

White Paper



Supply Chain 4.0: Enable it with Digital Twins and AI!

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Introduction

The new normality has brought dramatic supply chain changes: supply disruptions, different consumer patterns, unexpected e-comm growth, pressure to respond faster to demand volatility, and (as if it weren't enough) pressure for cost reduction - and the list could go on.

The bright side of the situation is that companies have realized the importance of the role of the supply chain in the organization, and there is more awareness of how critical a robust, efficient and digitalized supply chain is to be able to respond best to business changes.

The days with old-fashioned manual data processes are numbered, and this momentum should be exploited by supply chain leaders to push for their next level supply chain. To quote from *The Art of War*, by Sun Tzu, "Where there is chaos, there is also opportunity."



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Let's get down to industry 4.0

It is key to push key to incorporate new technologies in the whole supply chain spectrum: going from E2E (end to end) strategic decision making down to physical infrastructure and operating models.

In this paper, we are going to focus on Supply Chain Digital Twins and how they can become part of Artificial Intelligence Applications.

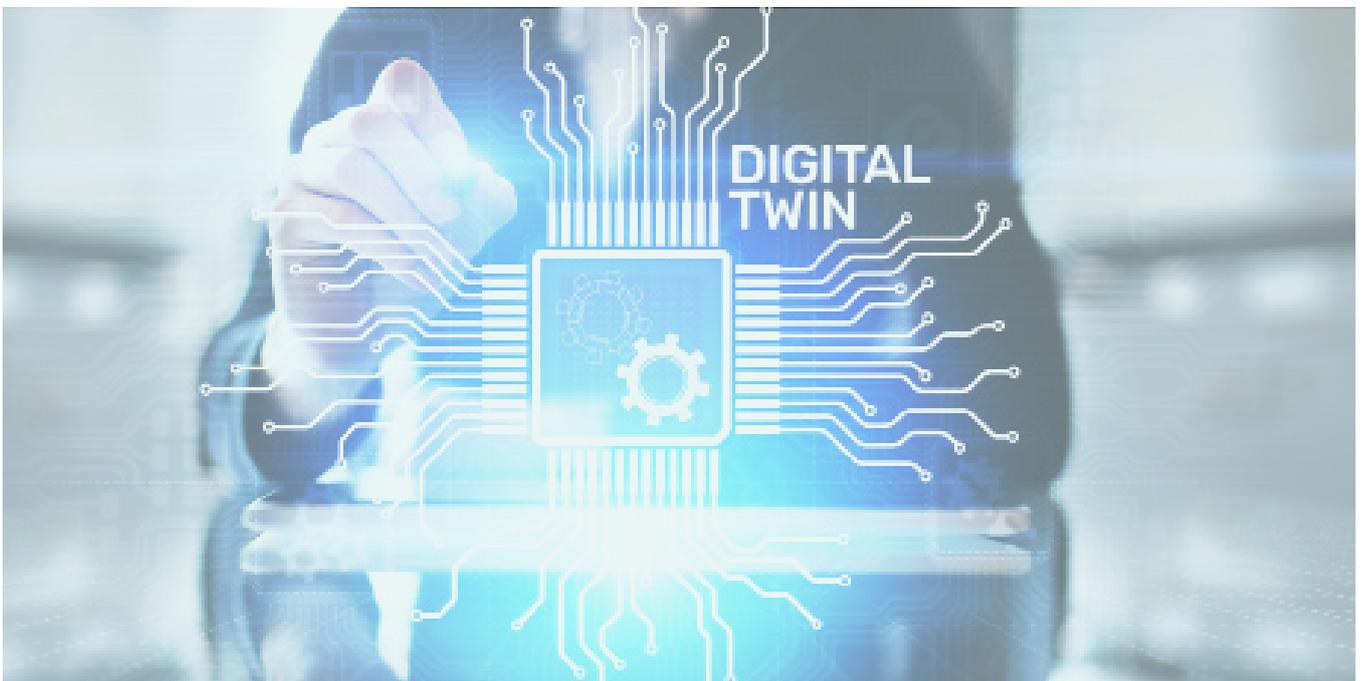
What is a Digital Twin?

A digital twin or digital replica is the virtual image of a process, product or service which connects the real and the virtual world. You can have a digital twin of your warehouse and its processes, another one of your E2E supply chain and its flows, etc. These replicas of reality can vary in scope and level of detail.



