Military Cyber Affairs

Volume 6
Issue 1 *HammerCon 2023 Issue*

Article 1

May 2023

Enhancing the Battleverse: The People's Liberation Army's Digital Twin Strategy

Joshua Baughman

Recommended Citation

Joshua Baughman (2023) "Enhancing the Battleverse: The People's Liberation Army's Digital Twin Strategy," *Military Cyber Affairs*: Vol. 6 : Iss. 1 , Article 1.
https://doi.org/10.5038/2378-0789.6.1.1091
Available at: https://digitalcommons.usf.edu/mca/vol6/iss1/1

Enhancing the Battleverse: The People's Liberation Army's Digital Twin Strategy

Joshua Baughman

Introduction

After 2021 was dubbed "year one of the metaverse" in China, the Chinese Communist Party (CCP) continued to pursue rapid advancement in metaverse related technologies as part of Xi Jinping's comprehensive digital grand strategy known as "Digital China." Of the various technologies that make up the metaverse, digital twin has emerged as a top priority in China. Digital twin, as defined by IBM is, "a virtual model designed to accurately reflect a physical object." [1] While the concept of digital twin can be traced back to NASA in the 1960s when they created a "living model" of the Apollo mission, Artificial Intelligence (AI) and other technologies have massively enhanced the potential for new and more sophisticated applications.[i] Top Chinese universities such as Beijing University, Tsinghua University and Beihang University, as well as other major academic institutions, have conducted significant research on the topic in recent years. In industry, top tech companies including Tencent and Alibaba as well as one of the leading metaverse focused companies, 51World, have all recently released their own digital twin platforms.

The People's Liberation Army (PLA) also sees major value in digital twin technology as they continue to enhance their capabilities in the "battleverse."[ii] In recent PLA media and Chinese tech coverage there have emerged six main applications of digital twin technology that they believe will provide advantage on the battlefield. Applications include: education, decision making, training, research and development, maintenance and finally, logistics. The overarching goal is to build a better educated, trained and efficient military that adapts and improves rapidly. In an interview in 2021, Major General Wang Mingxiao, a Deputy to the National People's Congress and a Senior Engineer of the Army Research Institute, stated digital twin technology will, "help realize the strategic transformation of battlefield situational awareness and planning capabilities."[2] The goal is to create a force multiplier that will allow the PLA to better prepare and win future conflicts with an information advantage that creates decision dominance.[iii] Digital twin

[i] To learn more about the origin of the digital twin concept read "Digital Twins and Living Models at NASA" https://ntrs.nasa.gov/citations/20210023699.

[ii] The "battleverse" refers to China's aim to build a separate metaverse specifically built for the PLA. To learn more about the "battleverse" read "Enter the Battleverse: China's Metaverse War" https://digitalcommons.usf.edu/mca/vol5/iss1/2/.

[iii] Decision dominance is "a desired state in which a commander can sense, understand, decide, act and, assess faster more efficiently than an adversary". Information advantage is "a condition where a force holds the initiative in terms of relevant actor behavior, situational understanding, and decision making through the use of all military capabilities". To learn more on these concepts read Ian Sullivan's work "Thoughts on Information Advantage": https://community.apan.org/wg/tradoc-g2/mad-scientist/m/articles-of-interest/395306. and

technology has the potential to rapidly enhance and give the PLA a clear image on the outcome of a possible Taiwan invasion, or any other military actions. If the CCP chooses to invade, digital twins could help them prepare the best possible strategy, shore up weaknesses and rapidly adapt once the conflict begins.

Defining Digital Twin

In a recent PLA media article "Digital Twin Technology: "Outsmarting" the Future Battlefield," they define digital twin as:

> The so-called digital twin is to make full use of data such as physical models, sensor updates, and operation history, integrate multi-disciplinary, multi-physical quantities, multi-scale, and multi-probability simulation processes, and complete the mapping in the virtual space, thereby reflecting the full range of the corresponding physical equipment life cycle process.[3]

Major General Wang Mingxiao uses a mirror as a metaphor to describe digital twin technology stating, "Digital twin, literally, is to build a highly mirrored digital world for the real physical world. How well a system or a machine is operating can be clearly perceived through the digital world, just like looking in a mirror."[4] In essence, a digital twin is a digital clone of a device or system using real-time data to enable understanding, learning and judgment. The CCP views digital twin as one of various technologies that make up the metaverse that constitute a collection of virtual time and space.

