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Final Research Paper

How OSINT can aid the collection of the Chinese Quantum Industry's Plans and Capabilities

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I verify that this submission is my own original work.
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Introduction

Open-source intelligence (OSINT) is a crucial tool for intelligence professionals across the globe, providing insights from publicly and commercially available data that can offer detailed understandings of strategic developments, military capabilities, and the broader geopolitical landscape. There are specific areas where intelligence professionals can leverage OSINT to better understand highly technical capabilities that require development in academic and scientific collaboration or appeal to private industry investment. A specific research area where OSINT can aid intelligence professionals is Quantum Information Science (QIS), an area of intense international competition that stands to revolutionize information technology and military capabilities.[1]

This paper explores how OSINT can aid intelligence professionals in gaining a deeper understanding of China's Defense Industrial Base (DIB) and its role in supporting the development of military capabilities. As China increasingly emphasizes leveraging information warfare for strategic and tactical advantages, understanding the DIB's involvement in developing these capabilities is essential for forecasting Chinese military intentions, preparing countermeasures, and ensuring strategic stability.[2]

The Chinese DIB is comprised of a complex network of state-owned enterprises (SOEs), private companies, and academic institutions, which play a pivotal role in the modernization of China's military.[3] This interplay is inherently political in nature under the direction of the Chinese Communist Party (CCP). By harnessing OSINT, intelligence analysts can gain valuable

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[1] Edward Parker et al., "An Assessment of the U.S. and Chinese Industrial Bases in Quantum Technology" (RAND Corporation, February 2, 2022), https://www.rand.org/pubs/research_reports/RRA869-1.html.
[2] Wilson Beaver, "The Urgency of the Quantum Computing Race With China," The Heritage Foundation, accessed October 11, 2024, https://www.heritage.org/technology/commentary/the-urgency-the-quantum-computing-race-china.
[3] Parker et al., "An Assessment of the U.S. and Chinese Industrial Bases in Quantum Technology."

insights into the role of QIS capabilities and research in advancing China's information warfare strategies by exploiting publicly and commercially available information on Chinese research advancements and identify political-military priorities of the CCP.

Quantum Information Science Defined

Quantum Information Science (QIS) represents a rapidly evolving field that leverages the principles of quantum mechanics to enhance computation, communication, cryptography, and sensing.[4] As research advances, the potential of quantum technologies in both civilian and military applications is becoming more evident, especially in the realm of information warfare.[5] QIS promises to disrupt current data security, intelligence gathering, and secure communications capabilities, which could reshape future conflicts and geopolitical power structures.[6]

The United States and China are leading the global race to harness the power of quantum information science (QIS), but their approaches reflect distinct priorities, strategies, and institutional frameworks. Both nations view quantum technologies as vital to national security, economic leadership, and technological supremacy, yet they differ in how they mobilize resources and pursue innovation.[7] Policymakers divide QIS research into three primary areas: Quantum Computing, Quantum Sensing, and Quantum Communications.[8]

Quantum computing is the most developed area within QIS. Companies like IBM and Google and federally funded research and development centers are actively building quantum processors with physical and logical quantum bits or qubits; the most powerful quantum computer as of 2024 leveraged 56 physical qubits.[9] These processors aim to solve specific

[4] Hodan Omaar, "The U.S. Approach to Quantum Policy," n.d.
[5] Edward Parker, "The Chinese Industrial Base and Military Deployment of Quantum Technology" (RAND Corporation, February 1, 2024), https://www.rand.org/pubs/testimonies/CTA3189-1.html.
[6] "Defense Primer: Quantum Technology," accessed March 1, 2024, https://apps.dtic.mil/sti/citations/AD1135780.
[7] Parker et al., "An Assessment of the U.S. and Chinese Industrial Bases in Quantum Technology."
[8] "Defense Primer: Quantum Technology."
[9] Matthew DeCross et al., "The Computational Power of Random Quantum Circuits in Arbitrary Geometries" (arXiv, June 21, 2024), https://doi.org/10.48550/arXiv.2406.02501.

complex problems, such as simulations and optimization tasks, far beyond the reach of classical computers, such as breaking modern encryption standards. The increase in quantum computing is possible because while classical computers leverage binary digits or bits that perform logical calculations using either a 1 or a 0, quantum bits leverage superposition to physically simulate 1 and 0 simultaneously, which exponentially increases calculation capabilities.[10] Recent progress includes quantum supremacy demonstrations, where quantum devices performed tasks impossible for classical supercomputers within a practical timeframe. For example, Google's Sycamore Quantum computer can solve a problem in 200 seconds, which would take a classical supercomputer 10,000 years to solve.[11] However, issues such as noise (environmental factors that impact calculations such as ambient heat), decoherence (random failures in quantum state maintenance), and limited qubit connectivity (quantum computers cannot maintain coherence with more than a few qubits) hinder practical large-scale computations.[12]