In practice, digital twins are often used for simulating the effect of changes, and the nature of those changes will of course depend on the scope of your digital twin. For example, in the case of an E2E Supply Chain Digital Twin -integrated with analytics applications- you could simulate things like:

- ✓ The downstream effect of a supplier disruption
- ✓ The effect on suppliers due to growth assumptions
- ✓ The manufacturing assets needed based on growth assumptions
- ✓ The upstream effect of a warehouse relocation
- ✓ The effect of a DC closure in terms of service and cost



Main benefits of the digital twin's use in supply chain



- + Continuous supply chain analyses and to move away from ad-hoc projects where the effort of collecting and processing data is repeated every time
- + Understanding supply chain dynamics and behavior and its end-to-end processes: find bottle-necks and improve performance beyond all expectations.
- + Monitoring risk and testing contingencies
- + Achieving excellence in your daily supply chain network and increasing visibility and transparency of your end-to-end supply chain
- + Supply chain transformation: Enabling understanding on the how and why of the supply chain opens previously hidden opportunities for transformation and growth.
- + Multi-Echelon Inventory Optimization
- + Cash to serve and cost to serve analysis
- + Forecasting and testing operations over the coming weeks and months

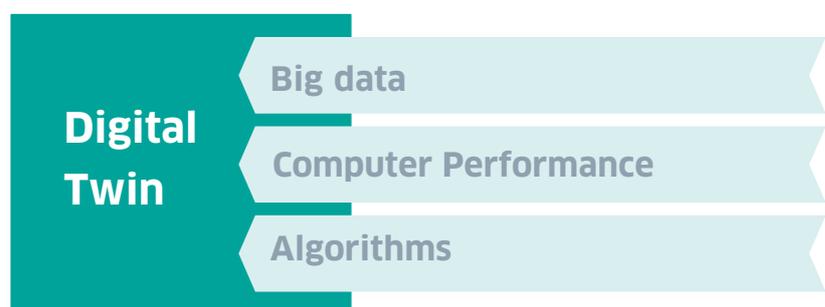
Requirements to create a digital twin

According the Gartner definition, "Big data is high-volume, high-velocity and/or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation."

To achieve the necessary processing for that volume of data, it follows logically that powerful computing capabilities are required.

For incorporating algorithms into the equation there are two main options:

- Use an existing tool designed to cover the scope of your "twin"
- Design a Customized AI Application, made specifically for you.