"Digital China" and Digital Twin

The importance of digital twin technology can be traced all the way to the top of the Chinese Communist Party as part of Xi Jinping's comprehensive digital grand strategy known as "Build Digital China" [建设数字中国] or most often just called "Digital China" [数字中国]. Xi views "Digital China" as not simply a commercial or industrial strategy, but an all-of-nation effort to digitally transform China. In the recently released document from the Central Committee of the Communist Party of China and the State Council titled, "Overall Layout Plan for the Construction of Digital China," they write:

> By 2035, the level of digital development will enter the forefront of the world, and major achievements will be made in the construction of digital China. The systematic layout of the digital China construction is more scientific and complete, and the digital development in the fields of economy, politics, culture, society, and ecological civilization construction is more coordinated and

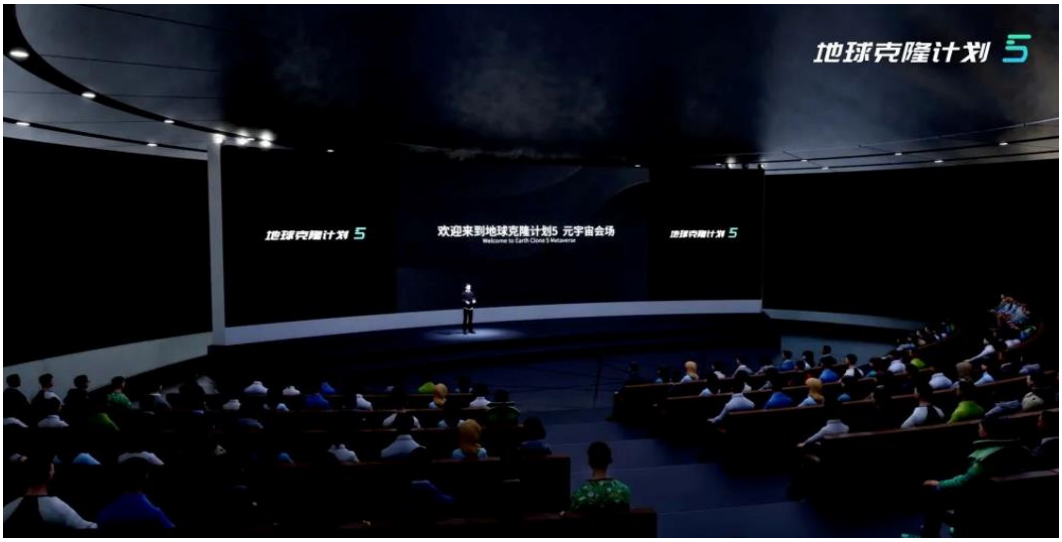
"INFO1: The Information Operations & Capabilities SMARTbook (Guide to Information Operations & the IRCs)" by The Lightning Press: https://www.thelightningpress.com/information-advantage-and-decision-dominance/.

> sufficient, which strongly supports the comprehensive construction of a modern socialist country.[5]

Technological advancement and innovation are tied directly to China's "great rejuvenation" and of paramount importance with policies that resonate throughout China's industry and military sectors.

In the CCP's latest, "Fourteenth Five-Year Plan for National Informatization," digital twin technology is specifically mentioned as part of a strategy to "deploy strategic advanced technologies" with the ambition to "strengthen strategic research deployments and scalable technological innovation."[6] A major goal set for industry is to "explore the construction of digital twin cities."[7] The National Development and Reform Committee (NDRC), the Ministry of Science and Technology (MST), the Ministry of Industry and Information Technology (MIIT), the Ministry of Natural Resources (MNR) and the Ministry of Housing, Urban-Rural Development (MHUR) are all advocating for policies to support digital twin cities such as the City Information Model (CIM) and Building Information Model (BIM).[8]

