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A Digital Twin Ecosystem for the Great Lakes–St. Lawrence River Maritime Corridor

Executive Summary

Report of the Intelligent Maritime Corridors International Council (IMC IC) Digital Twin Strategic Table

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Context

The current global trade and geopolitical context, foreseeably unstable and continuously changing, provides opportunities requiring a consolidated strategic and tactical approach to position Canada as an international leader in intelligent maritime corridors (IMCs). The Great Lakes–St. Lawrence River (GL–SL) corridor is a critical economic artery in the North American supply chain. Its economic power stands out as one of the largest in the world. But like any maritime corridor, it faces enormous pressures in terms of capacity, emissions reduction, sustainability and socio-economic impacts. Growing digitalization and the rise of artificial intelligence only increase the pressure to accelerate digital transformation. The major players in international ports and maritime corridors are turning to the development of technological solutions to take full advantage of this new transformation and embrace IMCs. Given the greater capacity and performance expectations in the current geopolitical context, the GL–SL corridor has no choice but to rely on innovation and this transformation. Maritime corridors that leverage these technologies and address these pressures will be more efficient and resilient, becoming the leaders of tomorrow in an increasingly competitive world.

The **Digital Twin Strategic Table**, operating under the authority of the IMC IC, was created to bring together experts from various sectors to identify anticipated public, private and academic issues and needs with respect to digital twins in the GL–SL corridor. The Strategic Table's members have been tasked with contextualizing the current challenges and gaps in order to propose research areas that lead to solutions. The Strategic Table is thus a neutral and credible think tank capable of rallying stakeholders around a common vision and suggesting a path forward utilizing digital twins to facilitate the sustainable collaborative digital transformation of the GL–SL corridor.

Discussion

The complexity of the GL–SL corridor makes it difficult to establish a single digital twin. According to the Strategic Table, the digital twin of an intelligent maritime corridor must instead entail an **ecosystem of public- and private-sector digital twin projects**, whose core architecture and analytical technologies are designed to benefit all stakeholders. This digital twin ecosystem will allow the corridor to progressively build upon the knowledge acquired by each of the stakeholders

and, over time, become a more interconnected and interoperable network of virtual models representing ships, navigation, ports, locks, waterways, logistics systems, and natural and social environments. The result will be more reliable information and predictive analyses to support evidence-based decision-making, optimize operations, protect ecosystems, strengthen sustainability and resilience to climate change, and enhance international competitiveness. This approach will enable the development and continuous improvement of digital twins with an emphasis on interoperability and collaboration.

The main challenges involved in developing digital twins for the GL–SL corridor stem from the lack of a clear vision and Canadian leadership to guide the project. There is no structured plan or hierarchy for the complete digitalization of the system. In this new context, data has become the key driver of innovation, but the data quality, availability, operability and accessibility remain major challenges. Moreover, the communications infrastructure must be robust enough to ensure connectivity, speed and information security across the entire corridor. These are just some of the issues that the Strategic Table’s members have flagged. They can be divided into five categories: strategic, technical, operational, financial and political.

Implementing digital twins in this context requires careful attention to several strategic considerations, a full list of which is provided in the report. The two main considerations are:

- The ongoing spatiotemporal variability of these models, which makes absolute accuracy impossible. Access to the best available data is therefore imperative, although the level of reliability may fluctuate depending on the location and timeframe of analysis.
- The scope of the project, which will need to extend beyond the Canadian portion of the GL–SL corridor and be binational in nature.

The experience and expertise of the Strategic Table’s members have been invaluable in identifying the challenges that could hinder innovation and progress in setting up an intelligent maritime corridor. The Strategic Table’s report sets out the challenges to be considered from an organizational/strategic, technical, financial/economic, environmental and societal perspective, as well as some of the opportunities that exist. The report also outlines eight key elements that the Strategic Table’s members have suggested be included in the vision, governance structure and strategies underpinning the creation of the ecosystem.

The report is the result of a collective effort to reflect on the issues, needs and opportunities at stake and proposes potential solutions as well as six recommendations and priority actions to guide the IMC IC in accelerating the transformation of the GL–SL corridor.

Various elements critical to the successful development of an ecosystem of interconnected digital twins are emphasized in the report. Good leadership and a robust multi-level governance plan will be paramount to enlisting the cooperation of various levels of governments and other stakeholders. It will take a strong, aligned and transparent foundation to build trust with a clear voice and a clear path.

The ambitious roadmap to 2040 contained in the report is divided into three phases, each with a series of actions and objectives to be implemented on a progressive basis. The highest priorities are included in the first phase.

Conclusion

The Strategic Table's discussions clearly pointed to a lack of Canadian leadership and the absence of a well-defined vision for developing an intelligent maritime corridor, including a lack of action in terms of data standardization and access. Federal, provincial, territorial and state governments in Canada and the U.S. will need to be convinced of the importance of charting a strategic course forward and putting a multi-level governance framework in place to transform this corridor and maximize its capacity, competitiveness, resilience and sustainability.

Six recommendations have been made, based on the identified requirements and available opportunities. The result is a realistic, step-by-step roadmap that can be used to guide this transformation forward. Leveraging the extensive expertise of its members, the Digital Twin Strategic Table has managed to capture the essence of the digital transformation needs for the GL–SL maritime corridor and the powerful impact that digital twins can deliver.

The report aims to offer a broader view of the transformation that must take place if we are to fully realize the corridor's potential. The constraints and pressures imposed by the economy, the environment and the geopolitical climate will persist, but they can serve as unprecedented opportunities for learning and growth to make the GL–SL maritime corridor and the hydrospatial domain an international example of leading-edge ingenuity and collaboration.

This will take a coherent and collaborative approach that aligns all levels of government, regulatory authorities, researchers, innovators, users and others. Multi-level governance structures will be key to building this cooperative, innovation-driven environment.

The result will allow the various players to optimize their operations and develop innovative, interoperable technological, which will in turn unlock new possibilities.

About the Executive Summary

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The information contained in this executive summary and the full report reflects a point-in-time analysis based on information available at the time of preparation and is subject to change.

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