As supply chains become more global and interconnected, their exposure to risk increases. Higher demand volatility, unprecedented technological changes, and supply chain speed intensify risk exposure. In this context, academics and practitioners often suggest that supply chains have not been as exposed to risks as they are now since the end of World War II. Of the many diverse challenges that supply chain management faces today, the most compelling one is the new technology revolution, with breakthroughs in several fields, such as artificial intelligence, robotics, the Internet of Things (IoT), autonomous vehicles, and 3D printing, among others. We are at the beginning of the Fourth Industrial Revolution, a revolution that will significantly change production and consumption as we know it today. Despite the uncertainties of these unprecedented times, it is expected that new technologies will create important opportunities to improve supply chain management. Indeed, new digital technologies can foster the emergence of fully, end-to-end connected supply chains, where the seamless flow of materials, information, and financial resources along the supply chain is enabled by both enhanced information systems and physical connectivity.

**SUPPLY CHAIN CONNECTIVITY**

According to recent data, there will be more than 50 billion devices connected to the Internet by 2020, a trillion sensors connected to and transmitting information to analytical platforms in the cloud, and 44 trillion gigabytes generated (DHL, 2018). In supply chain management, the growing adoption of technologies such as IoT, artificial intelligence and cloud computing will allow for enhanced information systems connectivity—or the electronic linkage of partners up and down the supply chain—thus enabling unprecedented high supply chain visibility.

With a higher capability in sharing end-to-end on-time and accurate data, supply chains will be able to make decisions in real time, optimize operations, handle incidents that require risk-mitigation actions, avoid disruptions, and satisfy an increasingly volatile demand, therefore leading to better risk management. For example, placing sensors on supply chain materials can enable a more precise and reliable monitoring of inventories that flow across the actors and processes involved in the supply chain, thus avoiding human errors, input shortages, and the high cost of unnecessary inventory carrying. Likewise, sensors capable of reporting on machinery performance and physical assets can indicate when maintenance is required and when machinery is likely to fail, thus avoiding damage and downtime. Moreover, in the event of an incident, the
Supply chain can capitalize on real-time connectivity across the extended supply chain to respond in a rapid, coordinated fashion (IBM, 2015). It is expected that new digital technologies will also enhance physical connectivity among supply chain nodes distributed across space. Given that the network of infrastructure and logistics services can speed up or delay the flow of materials, information, and financial resources across a supply chain (Calatayud et al., 2016), physical connectivity has a direct impact on supply chain costs and efficiency. Poor transport infrastructure results in higher transportation costs, large inventories and inventory costs, long and uncertain delivery times, and congestion (IDB, 2016). There are several ways in which new digital technologies can help improve physical connectivity, particularly in the case of the port-supply chain interface. Indeed, larger amounts of real-time supply chain data can help port terminals better accommodate the growing capacity of maritime transportation, increase asset productivity, improve coordination with shipping lines and trucking companies, optimize resources and networks, and reduce costs in a highly fluctuating, competitive, low-margin industry.

For example, IoT sensors placed on traffic lights can measure congestion levels and send this information to truck drivers for alternative routing and to public agencies for traffic management decisions. Sensors placed on parking spots at logistics and port facilities can generate information on available spots, the best route to reach them, and the expected cost. Importantly, the information generated by sensors can dramatically increase real-time performance monitoring, improve the accuracy of simulations, and prevent infrastructure failure before problems even emerge. The integration of supply chain information with transport and logistics management systems is consistent with the emerging interest from public and private sectors in moving towards integrated transport systems, so that the integrated management of infrastructure, services, policies, and information results in a more efficient and seamless movement of people and goods (ITF, 2012).

Other technologies expected to revolutionize physical connectivity are unmanned aerial systems (UAS) also known as drones, autonomous vehicles, and artificial intelligence. Drones can be used to expand distribution channels and market access to areas where physical connectivity is difficult due to congestion or lack of (adequate) transport infrastructure. Moreover, drones are currently being tested to ensure delivery in situations where the logistics chain has been disrupted due to, for instance, natural disasters or transport infrastructure failure. Autonomous technologies are being tested on other modes of transportation.
such as trucking, rail, and shipping. With the implementation of IoT and artificial intelligence, trucks, trains, and ships will be able to communicate with each other, with their passengers, other intelligent devices, supply chain control centers, and traffic controllers to coordinate movements, optimize routes, and transmit real-time data so as to improve reliability and efficiency in logistics processes (DHL, 2018).

**BARRIERS TO THE CONNECTED SUPPLY CHAIN**

Despite the benefits of the connected supply chain in terms of operational efficiency and risk management, the reality is that supply chains and firms, particularly those in developing countries and those of smaller size, are lagging behind in their efforts to increase connectivity through the adoption of new digital technologies. According to recent surveys (GA, 2017; WEF, 2018), the main barriers from the private sector’s perspective are:

- The cost of technology adoption
- The lack of access to finance
- Outdated or lack of Information Systems capabilities
- Lack of (adequate) transport, logistics, energy, and telecommunication infrastructure
- Low performance of logistics services
- Short-term organizational perspective
- Lack of labor skills
- Regulatory uncertainty
- Privacy and security protection
- Lack of trust, willingness to collaborate, or common goals

What role can the public sector play in overcoming these barriers? Certainly, private sector action and collaboration is needed to solve connectivity challenges such as lack of trust or unwillingness to collaborate with supply chain partners.

In other areas, however, the public sector can play a critical role. On the one hand, the public sector can put in place a regulatory framework and business climate that maximizes the benefits and minimizes the risks of the new technologies, leverage private sector investments in logistics infrastructure and information systems, and enhances public-private sector collaboration, among others. In the context of the Fourth Industrial Revolution, specific regulatory areas that will require government attention are: privacy and data protection; social safety; digitization of public sector procedures; cybersecurity; standards and interoperability; public-private partnerships; and spectrum allocation.

On the other hand, the public sector can also strengthen connectivity by designing programs aimed at, for example, building logistics, energy, and telecommunication infrastructure in areas where it is needed; increasing technology adoption by public institutions that take part in supply chain processes (e.g., Port and Customs Authorities); increasing access to finance for technology adoption; promoting training and helping firms address the shortage of human capital in STEM sectors; and promoting R&D.

International Development Institutions such as the Inter-American Development Bank (IDB) are supporting both public and private sectors in countries around the world to improve technology adoption across supply chains, as a means to both enhance productivity and economic growth in such countries and minimize the impact of technology disruption.

Support is focused on three main areas. First, International Development Institutions are generating knowledge, identifying best practices and sharing lessons learned to raise awareness on the challenges and opportunities from the Fourth Industrial Revolution. Second, they are providing support to update policy and regulatory frameworks, promote policy dialogue, and create areas for private-public sector collaboration. Finally, they are providing financial and technical support to strengthen institutional capacity, improve infrastructure, develop the private sector, promote innovation, test technologies, and, importantly, prepare economies and societies for their transition to the Fourth Industrial Revolution.

**REFERENCES**


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**ABOUT THE ORGANIZATION**

The IDB works to improve lives in Latin America and the Caribbean. Through financial and technical support for countries working to reduce poverty and inequality, IDB helps improve health and education, and advance infrastructure. Its aim is to achieve development in a sustainable, climate-friendly way. With a history dating back to 1959, today IDB is the leading source of development financing for Latin America and the Caribbean. It provides loans, grants, and technical assistance; and conduct extensive research. IDB maintains a strong commitment to achieving measurable results and the highest standards of increased integrity, transparency, and accountability.

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