With the strategic emphasis on digital twin technology there have been significant developments both in academia and the commercial sector in China. China's top universities such as Beijing University, Tsinghua University, and Beihang University, and academic institutions such as the Institute of Automation of the Chinese Academy of Sciences (IACAS), and most recently the Internet Society of China, have focused research efforts on digital twin cities and related industrial applications.[9] In industry, companies such as 51World, Alibaba and Tencent are making major strides to accelerate digital twin development unveiling new platforms in recent months. 51World, in its broader push to tap into the metaverse industry, has built a new platform, 51World Developer Platform (51WDP), to make it easier and more efficient to develop digital twin applications.[10] 51WDP is fully open for any individual or company to utilize. Li Yi, founder and CEO of 51World, said, "We aim to create a complete virtual world by 2030, and we will provide digital twin services for 1 million enterprises and users."[11]



51World holds a conference in metaverse

Alibaba has released their own digital twin platform dubbed, "Ultra Integrated Digital Twin Platform" [超融合数字孪生平台正式发布]. Zhang Lei, Vice President of Alibaba Cloud Intelligence stated, "Compared with traditional digital twin technology, the platform can integrate and calculate data from four domains including perception, simulation, control, and visualization, making the algorithm faster and more powerful, and ensuring the speed and accuracy of analysis, deduction and decision-making."[12] Currently, the new platform is being used for highways, urban traffic, docks and airports. One example is the Chengyi Expressway,[iv] in partnership with the Future Transportation Engineering Institute. Dr. Chen Ken, Director of the Future Transportation Engineering Institute, stated, "The Chengyi Expressway has a total length of about 157 kilometers and is the first smart expressway with all elements and full coverage utilizing digital twin technology."[13]

Digital Twin of Chengyi Expressway

[iv] Chengyi Expressway is an important section of the Chengdu-Chongqing Ring Expressway in the national expressway network

Finally, Tencent has released their own digital twin platform designed to, "help industry develop twin applications with low threshold and low cost, achieve a leap in efficiency, and make digital twin applications lighter and faster."[14] Tencent is gradually building their platform to work on solutions for transportation, construction, parks, cities, industry, energy, and automobiles.[15]

Military Application

While there are many commercial applications that can utilize digital twin technology, the PLA (per media reports) see six major areas for military application.

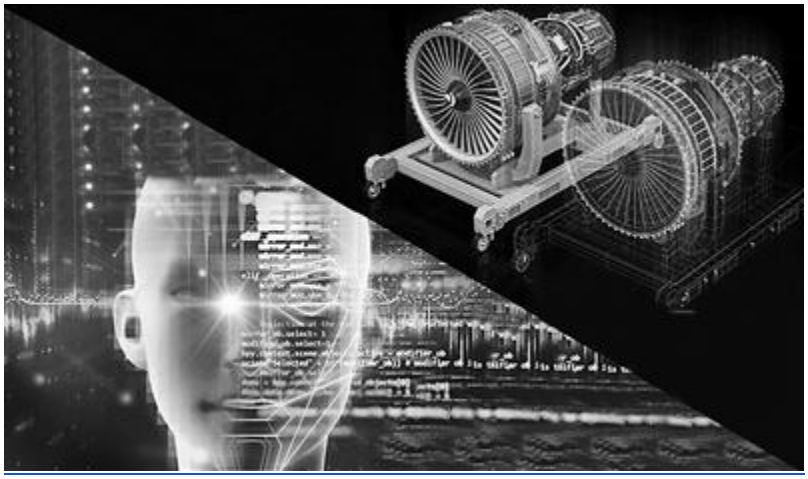
Table 1: Overview of the Military Application of Digital Twin Technology

Military Application	Description
Education	Enhance visualization and overall learning experience
Decision Making	With comprehensive and real-time situational awareness of the battlefield commanders can effectively pursue the best course of action
Training	Better simulate actual combat
Research & Development	Enhance the speed and cost effectiveness of developing new military weapon systems
Maintenance	Full life cycle management will allow for effective anticipation of repair needs
Logistics	Create an on-demand and faster supply chain that is less centralized and more flexible

1. Education

Education is cited as a leading reason for military application of digital twin. The authors Zhang Zhen and Shang Dunmin, of "Digital Twin Technology: "Outsmarting" the Future Battlefield," give the example of a new machine or component. The easiest way to understand new machinery is to take it apart from its individual components. However, as the authors point out, this can be difficult and extremely time consuming. They use the example of a Russian AL-31 aero engine; simply seeing a two dimensional diagram is insufficient to understand how

the engine works and using a real-life model is not practical. Zhang and Shang write, "The emergence of digital twin technology provides a new idea for the teaching of aero-engine majors, and effectively solves the problem that it is difficult to show the structure and principles of complex systems on two-dimensional plane drawings."[16] Digital twin technology allows for the visualization of components with complex structures that are not easy to disassemble. Moreover, digital twin can "more intuitively display the equipment structure, machine status, and mechanical principles, making the teaching content richer and easier to accept."[17] Thus, in the education field digital twin can both effectively increase the learning experience of students while decreasing the cost (both time and money) of trying to use an actual machine for every lesson.