Quantum communication focuses on secure data transfer, leveraging quantum cryptography techniques like Quantum Key Distribution (QKD). QKD ensures unbreakable encryption by using quantum states to distribute encryption keys that cannot be intercepted without detection.[13] Photonic Quantum Key Distribution splits photon or light particles into two subatomic particles. These two subatomic particles have an opposing spin and become "quantum entangled" at the time of the splitting. If someone were to observe the direction one particle is spinning, that particle would likely slow down, and so would the particle with opposing spin. If

[10] Congressional Research Service, "Quantum Computing: Concepts, Current State, and Considerations for Congress" (Congressional Research Service, September 7, 2023), https://crsreports.congress.gov/product/pdf/R/R47685.
[11] Frank Arute et al., "Quantum Supremacy Using a Programmable Superconducting Processor," *Nature* 574, no. 7779 (October 2019): 505–10, https://doi.org/10.1038/s41586-019-1666-5.
[12] "Quantum Computing: What Leaders Need to Know Now | MIT Sloan," April 24, 2024, https://mitsloan.mit.edu/ideas-made-to-matter/quantum-computing-what-leaders-need-to-know-now.
[13] "China Reaches New Milestone in Space-Based Quantum Communications | Scientific American," accessed May 2, 2024, https://www.scientificamerican.com/article/china-reaches-new-milestone-in-space-based-quantum-communications/.

someone attempted to read the spin other than the intended recipient, both particles would collapse, rendering the keys unusable.[14] Nations such as China and the European Union are investing in quantum communication networks, with the ultimate goal of establishing quantum internet infrastructure in order to ensure truly secure communications physically incapable of being intercepted.[15] Early demonstrations of satellite-based QKD have shown promise in providing secure global communication. Current challenges lie in increasing the range and reliability of quantum networks and integrating them with existing communication systems.[16]

Quantum sensing harnesses the principles of quantum mechanics—such as superposition, entanglement, and tunneling—to achieve extremely precise measurements beyond the capabilities of classical sensors.[17] These advanced sensors can detect tiny changes in physical quantities like magnetic fields, gravitational forces, time, temperature, and acceleration, making them invaluable in industries requiring high precision and sensitivity.[18] Quantum sensors use technologies like atomic clocks**,** magnetometers**,** and quantum gravimeters**.** Atomic clocks, for example, provide unparalleled accuracy in timekeeping, essential for GPS, financial transactions, and scientific research.[19] The U.S. national quantum strategy prioritizes Quantum Sensing,[20]

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[14] Dr. Richard Wolfson, *Einstein's Relativity and the Quantum Revolution: Modern Physics for Non-Scientists*, 2nd ed. (The Great Courses, 2000), https://www.thegreatcourses.com/courses/einstein-s-relativity-and-the-quantum-revolution-modern-physics-for-non-scientists-2nd-edition.
[15] NATO, "Summary of NATO's Quantum Technologies Strategy," NATO, accessed April 26, 2024, https://www.nato.int/cps/en/natohq/official_texts_221777.htm.
[16] "Report: China and Russia Test Quantum Communication Link," accessed May 2, 2024, https://thequantuminsider.com/2024/01/02/report-china-and-russia-test-quantum-communication-link/.
[17] "Defense Primer: Quantum Technology."
[18] "Beating China in the Race for Quantum Supremacy | The Heritage Foundation," accessed May 2, 2024, https://www.heritage.org/technology/report/beating-china-the-race-quantum-supremacy.
[19] "Beating China in the Race for Quantum Supremacy | The Heritage Foundation."
[20] SUBCOMMITTEE ON QUANTUM INFORMATION SCIENCE, "NATIONAL STRATEGIC OVERVIEW FOR QUANTUM INFORMATION SCIENCE" (NATIONAL SCIENCE & TECHNOLOGY COUNCIL, September 2018), https://www.quantum.gov/strategy/.

whereas the Chinese national strategy prioritizes Quantum Computing and Quantum Communication.[21]

The Advantages of OSINT

For the specific task of collecting data on Chinese QIS research, OSINT provides many distinct advantages when compared with other intelligence disciplines, such as accessibility, cost-effectiveness, and public target development. Additionally, validation of the collected material often happens in the public sphere due to the inherent competition in this area.[22] The scientific community will challenge and attempt to validate claims made by Chinese researchers to determine the extent of their capability and whether claims to have developed a quantum computer capable of breaking modern encryption are truthful or skillful exaggeration to generate a propagandistic win.[23]

One of the most significant advantages of OSINT is its wide availability. Since OSINT relies on public sources, intelligence analysts can easily access data without requiring specialized equipment or classified clearance.[24] This makes OSINT particularly valuable for initial assessments, corroborating classified intelligence from other sources, or sharing with foreign partners. The additional capability here is that Intelligence Professionals may not need to understand the nuance within Chinese quantum claims – the public sphere will accomplish that.

