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Literature Review on the Construction of the Kill Chain of the Informationized and Intelligentized Combat System

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Abstract: Currently, modern technologies centered on artificial intelligence are driving the evolution of warfare from informatization to intelligentization at an accelerated pace. The construction of informationized and intelligentized combat system kill chains has become a hot topic in military research in recent years. This paper adopts a multi-perspective approach, integrating various research methods to analyze and summarize existing literature on kill chain studies. It focuses on aspects such as conceptual essence, winning mechanisms, design philosophies, model construction, effectiveness evaluation, scenario applications, and research on foreign militaries. Furthermore, by examining the current status of kill chain research and application among the world's major military powers and considering the demands of military struggle preparations, the paper looks ahead to future research directions.

Keywords: Combat System; Kill Chain; Construction Design; Informationized; Intelligentized.

1. Introduction

The theory of "kill chain" originated in the United States. In the 1990s, Ronald Fogelman, the former chief of staff of the US Air Force, summarized the generation of lethality as the theory of kill chain, that is, the closed loop of detection, location, tracking, aiming, engagement and evaluation (F2T2EA) for target attack [1]. Although the theory of "kill chain" was put forward late, since the war activities, the kill chain has been developing with the evolution of the form of war. The connotation and extension of the concept of kill chain have been constantly enriched in the practice of war. No matter what kind of combat mode, the two sides essentially plan specific actions around the construction of the kill chain, and the toughness, elasticity, flexibility and efficiency of the kill chain become the key issues that commanders must consider and decide the victory or defeat of the war. At present, with the rapid development of artificial intelligence technology and the acceleration of the new military revolution, the form of war is accelerating its evolution to intellectualization, and the unmanned intelligent combat system is enabling the kill chain from the platform, scale, speed, system, decision-making and other dimensions in an all-round way, triggering structural changes in the kill chain [2]. How to build a kill chain based on intelligent unmanned combat system has become a hot topic in the study of the world's major military powers. Therefore, it is necessary to sort out the relevant literature and fully understand the current situation of the relevant theoretical research on the construction of the kill chain for intelligent warfare and play a better leading role of the kill chain theory in promoting the preparation for military struggle is of great reference significance for winning future wars.

2. Research Design

2.1. Literature Collection and Screening

According to the common way of systematic literature review and taking into account the individual characteristics of military articles, this paper collects, screens and summarizes the relevant literature in the past five years from four aspects. Firstly, search for relevant literature in the domestic and foreign database platforms such as CNKI, Wanfang, VIP, Google Scholar, PubMed, etc. Secondly, search for relevant articles from the article sharing column of the Military Network and browse the published books from the online library. Thirdly, with the help of DeepSeek, ChatGPT, ERNIE Bot, iFLYTEK Spark and other large model software tools to search for relevant keywords to understand the research progress. Fourthly, focus on the main views of the authors of Core Journal of China, EI, WJCI, CSSCI, CSCD and other authoritative literature sources. The time span of literature retrieval is from January 1, 2021 to December 31, 2025.A total of 417 qualified literatures were retrieved, and 349 valuable literatures were sorted out after checking and eliminating duplicates.

2.2. Basic Information of the Literature

After thorough analysis, the research results on the construction of the kill chain are mainly presented through academic papers. The most typical articles are published in journals such as "Command Information System and Technology", "Journal of Command and Control", "Military Digest", "Tactical Missile Technology" "Journal of China Academy of Electronic Sciences" etc. The main research institutions include National University of Defense Technology, China Electronics Technology Group Corporation, Academy of Military Sciences, and Chinese Academy of Electronic Sciences, etc. In 2021, the number of research literature increased by double compared to 2020. In 2022, the number of literatures was the same as that in 2021. From 2023 to 2025, the average annual growth rate of literature was approximately 30%. As shown in Table 1, it indicates that although the theory of kill chain was studied relatively late in China, it has made rapid progress and achieved many results. On the one hand, it shows that the

major military powers around the world is accelerating the modernization of military theories, especially under the guidance of the new combat concept, studying the theory of kill chain can effectively guide war practice and grasp the key to winning the war; on the other hand, it also demonstrates that the major military powers in the world are striving to take the initiative in the new round of military transformation. Relevant research institutions are sensitive to the intelligent war form and have continuous interest and potential for research on the theory of kill chain under this form of evolution.