Conceptual drawing of a digital twin engine

2. Decision Making

Zhang and Shang view the application of digital twin as a supplement to decision making on the battlefield. The authors write, "Through the digital twin technology, the actual combat situation can be mapped to the virtual battlefield, and the battlefield data can be presented in real time."[18] Digital twin technology creates copies of war entities such as combat platforms, weapon systems, and battlefield environments in virtual space, and integrates all copy models to show the commander the most comprehensive and real-time real situation on the battlefield, so that the commander can form the most accurate view of the battlefield situation. In the era of intelligent warfare with complex enemy situations and battlefield environments, knowing the current battlefield situation is critical to making the best command decisions. In an article in *Military Digest* magazine the authors write, "With the assistance of battlefield learning algorithms, they can simulate the combat effects that different combat schemes can achieve, helping commanders choose the best in the shortest possible time."[19] Digital twin allows for an accurate and real time assessment of the battlefield and gives commanders the ability to make the best possible decisions to lead to victory.

3. Training

Authors Zhang and Shang discuss the benefit of immersive training that digital technology provides to soldiers. The authors write:

> Digital twin integrates real-scene 3D modeling technology, big data technology, etc. to build a digital twin platform for military training scenes, which can realize the organic combination of people, equipment, and environment virtual and reality, and form a dynamic virtual presentation of the battlefield environment.[20]

The authors imagine sophisticated twin technology of the future that can accurately simulate in real time all five senses allowing soldiers to "feel the flames of war."[21] They see other examples currently happening as other countries apply digital twin technology to training. They emphasize the American company Slingshot Aerospace which has been awarded a contract from the U.S. Space Force to build a "Digital Space Twin." From their website they write, "The product combines real-time mapping of objects in orbit and space weather data with physics-based simulations to show users how planned missions will behave in the real space environment."[22] Zhang and Shang view a similar capability for the PLA as a cost-effective way to train Chinese forces.