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[21] Jakob P, "Chinese Quantum Companies and National Strategy 2023," The Quantum Insider, April 13, 2023, https://thequantuminsider.com/2023/04/13/chinese-quantum-companies-and-national-strategy-2023/.

[22] Timothy Charlton, Anna-Theresa Mayer, and Jakob Ohme, "A Common Effort: New Divisions of Labor Between Journalism and OSINT Communities on Digital Platforms," *The International Journal of Press/Politics*, September 9, 2024, 19401612241271230, https://doi.org/10.1177/19401612241271230.

[23] Craig S. Smith, "Debunking Hype: China Hasn't Broken Military Encryption With Quantum," Forbes, accessed October 24, 2024, https://www.forbes.com/sites/craigsmith/2024/10/16/department-of-anti-hype-no-china-hasnt-broken-military-encryption-with-quantum-computers/.

[24] ODNI & DCIA, "The IC OSINT Strategy 2024-2026," March 8, 2024, https://www.dni.gov/index.php/newsroom/reports-publications/reports-publications-2024/3785-the-ic-osint-strategy-2024-2026.

The Intelligence Community needs to monitor those activities in scientific research journals and on quantum or cyber-specific news sources.

Chinese DIB Political-Military Considerations

The Chinese Defense Industrial Base is one of the world's most complex and expansive networks. It consists of state-owned defense enterprises, private technology companies, academic institutions, and research centers, all working to develop critical military technologies as directed by the Chinese Communist Party (CCP). This base plays a central role in China's military modernization efforts.[25]

The CCP seeks to break down barriers between China's civilian economy and military-industrial complex, enabling dual-use technologies to be easily integrated into defense projects. Under this framework, China's DIB is heavily involved in supporting the PLA's ambitions in information warfare, including developing cyber capabilities, electronic warfare systems, and artificial intelligence (A.I.)-driven military applications.[26]

Key Sources of OSINT

When analyzing China's DIB and its role in supporting Quantum Information Science Capabilities development, intelligence professionals can rely on a range of OSINT sources, including corporate websites and publications, government documents, academic research papers, patents and technology transfers, social media, and commercial satellite imagery.[27] Chinese defense SOEs and private tech companies often publish annual reports, technical papers, and press releases that provide insights into their projects and capabilities. By analyzing these documents, intelligence professionals can better understand the quantum technologies being

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[25] Parker et al., "An Assessment of the U.S. and Chinese Industrial Bases in Quantum Technology."
[26] B A Friedman, "Finding the Right Model: The Joint Force, the People's Liberation Army, and Information Warfare," n.d.
[27] Parker, "The Chinese Industrial Base and Military Deployment of Quantum Technology."

developed for military or dual-use purposes. Chinese government documents, including defense white papers, policy briefs, and speeches by military officials, can provide valuable insights into the country's strategic quantum priorities and the role of the DIB in supporting these goals. It will be incumbent upon the analyst to draw linkages between public statements, military doctrine, and developing capabilities. In the context of quantum computing and quantum communications, these align with multiple efforts across China's Information Warfare strategy to seek an "intelligent-ized" military that leverages artificial intelligence across all echelons to automate tipping, cueing, and targeting.[28] Quantum Computing's theoretical superiority over classical computing could dramatically decrease the timeline for developing advanced and specialized A.I. for these uses.

Universities and research institutions in China publish academic papers and technical reports that offer detailed information on emerging technologies, including A.I., quantum computing, and cyber warfare tools. These publications are often accessible through academic databases and can provide early indications of new trends in China's defense sector. Monitoring patent filings and technology transfer agreements can provide intelligence professionals with early warning of new technologies being developed within the Chinese DIB. Patents often contain detailed technical descriptions that can shed light on the capabilities of emerging systems. Chinese President Xi Jing Ping identified patents as a key instrument of soft power and directed the DIB to increase its output of scientific patents.[29] Unfortunately, many of these new patents are "junk patents," whereby the owner alters minor details of previous patents or of non-Chinese-owned patents to claim ownership.[30]

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[28] "China's Strategy of 'Informationised and Intelligent' Warfare," accessed October 11, 2024, https://www.spsnavalforces.com/story/?id=802&h=Chinas-Strategy-of-Informationised-and-Intelligent-Warfare.
[29] "CSET Original Translation: China's 14th Five-Year Plan," *Center for Security and Emerging Technology* (blog), accessed April 26, 2024, https://cset.georgetown.edu/publication/china-14th-five-year-plan/.
[30] Yuen Yuen Ang et al., "China's Low-Productivity Innovation Drive: Evidence From Patents," *Comparative Political Studies*, November 3, 2023, 00104140231209960, https://doi.org/10.1177/00104140231209960.