Table 1. Distribution of Publication Dates and Quantity of Main Literature

Time	Number
2021	46
2022	43
2023	62
2024	81
2025	117
Total	**349**

Further analysis of related articles on the kill chain helps clarify associated disciplines and themes, as shown in Table 2. After cluster analysis, the research on the concept of the kill chain (#A1, #A2, #A4) was closely related to the topic words (#B1, #B2); the research on the development and military application of the kill chain technology (#A2, #A3, #A5, #A6, #A7) was closely related to the topic words (#B3, #B4, #B5, #B6, #B7).

Table 2. Related disciplines and main research topics of the kill chain

Related Discipline	Frequency	Number	Hot Topic	Frequency	Number
Weapon Industry and Military Technology	224	A1	Core Meaning	93	B1
Military	89	A2	Winning Mechanism	29	B2
Internet Technology	56	A3	Design Concept	46	B3
Aerospace Science and Engineering	33	A4	Model Construction	80	B4
Automation Technology	26	A5	Effectiveness Evaluation	48	B5
Computer Software and Applications	19	A6	Scenario Application	54	B6
Telecommunication Technology	15	A7	Research on Foreign Militaries	37	B7
Total	462			387	

3. The Current Research Status of the Kill Chain Construction for the Informationized and Intelligentized Combat System

This paper categorizes existing research findings into conceptual interpretation and military applications. Conceptual interpretation primarily includes core meaning and winning mechanisms, while military applications mainly encompass design concepts, model construction, effectiveness evaluation, scenario applications, and research on foreign militaries.

3.1. Explanation of the Concept of the Kill Chain Construction

3.1.1. Core Meaning

Currently, the academic community's references to the concept of the kill chain primarily revolve around the kill chain theory summarized by former U.S. Air Force Chief of Staff Ronald Fogleman and others. Some literature, while describing the kill chain concept in different forms across various combat scenarios, is fundamentally based on the "F2T2EA" theory. Many documents also refer to the kill chain as a kill web, where the kill chain serves as the microscopic component of the kill web, and the kill web represents a macroscopic extension of the kill chain's structure and functionality. Essentially, both are the same concept. For instance, Fei Hao and others conducted a comparative study of the kill chain and kill web, proposing that the kill web exhibits new characteristics such as "iterative upgrades, omnipresent domain coverage, distributed autonomy, faster closure, emphasis on redundancy, and multi-functional application" compared to the kill chain[3]. Building upon the original U.S. military definition of the kill chain, some domestic scholars have summarized and refined the concept in the context of informationized and intelligent conditions, incorporating operational concepts like distributed warfare, mosaic warfare, area denial operations, and cognitive domain operations. A typical example is Lijian Sun and others, who further elaborated on the kill chain from macro and micro levels, as well as theoretical and practical perspectives. They classified kill chains and proposed that the construction of a kill chain should aim to be "as fast as possible" and "as reliable as possible" [1].

3.1.2. Winning Mechanism

The essential requirement of the design of the kill chain is

closure. Many scholars describe the process of the kill chain in the formation of the closed chain of intelligence reconnaissance, command and control, fire strike, evaluation and feedback, which is compared with Boyd's OODA command cycle theory of observation, judgment, decision-making, action and control. The operation process of the two is basically the same. They all follow the winning mechanism of quick victory, system victory and intelligent victory. For example, Jing Ma and others combined with the typical combat mode of algorithmic warfare, believed that the cognitive advantage, efficiency advantage and emergence advantage brought by the algorithm enabled the construction of the kill chain, which promoted the more efficient completion of the kill chain closed-loop [4]. Shuliang Wang and others believe that the "electromagnetic +" new quality killing chain, which is characterized by precision, distribution and cross-domain, should be constructed to grasp the "integration into the system" behind the new quality killing chain of joint operations. The electromagnetic enabling mechanism of "promoting form dispersion and spirit convergence and supporting multi-domain linkage" can promote the better integration of electromagnetic elements into the killing chain to form a confrontation advantage [5].