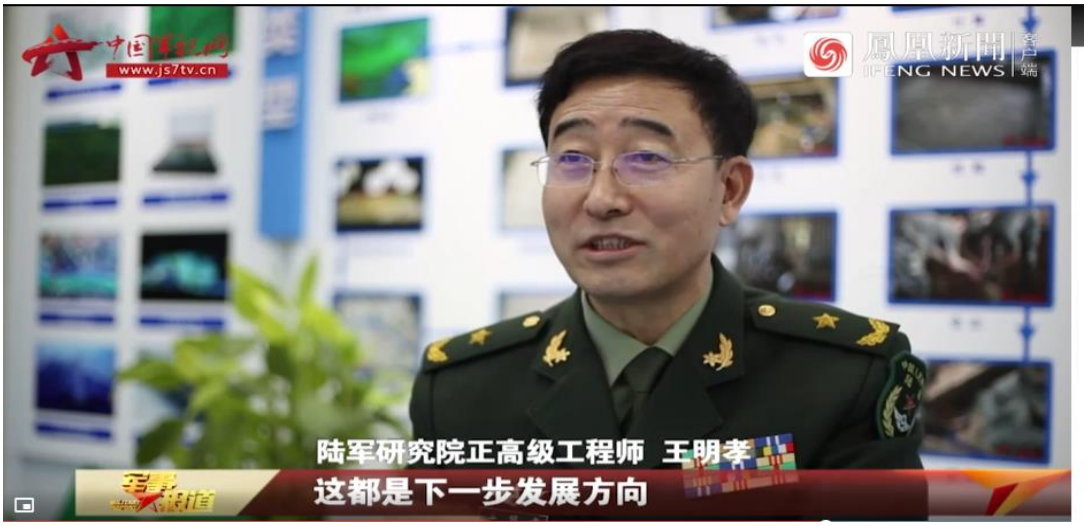
4. Research & Development

Zhang and Shang argue that digital twin created a new paradigm for R&D. Previous physical models required many steps, were very slow and costly. Digital twin allows for a new process of ""digital model-test-modification-finalization."[23] The authors look to examples from three countries for R&D using digital twin. First, in France they mention Dassault Aviation Company which used digital twin technology to create an advanced intelligent equipment testing system, reducing the research and development cost of a new fighter jet by 25%. Second, United Kingdom's BAE Systems' Tempest sixth generation fighter jet being designed for the Royal Air Force is using a combination of computer-simulated digital twins and 3D-printed models, the goal is to simplify and speed up the development of the combat aircraft, which is scheduled to enter active service by 2035. Third, the United States' Lockheed Martin utilizes their "Aeronautics Common Analysis Toolset Data Manager (CATDM)" as a tool to generate an aircraft's "Structural Digital Twin." With the use of digital twin, the PLA hope to more quickly develop their next generation of weapon systems.

5. Maintenance

Maintenance becomes far more efficient with the use of digital twin technology. Major General Wang Mingxiao is a high-ranking official and major proponent of accelerating military application of digital twin technology. In particular, his research has focused on the benefit of digital twin technology on maintenance of military equipment. In an interview with *PLA Daily* he stated, "For equipment, this means that the transparency of equipment maintenance will be greatly increased,

and full life cycle management will become possible."[24] The goal is to accurately predict when and how certain hardware components will break down. Sensors that are constantly monitoring every component of equipment log when any issues occur. This creates a record of data used in digital twins to accurately predict when equipment will need repairs and even help predict potential maintenance issues if the product is changed or upgraded.



Major General Wang Mingxiao on the benefits of digital twin

6. Logistics

Logistics, while not mentioned in PLA media, is featured in China tech giant Sina Corporation's magazine *Military Digest* article titled, "Application of Digital Twin Technology in Intelligent Warfare." There, the authors write:

> Digital twin technology can be applied to supply chains, transportation networks, and logistics operations, which enables logistics support departments to predict and instantly perceive battlefield logistics needs, and solve problems such as battlefield equipment failures and logistics with high quality and efficiency, so that logistics support can meet the requirements of intelligent warfare.[25]

The idea is that "intelligent war logistics" will require "on-demand and fast supply" as allocation is less centralized and more flexible. Instead of going through a bogged down system of supply chain management, the digital twin will allow for rapid adaptation to both predict and deploy material required. Moving people and supplies, as has been seen in the recent failures of the Russian military in the Ukraine conflict, are critical to achieving victory in battle.

Conclusion

While the potential advantages of the digital twin for the PLA are clear it must be understood that much of the capabilities being described in Chinese media are more in early developmental stages than current capabilities. The PLA, like other developed militaries, are able to build twin models such as a jet engine used to educate and help improve capabilities. However, the idea of a "combat situation can be mapped to the virtual battlefield" or "predict and instantly perceive battlefield logistics needs" among many other military applications are not yet a reality. Moreover, much of the PLA's understanding and desires for their digital twin capabilities come from the United States (such as companies like Slingshot Aerospace) as well as our allies. The PLA's assessment that digital twin technology can help provide an information advantage that creates decision dominance is accurate. As the PLA continues to improve their digital twin capabilities they will come closer in their aim to better prepare the best possible strategy, shore up weaknesses and rapidly adapt once the conflict begins whether it be in Taiwan or somewhere else. However, the United States has a major advantage, our partners and allies. Like the metaverse as a whole, major digital twin advancement will not come from just one country, but will be part of a larger global effort. Shaping international norms and restricting China's access to American digital twin technologies can help to prevent its use by the PLA for war, while maintaining the U.S. advantage and perhaps deterring China from military conflict.

Opinions, conclusions, and recommendations expressed or implied within are solely those of the author and do not necessarily represent the views of the Air University, the Department of the Air Force, the Department of Defense, or any other U.S. government agency. Cleared for public release: distribution unlimited.

