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RISK-AND-RESILIENCY-INTELLIGENT SUPPLY CHAIN (RRiSC)

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ABSTRACT

This work proposes a risk-and-resiliency-intelligent supply chain (RRiSC) tool which is an SC risk management framework that leverages cutting-edge technologies in Artificial Intelligence (AI), Big Data Analytics (BDA), and Digital Twins (DT) to develop specific capabilities for SC risk management. RRiSC is a convergence of mature tools and techniques embedded in three modules: Modeling, Simulation, and Visualization – all together integrate the optimization, simulation, and data analytics to test the performance of the whole supply network under different scenarios through measuring the vital KPIs, identifying the vulnerabilities, and setting proactive plans to diminish risks consequences.

Keywords: supply chain, risk, resilience, modeling, simulation, visualization, digital twin, FDNA.

1 INTRODUCTION

The resiliency of the supply chain (or more accurately, network) could be defined as its ability to endure, cope, and recover from unexpected events (i.e., disruptions) that may occur and have negative effects on delivering the demand to customers (Pinto, McShane et al. 2012). Risk events include natural disasters like hurricanes and pandemics, as well as manmade disasters like wars – all of which can cause an interruption in meeting society's various needs. As various technologies emerge and adapt towards Industry 4.0, it is now becoming possible to analyze complex systems in ways that were not possible a decade ago. The objective of this work is to build the RRiSC tool which is capable to assess SC risks and dynamically monitor supplier relationships while hierarchically accumulating risk throughout the SC.

2 PROPOSED METHODOLOGY

RRiSC is a convergence of mature tools and techniques embedded in three modules.: Modeling, Simulation, and Visualization, as illustrated in Figure 1. M1 Modeling: this module includes data analytics and risk analysis. Data analytics include building suppliers' risk profiles based on a set of risk archetypes. The risk analysis will be implemented using Functional Dependency Network Analysis (FDNA), (Garvey et al., 2014), to manage the potential propagation of risk through the network. Also used is Enterprise Risk algebra (R-algebra) to measure enterprise capability risk (Pinto & Garvey, 2012). M2. Simulation: a simulation model will be designed to assess and mitigate the risk of disruptions in supply chain networks based on

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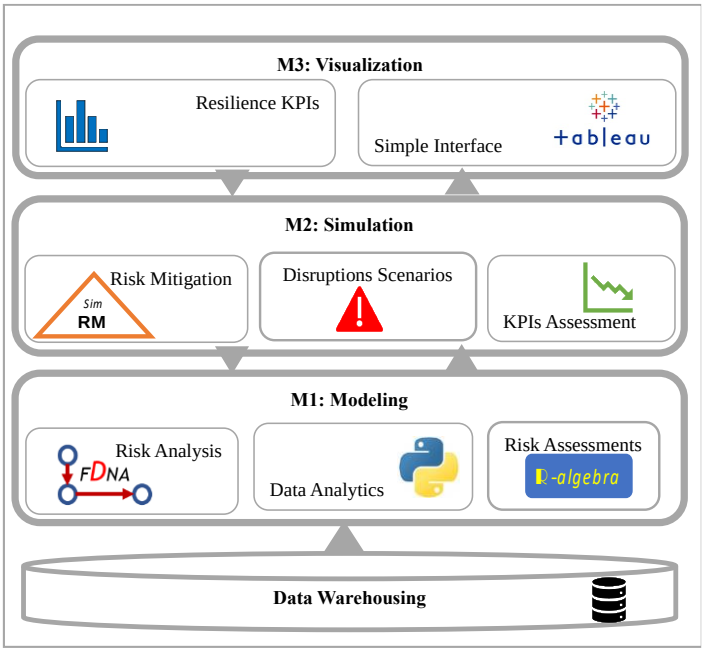
Sim-RM, as well as to measure its impact on the supply network KPIs (Seck et al., 2015) under various disruption scenarios. M3. Visualization: this module simplifies the interface for the end-user and allows controlling and monitoring of resilience KPIs (which are dependent on each company or system in terms of functional context, responsibilities, and goals (Karl, Micheluzzi et al. 2018)) for the supply network.

Figure 1. RRiSC Architecture



3 EXPECTED RESULTS

RRiSC will leverage the BDA approaches to assess each supplier based on historical data. The integration between optimization, simulation, and data analytics will confer a powerful tool for stakeholders to test the performance of the whole supply network under different scenarios by measuring the vital KPIs identifying the vulnerabilities, and setting proactive plans to diminish risks and consequences. Furthermore, RRiSC can be used to optimize the overall supply network's resiliency by controlling the ripple effect of risks in the supply network, such as sales, stock returns, and costs. Eventually, the Risks visualization module delivers a rich feedback loop through which managers can identify, mitigate, and monitor risks events to enhance supply network resiliency.

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