3.2. Military Applications of the Concept of the Kill Chain Construction

3.2.1. Design Concept

Aiming at the problems of technology incompatibility, slow stress response and difficult efficient coordination in the construction of traditional kill chain, especially for the inefficient attack on time-sensitive targets, domestic scholars generally believe that the construction of future intelligent war kill chain should adopt an open system architecture, according to the mapping relationship of tasks, capabilities and units. And realize that interaction of multi-node systems and the efficient configuration of global resource. Guohong Zhao compared the Internet order service mode with the military order strike mode, cited the case of kill chain construction in the conflict between Russia and Ukraine, proposed the concept of superior strike window and the closed-loop evaluation criteria of kill chain for the construction of time-sensitive target strike combat system, and proposed the kill chain design method based on combat scenarios [6-7]. Yu Zhao and others draw lessons from the commercial mode of dumping orders, dispatching orders and receiving orders. The connotation and mechanism of instant kill chain construction for time-sensitive targets are described, and a software-defined kill chain construction mode is designed[8]. Silai Wan Proposed a process framework for intelligent design of killing nets based on knowledge reasoning, and defined three evaluation indexes of killing chain, including time chain, precision chain and cost chain, to realize rapid intelligent design of killing nets in dynamic battlefield, and verified the effectiveness of the method on the simulation deduction platform [9].

3.2.2. Model Construction

The construction and optimization of the kill chain model is a key aspect of kill chain research. Domestic experts and scholars focus on achieving the goal of rapid early warning, stable tracking, accurate attack, low loss, and fast evaluation when closing the kill chain in military operations. They use methods such as establishing mathematical models, designing optimization algorithms, and conducting experimental simulations to build kill chain models and provide optimization solutions. A typical example is the kill chain optimization design method proposed by Silai Wan, which is based on AGE-MOEA. They conduct numerical simulation experiments and kill chain design experiments in air defense and anti-missile combat scenarios, demonstrating that the kill chain modeling and optimization methods can ensure the closure of all target kill chains while pursuing the optimal performance of strike effectiveness, weapon consumption, and damage threat, and verifying that this method can be used in actual military operations [10]. Zilong Zhang and others analyzed the DARPA's ACK project and proposed corresponding solutions and methods for issues such as kill chain pattern design, information interaction mechanism, value assessment, and scheme optimization modeling [11]. Siyu Lai and others modeled the equipment system using directed heterogeneous weighted networks and proposed a multi-start multi-end depth-first search algorithm based on meta-paths and maximum path restrictions, optimizing the timeliness of finding the earliest closed kill chain to enhance the success rate of military operations [12].

3.2.3. Effectiveness Evaluation

Analyzing and evaluating the advantages and disadvantages of the kill chain and its adaptability in different scenarios, and continuously improving the structure of the kill chain to achieve the best efficiency, play an important role in enhancing the scientificity of command and decision-making and optimizing the allocation of military resources. In view of the weak links in the effectiveness evaluation of the kill chain, many scholars have put forward scientific methods to optimize the effectiveness evaluation of the kill chain from the perspective of evaluation, index system and methods. For example, Zejing Zhao and others constructed the evaluation model of the system's kill chain from the perspective of static hierarchy and dynamic network respectively. Meanwhile, an effectiveness evaluation system is developed to optimize the evaluation process and improve the evaluation efficiency[13]. Minglei Han applied the Agent theory to the modeling of the naval battlefield kill chain, designed the hierarchical structure model of the naval battlefield kill chain evaluation, constructed the evaluation system based on HLA/RTI simulation framework and group decision analytic hierarchy process empowerment, and verified its feasibility [14]. Longfei Jiang and others respectively studied and explored two methods for evaluating the operational effectiveness of the kill chain based on the positive and negative feedback mechanism of the system theory and the complex network analysis based on the operational cloud, which were used to quantitatively evaluate the operational effectiveness of the kill chain based on the order in the future air and space defense operations, and verified its feasibility [15].