About the Author

Joshua D. Baughman ("Josh") currently serves as an Analyst at Air University's China Aerospace Studies Institute (CASI). His research centers on China's People's Liberation Army (PLA) activity in the cyber and information domain, as well as work on the PLA Rocket Force. He guest-lectures at the National Defense University and Institute of World Politics, in both masters- and doctoral-level courses, on topics such as China's cyber strategy and misinformation efforts. He presents and publishes regularly, and has received international recognition for his work on the metaverse. Josh previously worked at National Defense University (NDU) College of Information and Cyberspace (CIC), U.S. Air Force Academy and Tsinghua University in Beijing. Collectively, he spent three years living in Beijing working as an editor and journalist on China security issues, as well as a television host, director, writer and producer. In his spare time, Josh volunteers for the Military Cyber Professionals Association, a 501(c) (3) educational nonprofit charity, as part of national leadership as the Chief Marketing Officer. Josh is professionally proficient in Mandarin.

References

[1] "What Is a Digital Twin? | IBM." Accessed January 27, 2023. https://www.ibm.com/topics/what-is-a-digital-twin.
[2] National People's Congress Wang Mingxiao: Speed up the military application of digital twin technology. PLA Daily. Accessed March 8 2023. http://www.81.cn/zt/2021nzt/2021qglh/lhjs/9993836.html.
[3] Zhang Zhen; Shang Dunmin. "Digital Twin Technology: 'Outsmarting' the Future Battlefield." PLA Daily. Accessed January 11, 2023. http://www.81.cn/jfjbmap/content/2022-07/29/content_320893.htm.
[4] National People's Congress Wang Mingxiao: Speed up the military application of digital twin technology. PLA Daily. Accessed March 8 2023. http://www.81.cn/zt/2021nzt/2021qglh/lhjs/9993836.html.
[5] "The Central Committee of the Communist Party of China and the State Council issued the "Overall Layout Plan for the Construction of Digital China". People's Daily. Accessed March 8, 2023. http://paper.people.com.cn/rmrb/html/2023-02/28/nw.D110000renmrb_20230228_3-01.htm.
[6] "14th Five-Year Plan for National Informatization." *DigiChina*. Translated by Stanford Cyber Policy Institute Freeman Spagli Institute. Jan. 24, 2022. https://ssrn.com/abstract=4190967
[7] Ibid.
[8] Ibid.
[9] Ibid.
[10] Ma, Si. "51World to Accelerate Development of Digital Twin". *China Daily*. Accessed January 11, 2023. http://www.chinadaily.com.cn/a/202208/23/WS6304903ba310fd2b29e73d12.html
[11] Ibid.
[12] "Ultra Integrated Digital Twin Platform Officially Released. *Aliyun*. Accessed January 15, 2023. https://developer.aliyun.com/article/988967.
[13] Ibid.
[14] "Tencent Releases Digital Twin Cloud, Four Core Technologies Accelerate the Twinning of All Things." *Tencent Cloud*. Accessed March 20, 2023. https://cloud.tencent.com/developer/news/962100
[15] Ibid.
[16] Zhang Zhen; Shang Dunmin. "Digital Twin Technology: 'Outsmarting' the Future Battlefield." PLA Daily. Accessed January 11, 2023.
[17] Ibid.
[18] Ibid.
[19] Pang Xuefan; Wang Zhenyu. "Application of Digital Twin Technology in Intelligent Warfare." Military Digest. Accessed January 23, 2023. https://www.secrss.com/article/46111.
[20] Zhang Zhen; Shang Dunmin. "Digital Twin Technology: 'Outsmarting' the Future Battlefield." PLA Daily. Accessed January 11, 2023.
[21] Ibid.
[22] Slingshot Aerospace. "Slingshot Aerospace Announces Industry's First Digital Space Twin; U.S. Space Force Space System Command's SpaceWERX Awards

$25 Million Contract to Slingshot Aerospace." Accessed January 26, 2023. https://slingshotaerospace.com/newsroom/slingshot-aerospace-stratfi.
[23] Zhang Zhen; Shang Dunmin. "Digital Twin Technology: 'Outsmarting' the Future Battlefield." PLA Daily. Accessed January 11, 2023.
[24] National People's Congress Wang Mingxiao: Speed Up the Military Application of Digital Twin Technology. PLA Daily. Accessed March 8 2023. http://www.81.cn/zt/2021nzt/2021qglh/lhjs/9993836.html.
[25] Pang Xuefan; Wang Zhenyu. "Application of Digital Twin Technology in Intelligent Warfare." Military Digest. Accessed January 23, 2023. https://www.secrss.com/article/46111.