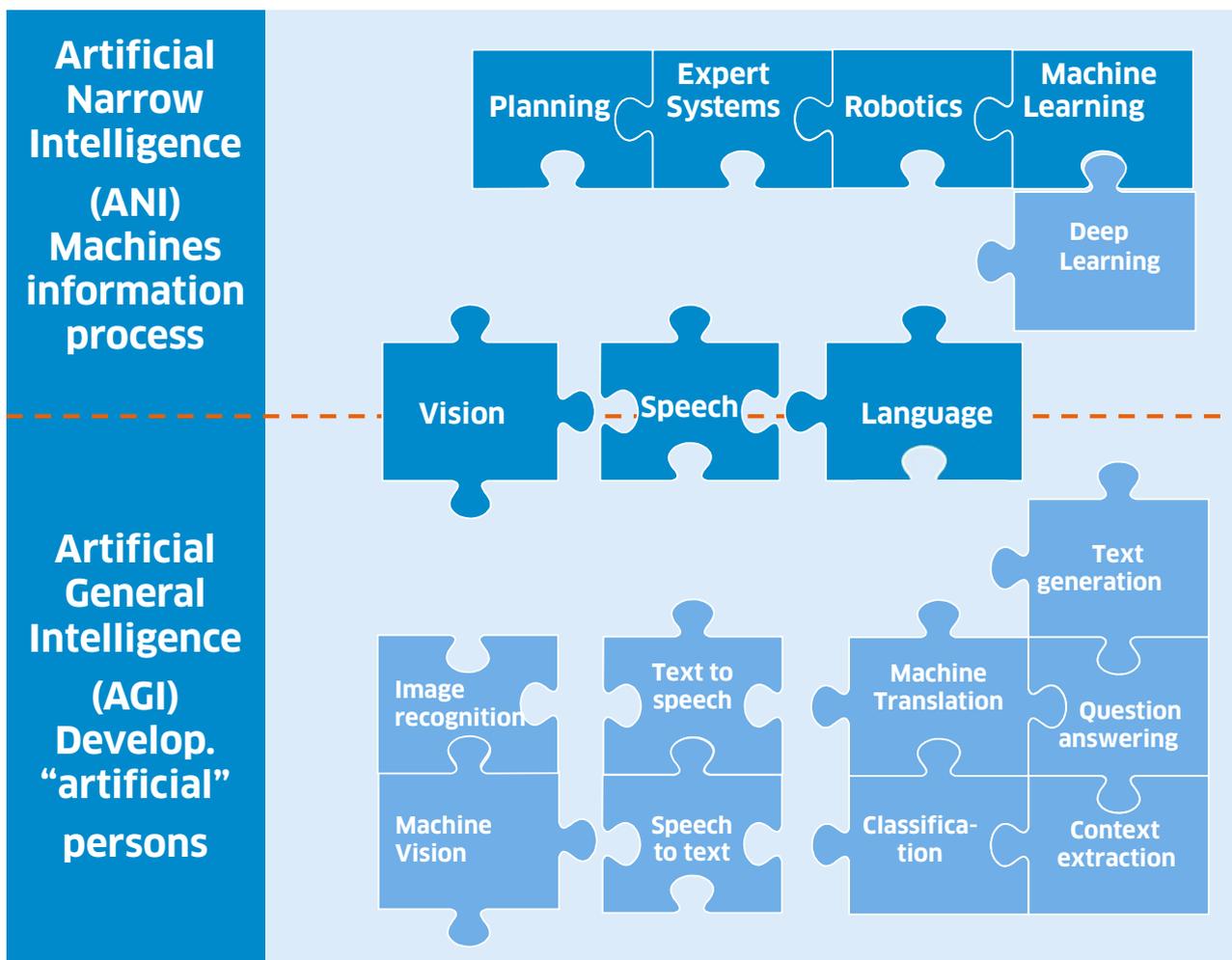
What does AI really mean?

“AI” is a tech buzzword that seems to take on a new meaning each time you hear it. This causes confusion for many business leaders who struggle to put it into perspective for their specific needs. To drill down this concept into actionable items, we first need to demystify the AI concept, and not see it as a “black scary dark science” box, and more for what it is: just a very flexible tool.

We can divide AI into two main categories: AGI (Artificial General Intelligence) aka. Strong AI and ANI (Artificial Narrow Intelligence) aka.

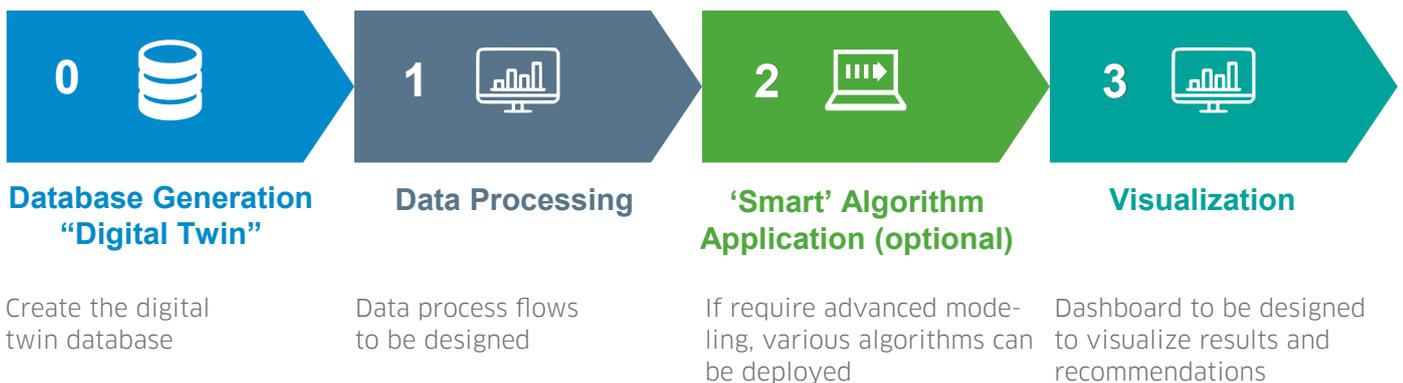
Weak AI. The good news is Supply Chain AI is Weak AI, so we can move our minds away from extremely sophisticated algorithms.

