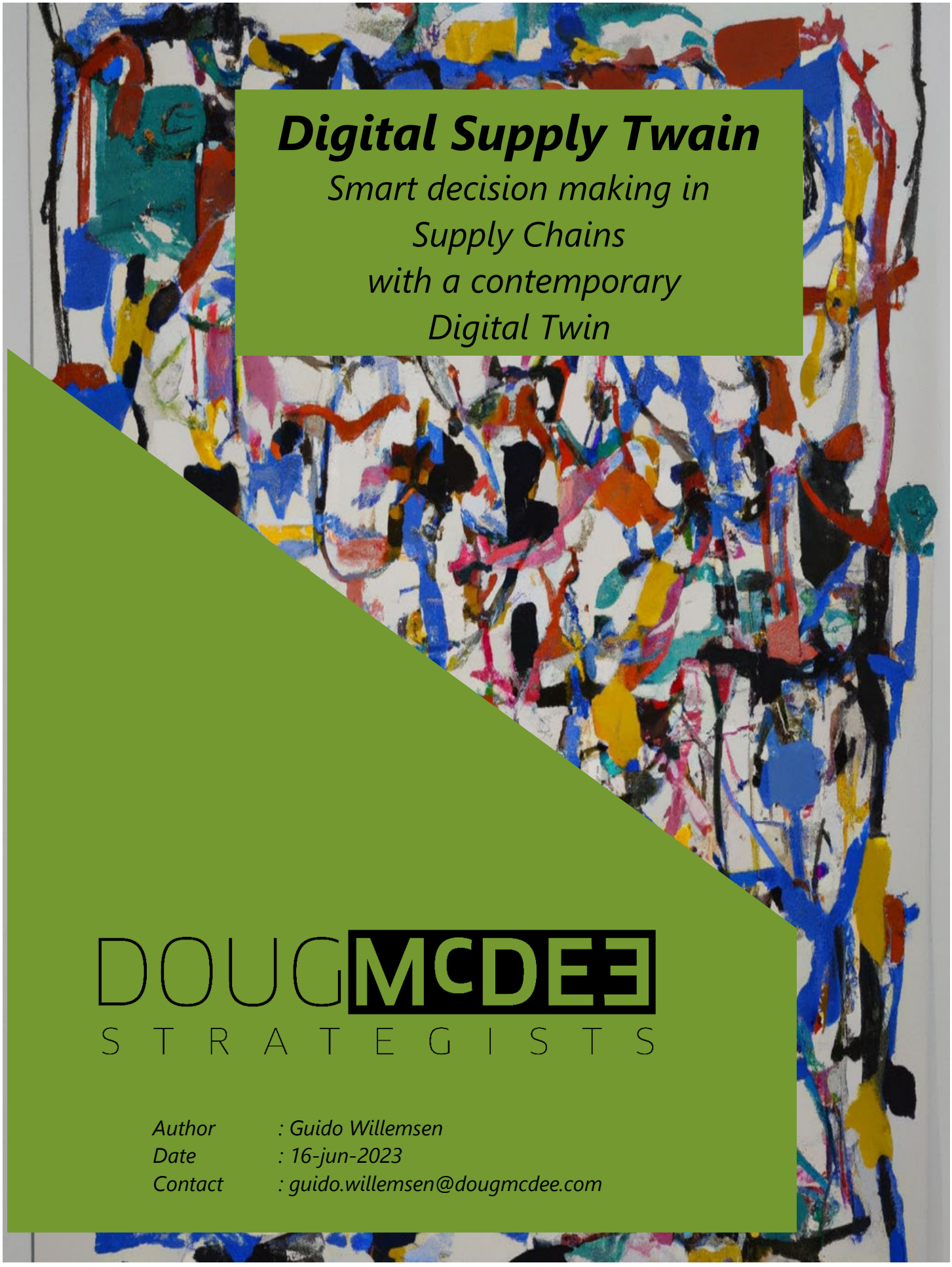

Digital Supply Twain

Smart decision making in Supply Chains with a contemporary Digital Twin

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So many data and still poor decisions

Supply chains have become tremendously complex over the years. Globalization, 3PL and 4PL partnerships, technological innovations, the rise of big data, artificial intelligence and social disturbances contributed to this complexity. This results in a multidimensional configuration space where decision taking has become challenging. The digitization of supply chains increased the amount of data available to drive these decisions. However, pragmatic short term and smart long term decision models are still lacking. This raises the question: how can we improve decision-making processes to improve the efficiency of supply chains? A Digital Twin, or in this case, the Digital Supply *Twain* could probably do the job.

The Digital Twin concept

There are many interpretations of the Digital Twin concept. The Digital Twin terminology was first described in a 2002 paper (Grieves, 2006) in the field of Product Lifecycle Management as a mirror of physical products. Innovations in technology like Agent-Based modelling and simulation enabled the Digital Twin concept for further application in information processing domains (Rao, 2022). A Digital Twin is more than a digital model (digital representation of a physical object) or digital shadow (digital representation created from real world data). The main difference is that the Digital Twin is an interactive concept, where data from the physical environment are digitized, analyzed, and applied before it returns its results to the real world again.

The Digital Twin has become a fruitful soil to achieve the next-level decision-making. Simulation, data processing, machine learning or quantum computing will help to make progress in its applicability in business processes. With this technology, both day-to-day tactical and strategic decisions could be supported by super-analyzed datasets and impact analysis on different time scales.

Applications of the Digital Twin in Supply Chain

Today's multilayered, non-linear supply chains require advanced decision-making tools. The digital twin of the supply chain seems to be a suitable direction to gain a competitive advantage by improved trade-offs between costs, service levels, emissions or seizing. Although AI is used in many logistic processes, the use of digital twins for explanation, prediction exploration, change or scenario generation are still limited.

A study by Tazanli and Saénz (**(Tozanli, Özden; Saénz, Maria Jesus, 2022)** describes several business cases in supply chain planning, warehouse management, transportation management and last-mile delivery. One of the interesting outcomes of this study is that

besides a better solution for optimization and dynamic capacity allocation, the digital supply twin offers insight into the long-term impact of current decisions. Especially in building up strategic advantages it seems that the digital twin is a critical precondition of contingency planning and gaining competitive advantages. In the complex supply chain networks of today and our future this could be a real deal-breaker.

Real time simulation for tactical and strategic decisions

As mentioned above, the digital twin is an interactive platform for simulation and scenario analysis. In previous days, analysis of processes was mainly focusing on historic or extrapolated data. However, current technology facilitates in much more than that. When digital twins are integrated into operational systems, inside or even outside the organizational environment, real time simulation will become possible. And what about the introduction of quantum computing? This will increase computation power and improve decision speed exponentially.

With real-time simulation, the complexity of supply chains can be absorbed and paves the way for smarter and quicker information processing. But, as recent research shows, not the lack of knowledge of technology is blocking progress, the organizational structure and process inefficiencies are the bottleneck **(Joshi, Amit; Buche, Ivy; Sadler, Miguel Paredes, 2023)**. So, the integration of a digital twin in the supply chain requires a change in business architecture to enable real-time and dynamic decision making. When this is achieved, only technology must be embraced. Islands of experimentation flow into Center of Excellences or even a sophisticated Federation of Expertise. This will result in a clear-cut competitive advantage and significant cost reduction.

So, are you ready for the Digital Supply *Twain*?

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