3.2.4. Scenario Application

Different types of combat have both commonness and individuality in the construction of kill chain, and many scholars have explored the construction methods of kill chain in combination with specific combat scenarios, which makes the research results more practical and instructive. For example, in view of the unique environment faced by urban operations, Xiang Xiang and others analyzed the capability requirements of manned/unmanned cooperative kill chain system and proposed the construction path, and analyzed its application in the typical urban operations such as seizing control, search and suppression, and defense operations[16].Xiangyu Liu and others designed a kill chain construction mechanism based on the strategy of snatching

and dispatching orders for regional joint air defense combat scenarios, proposed a kill chain design method of “zone-layer-by-layer division of labor”, and verified the effectiveness of the method through simulation scenarios[17]. Aiming at the anti-UAV bee combat scenario, Yong Bao and others put forward the dynamic construction strategy of anti-UAV bee colony killing chain based on the theory of dynamic killing chain construction. Improving the adaptability of defense systems to UAV swarms[18]. Aiming at the open sea combat scenario, Baohui Gao and others proposed a method to construct the kill chain based on space-based reconnaissance information to guide the sea attack, established the kill chain model, designed the kill chain construction algorithm, and verified the rationality of the method [19].

3.2.5. Research on Foreign Militaries

Domestic scholars have paid great attention in their research to drawing on the progress of foreign military forces, especially the US military, in the field of kill chain studies. At the same time, they have been tracking the new characteristics of kill chain construction demonstrated in recent world military exercises and conflicts, bringing inspirations for the construction of our military's kill chain and the development of equipment. For instance, Longyue Li and others systematically expounded the concept, development status and trends of the US military’s kill network [20]; Zhong'an Bi, based on the process of the “Peak Predator” joint exercise participated by Norway, the UK and the US in December 2024, interpreted the construction and organization of dynamic kill chain [21]; Xinghua Li and others analyzed the application and characteristics of unmanned intelligent equipment in the Ukraine-Russia conflict from the perspective of kill chain, and proposed inspirations and suggestions for the development of unmanned intelligent equipment, focusing on accelerating the development of artificial intelligence technology to enable the kill chain, shortening the kill chain closure time, and paying attention to the uncertainty of the kill chain to promote the multilateral governance process [22]. Tianqi Wu and others introduced the military application and development characteristics of the US military's kill chain under the empowerment of artificial intelligence, and proposed ideas for accelerating the development of artificial intelligence technology to empower the kill chain, shortening the kill chain closure time, and paying attention to the uncertainty of the kill chain to promote the multilateral governance process [23].

4. The Problems Existing in the Current Research

From the current research situation of the literature, although scholars in the industry have shown greater interest in the theory of kill chain in recent years, the research on the construction of kill chain in the combat system based on the background of informatization and intelligence has become increasingly extensive, with more methods and deeper content. However, military practice is essentially a dynamic process, and there are also some deficiencies in the existing literature research. First, the research theme is not yet distinct. Some literature, although its research basis is oriented towards intelligent warfare, the research content and methods still remain at the thinking mode of information warfare or even mechanized warfare. The components related to "intelligence" in the text are few, and the kill chains of different war forms have essential differences. The existing research does not deeply grasp the characteristics of intelligent warfare, resulting in the research results and conclusions of kill chain construction being difficult to play a significant guiding role in intelligent warfare. Second, the research focus is not yet focused enough. Many literature elaborates on the relevant concepts of kill chain in a large amount of space, and the content of different literature is also repetitive. The research on the construction of kill chain in the armies of major military powers in the world focuses more on the US military, while there is less research on the construction of kill chain for the armed forces of Taiwan independence, the Russian army, the Japanese Self-Defense Forces, and the Indian army. The research on the new characteristics of kill chains shown in recent military conflicts such as the Russia-Ukraine conflict, the Palestine-Israel conflict, and the US-Israel-Iraq war is insufficient. The observation of military transformation from the perspective of the kill chain theory is also lacking. Third, the research purpose is not yet prominent. The construction of kill chain requires the support of technology and equipment, but the research literature on the related technologies of kill chain in the existing literature is relatively scarce, and the research conclusions do not provide clear guidance for the development of military technology and equipment. From the perspective of the research subjects, most of them are academic personnel from research institutions, and the participation of frontline troops is relatively limited, resulting in the research content of some literature not closely combined with the actual tasks of the troops, and the problem orientation is not clear enough, making it difficult to effectively respond to the concerns of the troops.