Chinese social media platforms such as Weibo and specialized academic or research forums may contain discussions about quantum projects and emerging technologies. While these sources should be treated with caution due to potential misinformation, they can provide valuable insights when cross-referenced with other data.[31] Commercial satellite imagery can be used to monitor the physical infrastructure of China's DIB, including factories, research centers, and military installations. Changes in activity at key locations can provide intelligence professionals with clues about ongoing defense projects. U.S. plans for quantum research facilities can inform search and identification parameters because quantum computers typically require high and steady power supplies to sufficiently cool their processors to near -459 degrees Fahrenheit or just above absolute zero.

OSINT Challenges

Using OSINT to gather information on China's QIS industry presents several challenges, given the country's strategic prioritization of quantum technologies and the centralized, opaque nature of its research and industrial operations.[32] These challenges stem from a combination of data accessibility, language barriers, government restrictions, and deliberate information control.

The Chinese government treats quantum research as a national security priority, placing strict controls on the flow of information. Sensitive quantum projects are classified, especially those with military applications like secure communications and quantum cryptography. Research institutions and companies operating in QIS sectors, such as Alibaba, Baidu, and the National Laboratory for Quantum Information Science, rarely publish detailed information about their developments. Additionally, government censorship can limit the availability of reliable

[31] Jeff Kao, ProPublica, and Mia Shuang Li for ProPublica, "How China Built a Twitter Propaganda Machine Then Let It Loose on Coronavirus," ProPublica, accessed May 24, 2020, https://www.propublica.org/article/how-china-built-a-twitter-propaganda-machine-then-let-it-loose-on-coronavirus.
[32] Parker et al., "An Assessment of the U.S. and Chinese Industrial Bases in Quantum Technology."

online sources, restricting access to critical data that may appear on Chinese social media or internet forums. As such, many reports on quantum research either represent critical successes meant to increase Chinese prestige, which provide scant details for validation, or they represent primarily civilian or commercial advances.

Much of the primary research and industry information is published in Mandarin Chinese, making it challenging for foreign OSINT analysts to collect and interpret. Even with translation tools like Natural Language Processing, technical jargon, and nuanced meanings may be lost, reducing the accuracy of intelligence analysis.[33] Furthermore, important developments may be shared or censored on domestic platforms like WeChat, Weibo, or specialized forums, which can be difficult to monitor without cultural and linguistic expertise or may be difficult to access outside China.

China's quantum ecosystem involves a combination of state-owned enterprises, academic institutions, and private firms, making it challenging to map the full landscape. Companies often participate in dual-use programs—blending civilian and military research—creating ambiguity in project goals.[34] The Chinese government may also promote disinformation or intentionally obscure key partnerships and progress, complicating efforts to determine the actual state of research and development. Identifying links between academia, industry, and military projects is particularly difficult due to the deliberate use of vague or overlapping language in official documents.

The field of Quantum Information Science is developing at a fast pace, with breakthroughs and collaborations emerging frequently. Keeping track of such rapid developments requires constant monitoring of publications, patents, and announcements, many

[33] Alison Killing, "The Challenges of Conducting Open Source Research on China," bellingcat, April 18, 2023, https://www.bellingcat.com/resources/2023/04/18/china-challenges-open-source-osint-social-media/.
[34] Parker et al., "An Assessment of the U.S. and Chinese Industrial Bases in Quantum Technology."

of which may only become publicly available with significant delays. The lack of transparency further complicates efforts to assess the actual capabilities of Chinese quantum technologies in real time. Thus, the collection of primary or relevant sources may lag beyond the point of being relevant or timely to the requesting customer.

Conclusion

OSINT is an indispensable tool for intelligence professionals seeking to understand the role of China's Defense Industrial Base in supporting the development of Quantum Information Science capabilities. Analysts can uncover valuable insights into China's strategic goals and emerging technologies through data mining, geospatial tools, and open-source research. While there may be significant challenges with regard to finding targeted information on specific military relation projects because of China's autocratic government and highly controlled information environment, the nature of academic and scientific research represents a potential bypass by allowing for the collection of technologies which, when layered, may underpin critical capabilities. Despite OSINT Natural Language Processing tools, it may be difficult to accurately translate the highly technical jargon from Chinese reports to English. As China continues to invest in QIS, OSINT can play a critical role in helping intelligence professionals stay ahead of the curve and anticipate future developments in this rapidly evolving field.

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