AI has been exhaustively talked about as the next big milestone in supply chain. But, to be fair, we have been using AI for some years now to a certain extent. “AI” is an umbrella term that realistically includes current service offerings of optimization. For example, today many software incorporate machine learning algorithms, such as the ones used for Forecasting, Production Planning, Inventory Management, etc.

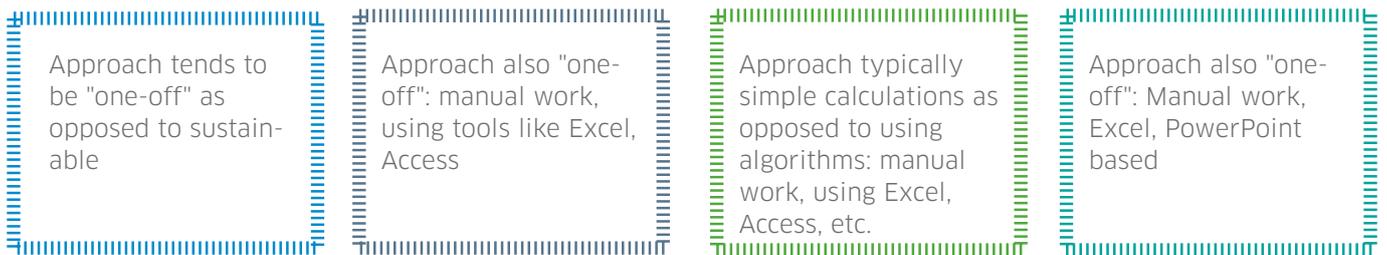


How to bring these concepts into action?

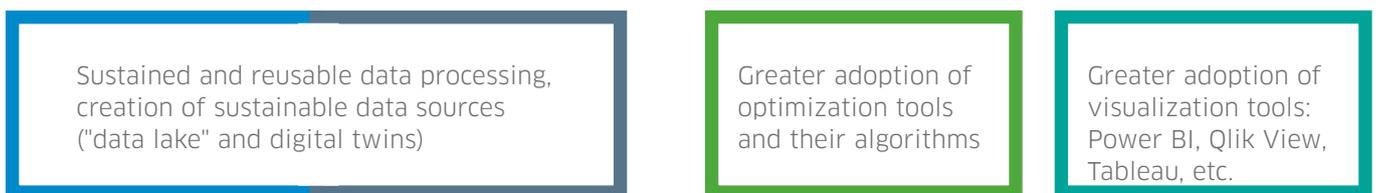
Digital Twin and AI are two concepts that work closely together, since the first one is a key component of a sustainable application of the second one. To visualize it in a workflow:



Gaps in the current process:



Progress made by some clients:



As shown in the graph, the workflow for creating AI Applications is the same as current analyses, but with an upgrade on how each step is executed. Current practices such as Control Towers can be leveraged as a starting point in the process, since a lot of progress has been done on the data end.

What algorithms can be applied?

There is an infinite number of algorithms, but the trick is knowing what the best algorithms are for a given issue and when to apply them. In general, the most common AI applications are meant to diagnose, optimize and/or predict. Here are some examples focused on predicting:

 Problem	 AI algorithm	 Main objective	 Solution
Need of highly accurate demand forecasts at high fidelity	Quantile Regression Model	Predict	Supply chain actionable forecast
Need to predict short-term volatile e-comm demand from from an e-commerce company	Quantile Regression Forests Model	Predict	Calculated stock-out probability and recommended action
Need to improve accuracy on manually-filled-forms to avoid delays and costs	Lightweight Bayesian Model	Predict	Auto-complete algorithm predicting field values in real time with few inputs

These examples portray how AI can solve issues of different kinds and complexities, ranging from improving filling-forms to highly complex forecasting solutions. AI can help you solve daily tasks or strategic ones: as said, AI is a really flexible 'tool'.



Supply Chain AI Applications

We see an evolution from ad-hoc analyses and one-time data extractions, to creating continuous flows of data to generate Data Lakes and Warehouses. Under this new scenario it is possible to use digital twins and/ or AI Applications, to continuously refine and improve Supply Chain decision making. Some examples might be:



Last mile optimization with real time data: such as traffic patterns, weather forecasts and delivery time windows.



