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SMART PORTS. HOW THEY PLAY A KEY ROLE IN THE GREAT POWER COMPETITION.

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Purpose of the Summary Report

This document is a summary of the "Smart Ports: How They Play a Key Role in the Great Power Competition" whitepaper dated July 2021. This summary includes an executive overview of the paper and a smart port definition. A discussion on the applicability of the Smart Port Framework, opportunities for risk mitigation, and the whitepaper's conclusions are also included.

The full Smart Ports whitepaper focuses on the technical aspects of the modern seaport ecosystem and specifically analyzes the Port of Djibouti smart port implementation. The specific technologies and companies covered in the paper are not meant to be comprehensive but rather the most representative examples found within a smart port. Information and communication technologies (ICT), which include a broad set of capabilities that facilitate the transmission, storage, creation, sharing and exchange of information, are foundational to modern smart ports. The technologies are discussed within the context of commercial container ports rather than military, passenger, or other commodity-specific ports, such as fishing ports. As there is a strong affinity between seaports and airports, the scope briefly touches on the similarities and applicability of a smart city framework to smart airports and seaports. Furthermore, the paper is oriented to smart port applications as they pertain to Digital Silk Road (DSR) seaports. We compare two port examples, the Port of Djibouti in Djibouti and the Durban Container Port (DCT) in South Africa (SA), to illustrate potential impacts of the DSR in eastern Africa associated with the stakeholders and actors relative to these ports.

The audiences for the whitepaper are internal MITRE Great Power Competition (GPC) researchers, DSR practitioners, and MITRE's U.S. government sponsors, as well as others who are interested in smart port technologies and potential courses of action relative to GPC.

Executive Summary

Modern smart ports, as important nodes in the global supply chain, are establishing themselves as logistics information exchange hubs serving their regional transport ecosystem. Implementation goals of a modern smart port range from reducing costs and increasing efficiency to boosting economic benefits and improving customs clearance efficacy. Ports have grown from being predominantly isolated and manually operated to being more interrelated and automated. As a result, many of the world's busiest container ports are becoming increasingly reliant on technology to optimize operations and increase resiliency. The role of ports in the GPC is to enable the delivery aspect of the global supply chain competition. If a country controls more ports or has improved access to more ports, then they would have a competitive advantage in the nations they serve. The People's Republic of China (PRC) has embarked upon a strategy to create a supply chain competitive advantage through exporting a smart port capability to lower income nations; one example is the Port of Djibouti.

This paper discusses the technologies present in today's smart ports, the important role of smart ports within the context of the Belt and Road Initiative (BRI) and the DSR, and the key actors involved. The Port of Djibouti provides an example of a modernized port with a relatively closed technology ecosystem that is influenced by the PRC as part of the DSR. By contrast, the Port of Durban, SA, is an example of a smart port with a relatively open technology ecosystem that has far less direct PRC influence.

While this paper focuses on the smart seaport, there are clear parallels with smart airports associated with smart technologies, intelligent infrastructure, and intelligent mobility. Like smart seaports, smart airports are undergoing digital transformation and moving away from distinct, disconnected IT systems to connected smart airports by harnessing advantages of digital platforms, big data, cloud technologies, and the Internet of Things (IoT). Due to the recognition and adoption of international standards, the U.S. and western tech stack actors may find that applying a Smart Port Framework to airports, in addition to seaports, would yield greater influence in eastern Africa countries.

MITRE identified several opportunities for potential U.S. influence, such as: the ability to develop alternative solutions based on the port framework, employing zero trust (ZT) approaches, adopting existing cross-border smart airport systems, operationalizing digital twin technology, and employing trusted and responsible artificial

intelligence (AI) for independent oversight of port operations. The potential to develop alternative technology solutions will enable new capabilities for more rapid prototyping and evaluation, testing of environmental parameters, and risk mitigation. Finally, one of the greatest opportunities centers around data. The role that smart port operators play and the influence they hold in the global supply chain will enable them access to tremendous amounts of valuable data. The U.S. can assist ports with increasing awareness of data sovereignty and privacy risks along with establishing open standards that enable secure, innovative, and competitive opportunities for future smart port ecosystems.

Smart Port Definition

A smart port is defined as an automated port that uses technologies, such as the IoT, blockchain solutions, AI, big data, automated guided vehicles and cranes, and other smart technology-based methods to improve performance and economic competitiveness. With these technologies, smart ports' improved efficiency can also decrease a port's negative environmental impact (e.g., energy consumption). In the smart port, processes are automated and increasingly integrate the IoT. Ports aiming to become smarter must complement their physical operations with digital processes, such as using digital twin technology to replicate the physical port. Smart port systems reduce overall shipping costs, which will increase the demand for port services from traders. To remain competitive, ports are increasingly implementing smart technologies.

Considerations

The dWith the implementation of smart technologies, there are risks associated with the increased generation and sharing of data and interconnectedness of systems, different data formats, and the need for further standardization to support autonomy and optimization. The expectation is that using new technologies and introducing innovative solutions will drive changes to supply chain and port dynamics, likely presenting challenges to existing stakeholder and seaport business models. While beyond the scope of this paper's Smart Port Framework, specific security considerations related to technologies used to enable smart ports are of concern and warrant further study. THE EXPECTATION IS THAT USING NEW TECHNOLOGIES AND INTRODUCING INNOVATIVE SOLUTIONS WILL DRIVE CHANGES TO SUPPLY CHAIN AND PORT DYNAMICS, LIKELY PRESENTING CHALLENGES TO EXISTING STAKEHOLDER AND SEAPORT BUSINESS MODELS.

