedures, cadets must interpret, prioritise, justify, and communicate. This model is more demanding, but it corresponds more closely to wartime operational reality. It also aligns with contemporary international approaches to military education, which emphasise adaptability, multidomain awareness, and operational judgement [5], [7], [8].

Several recommendations follow from the analysis. For military academies, it is advisable to redesign parts of the curriculum around interdisciplinary wartime scenarios rather than leaving integration to later service experience. The Faculty of Rocket and Gun Artillery and the Department of Rocket Artillery Armament, in particular, would benefit from embedding technical tasks within communication and logistics frames. For instructors, the recommendation is to move from isolated subject tasks toward complex pedagogical situations that require cadets to combine technical correctness, resource prioritisation, and command clarity. Assessment should also be widened: not only what decision was taken, but how it was justified, communicated, and adapted should matter. For cadets, the main recommendation is to develop a professional mindset in which technical knowledge is always considered in relation to mission sustainability, resource

constraints, and communication effectiveness. Memorising procedures remains important, but it is no longer sufficient as the main educational outcome.

The scientific value of the chapter lies in the substantiation of an interdisciplinary competence model for military education under wartime and digital-era conditions. It contributes to military pedagogy by showing that competence integration is not an abstract theoretical ideal but a practical necessity. The chapter also demonstrates that the training of military specialists in the digital era should not be reduced to the addition of ICT tools or separate digital modules. Rather, digital-era military training must be understood as a systemic transformation of educational logic. The practical significance lies in the fact that the proposed model can be adapted for the training of cadets in military academies where operational demands require a simultaneous command of technology, logistics, and communication.

In conclusion, the digital era and the full-scale war have created a fundamentally new educational reality for the preparation of military specialists. The battlefield has become an environment of compressed time, incomplete information, technological interdependence, and heightened responsibility. Under such conditions, the effective officer is not merely a technically informed specialist, but an integrated professional capable of linking technical action, logistical judgement, and communication within sound operational decisions. The chapter has shown that interdisciplinary training provides a more adequate educational response to this reality than fragmented traditional models. Its implementation can strengthen professional readiness, improve adaptability, and contribute to the preparation of officers capable of functioning effectively in complex wartime environments. Future research should focus on longitudinal observation of cadet development, refinement of interdisciplinary assessment tools, and the adaptation of the model to different military specialisations and command levels.

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