5. Subsequent Research Suggests

Intelligent warfare, as a new form of warfare, will continue to evolve with technological advancements. The research on the kill chain construction theory based on intelligent unmanned combat systems should adhere to the principle of maintaining tradition while innovating. It should continuously incorporate the essence of previous research and add new characteristics. The leading role of advanced theories in driving military transformation should be exerted, achieving a transformation from following to leading in the research of the kill chain theory, and striving to take the initiative in the new wave of military transformation worldwide. The following aspects can be focused on for further research. First, pay more attention to the research on soft kill chain theory. Artificial intelligence technology not only drives the transformation of the traditional hard kill chain but also gives rise to the new combat style of cognitive domain operations. This combat domain mainly involves human psychology, thoughts, will, and emotions. The theoretical research should break the mindset of hard kill chain construction thinking based on equipment and focus on strengthening the research on the construction and design of soft kill chains to target the goal of influencing the opponent's cognitive ability. Second, pay more attention to the research on the kill chain end in the edge control system. The combat opponent will regard influencing the end part of the weapon equipment's strike as an important aspect and window for counteracting our kill chain. We should focus on achieving both offense and defense to strengthen the theoretical research on the kill chain end based on the edge control system, ensuring the stability of the kill chain loop from beginning to

end. Third, pay more attention to the research on the construction of kill chains in typical scenarios. Intelligent warfare covers all-weather, all-time, and all-space domains, breaking through any limitations of time, space, and region. The combat scenarios will be more diverse, such as swarm operations, cross-media unmanned operations, and virtual operations of intelligent entities. The construction of kill chains in these combat types has more particularity and uncertainty. We should focus on conducting targeted research based on specific combat scenarios. Fourth, pay more attention to the research on related technologies for kill chain construction. The efficient closure of the kill chain is supported by advanced technological systems. The pace of technological update and replacement has accelerated, which has also shortened the lifespan of theories. We should keep pace with the times and look forward to conducting research on advanced technological systems and algorithms in the reconnaissance perception, command control, and strike evaluation links of kill chain construction, as well as strengthening research on technical confidentiality and security protection related to the operation process of the kill chain. This will make the research results more viable.

6. Conclusion

As warfare rapidly evolves from informatization to intelligentization at an accelerated pace, modern conflict is increasingly shifting from “size over strength” to “speed over scale”. Consequently, research on kill chain construction has become a prominent topic in the military domain in recent years. The primary stakeholders include defense contractors and operational forces, with studies predominantly combining qualitative and quantitative approaches. Research focuses mainly on the operational processes and mechanisms of kill chains under informationized and intelligentized conditions, aiming to shorten the time required for kill chain closure. Measures are proposed across various dimensions—including updating design concepts, innovating model construction, improving effectiveness evaluation, and enriching scenario applications—to enhance command effectiveness and combat efficiency.

In recent years, advanced technologies centered on artificial intelligence have developed rapidly and been widely applied in military domains, significantly impacting existing combat systems. However, current research remains insufficiently responsive to emerging war dynamics and new forms of warfare. Studies on kill chains within intelligent warfare systems lack depth, exhibit unclear technical characteristics, rely on overly idealized assumptions regarding background and conditions, inadequately reflect the complexity of real-world conflicts, and focus narrowly on limited subjects. Future research on kill chain construction should concentrate on the winning mechanisms of intelligent warfare, integrate with evolving combat doctrines under intelligent conditions, and align closely with military training and readiness missions. It should continuously expand typical combat scenarios, broaden research subjects, and leverage advanced simulation tools such as large-scale models to validate kill chain operations under complex environments. This will provide practical references for military training and preparation, thereby accelerating the development of new-generation combat capabilities.

References

[1] Sun, L. J., Zhou, D. Y., Zhu, X. Q., et al. (2023). Analysis of the kill chain concept. *Journal of Information Engineering University*, *24*(5), 614-618.

[2] Zhou, X. L. (2025, May 27). From platform, scale, speed, system to decision-making - Enabling the kill chain of unmanned intelligent combat system in all aspects. *PLA Daily*, p. 07.

[3] Hao, F., Fan, C. M., & Lu, C. Y. (2021, September 13). Joint destruction: From kill chain to kill network. *PLA Daily*, p. 07.