Applicability of the Smart Port Framework

There is a high degree of applicability of the Smart Port Framework to smart airports. Both are interconnected with sub-systems of the city region with associated smart technologies, intelligent infrastructure, and intelligent mobility. Smart airports are employing digital twin technology for ideation, engineering design, construction, and operations. In addition, digital twins are used to enhance the traveler's journey experience, entertain passengers, and drive retail revenue. Much like smart seaport transformation, smart airport development and transformation encompass six key characteristics: logistics, mobility, environment, economy, people, and governance.

The primary differences between smart seaports and smart airports are driven by their digital transformation focus. Digital transformation of seaports is primarily concerned with operational efficiency, cost containment/reduction, and safety and security. Digital transformation of the airport is focused on developing services and processes that will enhance passenger experience, increase revenue streams, and improve efficiency in daily operations.

Regardless of the differences, smart seaports and smart airports can employ many of the same smart technologies. Also, through application of a Smart Port Framework, we can transfer lessons learned in one smart environment to another smart environment.

Smart Port Related Opportunities

Smart port environments are comprised of many different systems, products, and technologies, all ideally integrated into a secure ecosystem that efficiently and effectively supports stakeholders' business needs. Inherent to these complex, heterogenous environments are opportunities to identify and mitigate areas of concern or risk. While not a complete or comprehensive list, some initial opportunities to consider include:

- Operating in smart environments, such as smart ports and smart airports, can further increase the amount of data created and consumed by stakeholder processes and technology use within those environments (e.g., devices in the sensing layer).
- Overall, there is an opportunity to increase awareness of existing data usage policies and considerations of data sovereignty within smart environments as well as establish policies that consider the entire data lifecycle.
- Identification of additional data confidentiality and privacy protections within the context of smart port business flows and interactions

may lessen potential risks for data owners while not undermining competitive positions in the port ecosystem.

- Environments that employ digital twin capability would benefit from opportunities to strengthen data security and the resilience of data ecosystems to ensure the integrity, availability, and reliability of data upon which digital twins depend.
- While requiring further study, it appears that the smart port industry would benefit from development of open Smart Port Frameworks in lieu of proprietary approaches and/or arrangements. This approach encourages innovation and competition within the port, comparable to current efforts of the O-RAN Alliance with fostering an open, flexible, and competitive Radio Access Network (RAN) ecosystem. Partnering with relevant standards organizations will help accelerate this framework development.
- One area of opportunity for improving security and resilience in smart ports may be with ZT concepts due to the plethora of devices, users, stakeholders, and technologies involved.
- Operationalizing digital twin technology to a greater degree in the port will enable new capabilities for environmental parameter testing and more rapid prototyping and evaluation; with this approach, ideally, risks can be safely identified and mitigated.
- Efforts already underway to develop trusted and transparent AI could be applied in conjunction with independent operations of smart ports, especially within systems that are labeled as "intelligent" or "automated." Use of trusted and responsible AI-based systems can decrease risk of unfair business practices and anti-competitive behavior.

Opportunities to address smart port security, while not the focus of this paper, emerged as a concern in three areas:

- 1. Overall security of the technologies employed in a smart port ecosystem.
- 2. Security of data about data ownership, aggregation, and potential misuse.
- 3. Security and privacy surrounding the collection and use of personal data for potential surveillance.

Conclusion

Smart ports represent complex systems of systems that offer significant opportunity for improved efficiency and optimization through application of the Smart Port Framework and implementing technologies associated with a smart port. Smart airports share enough similarities with smart ports to pursue the same benefits from the Smart Port Framework and associated technologies. Systems integrators will likely be in a challenging, yet powerful, position to determine how key systems within smart port ecosystems are leveraged to the benefit of local port organizations as well as the larger global supply chain and partner organizations world-wide. Existing ports have the potential to experience the greatest gains and pains as they evolve through the digital transformation and smart port incremental implementation.

PRC-related companies have invested significant resources in the smart and intelligent port technology space with a goal to further strengthen their position in the global supply chain. For smart port community systems, the PRC has several companies with strong offerings built upon their own standards (including industry standards they have influenced). These PRC offerings represent a significant competitive challenge to non-PRC providers even when fair and open competitive selection processes are used.

For Djibouti, the dominant PRC-related companies (China Merchants Port Holdings Company Ltd., IZP Network Technologies, , et al.) appear to be establishing smart port solutions that provide a foundation of big data collection and analytics with the data in this key global shipping hub. Similar to what has been seen with PRC-developed mobile handsets, the payment systems within the port appear on track to be RMB-based (i.e., based on the Chinese currency, renminbi) through IZP's stated platform capabilities. While some analysis of the Djiboutian smart port data may be local, the proximity to the Pakistan & Eastern Africa Connecting Europe (PEACE) cable makes it ideally situated to securely transport the large volumes of port data (to include any accessible port-park-city data) to the One Belt One Road (OBOR) big data centers based in China.

In Durban, SA, the evolving smart ports appear to be largely state controlled and port operation solutions home grown. However, there are indications that additional supplier diversity may be emerging. PRC influence in this port is not as evident as it is in Djibouti, although SA has partnered with PRC-related companies to automate port operations. The future trajectory of Durban container ports should be carefully observed.

Finally, while several other observations were identified, one of the greatest opportunities centers around data. Smart port operators play a significant role, and the influence they hold in the global supply chain will enable access to tremendous amounts of valuable data, which when aggregated and analyzed, will provide the basis for considerable smart system and workflow optimizations, automation, and resiliency. Stakeholders in the smart port ecosystem, including those outside the port but within the global supply chain, may be unaware of the risks with providing this data. In addition, stakeholders may not be positioned to control access to this data once it is ingested into the smart port system. Awareness of data sovereignty and privacy risks should be increased where possible, along with establishment of open standards that enable secure, innovative, and competitive opportunities for future smart port ecosystems.

ABOUT THE AUTHOR

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