[4] Ma, J., Liu, P., Wu, J. X., et al. (2024). Analysis of the winning mechanism of algorithm warfare from the perspective of kill chain. *Ship Electronic Engineering*, *44*(8), 1-4.

[5] Wang, S. L., Li, J. P., & Chen, L. (2024, November 19). Perspective on the mechanism of new quality kill chain enabled by electromagnetic empowerment. *PLA Daily*, p. 07.

[6] Zhao, G. H. (2022). Re-examining the application of kill chain in the Russo-Ukrainian conflict and the perspective of combat management system. *Tactical Missile Technology*, *43*(4), 1-16.

[7] Zhao, G. H. (2022). Time-sensitive target kill network design based on combat scenarios. *Journal of Command and Control*, *8*(4), 414-421.

[8] Zhao, Y., Zhou, Z. Y., & Pei, Y. Y. (2024). Key issues in constructing an instant kill chain. *Command Information System and Technology*, *15*(3), 28-34.

[9] Wan, S. L., Wang, G. X., Ming, Z. J., et al. (2024). Intelligent design method of kill network based on knowledge reasoning. *Journal of Ordnance Science*, *45*(4), 1025-1037.

[10] Wan, S. L., Wang, G. X., Ming, Z. J., et al. (2024). Modeling and optimization method of kill chain based on AGE-MOEA. *Journal of Ordnance Science*, *45*(8), 2617-2628.

[11] Zhang, Z. L., Huang, H. Y., & Fan, X. L. (2023). Construction method of adaptive cross-domain kill network based on extensible mode. *Command Information System and Technology*, *14*(6), 48-53.

[12] Lai, S. Y., & Fu, Y. D. (2024). Modeling of kill chain based on directed heterogeneous weighted network. In *Proceedings of the 6th Conference on System Engineering* (p. 50).

[13] Zhao, Z. J. (2025). *Construction and application of kill chain system effectiveness evaluation model* (Master's thesis). Qufu Normal University, Shandong.

[14] Han, M. L., Ma, J., & Zhou, Z. Y. (2022). Research on the evaluation system of kill chain in the sea battlefield based on agent modeling. *Computer Simulation*, *39*(3), 11-16.

[15] Jiang, L. F., & Zhao, J. B. (2025). Combat effectiveness evaluation of air-space defense kill chain based on orders. *Modern Defense Technology*. https://link.cnki.net/urlid/11.3019.TJ.20250722.1358.003

[16] Xiang, X., Wu, K. G., Ren, T. F., et al. (2024). Analysis of the construction problem of kill chain for human-machine coordinated combat in urban operations. In *Proceedings of the 13th China Command and Control Conference* (pp. 127-132).

[17] Liu, X. Y., Wang, G., Guo, X. K., et al. (2025). Design method of kill chain for regional air defense scenarios. *System Engineering and Electronic Technology*, *47*(5), 1582-1599.

[18] Bao, Y., & Cheng, S. (2024). Research on dynamic construction strategy of anti-UAV swarm kill chain. *Modern Defense Technology*. https://link.cnki.net/urlid/11.3019.TJ.20241008.0939.004

[19] Gao, B. H., Hu, H., Zhong, Z. T., et al. (2024). Construction method of sea strike kill chain guided by space-based guidance. *Journal of Command and Control*, *10*(2), 184-196.

[20] Li, L. Y., Jia, Z. H., Pi, L., et al. (2024). The concept, development status and trends of the kill network of the US military. *Aviation Weaponry*, *31*(5), 11-18.

[21] Bi, Z. A. (2025). Joint display of the US "dynamic kill chain" - Interpretation of the joint exercise "Peak Predator". *Tank Armament Vehicles - New Military*, *(2)*, 20-25.

[22] Li, X. H., Yu, Y. S., Meng, Z., et al. (2024). Application of unmanned intelligent equipment in the Russo-Ukrainian conflict from the perspective of kill chain. *Command Control and Simulation*, *46*(5), 6-12.

[23] Lu, T. Q., & Geng, X. (2024). Research on the development characteristics of the kill chain enabled by US artificial intelligence technology. *Military Abstracts*, *46*(7), 59-61