Better planning for number of drivers and vehicles needed: considering product types, dimensions and order timing patterns.



Forecast accuracy improvements: by adding external factors such as GDP growth, public spending, weather conditions, store traffic by day of week, pricing data and promotional activity of the competition.



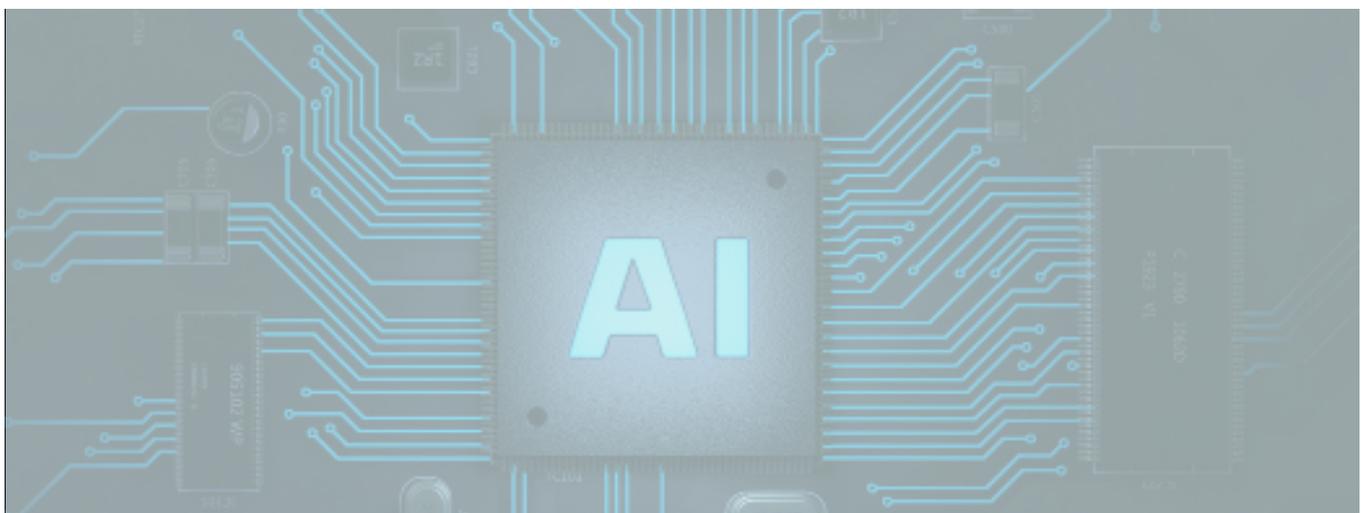
Improved production machinery maintenance: by closely monitoring the key factors of some specific parts, and better predict when they might break down to avoid rundowns and optimize maintenance costs.



More completed product master data: by filling the gaps based on available information of similar products.



Increased automation for the whole supply chain planning process: not only for the most complex calculations, but also for the most administrative and low value-added tasks through other uprising technologies such as RPA (Robotic Process Automation) or DPA (Digital Process Automation).



Two successful AI-based projects by Miebach Consulting

The range of Supply Chain AI applications is huge and has great potential. Let's deep dive in a couple of real business cases developed by Miebach.

1

Digital Twin design and implementation for a complex European distribution network



Our client:

Market leader in the consumer goods industry in Europe



Initial situation:

The company needed to reconfigure its distribution centers location and production allocation to optimize overall logistics flows on its continental network. In essence, optimize supply chain costs while meeting customer service requirements.



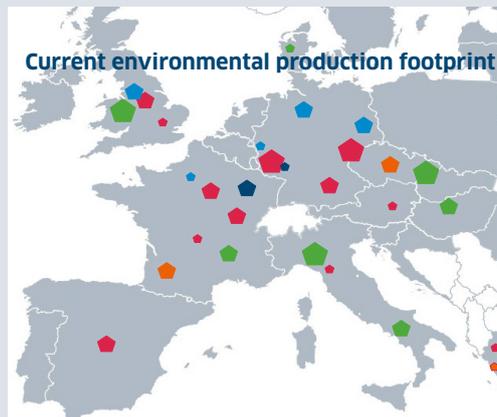
Miebach Consulting solution:

We have a long track record of executing this kind of ad-hoc analysis with a single dataset extraction. This approach has traditionally been enough, with supply chain conditions more stable than today's. However, in the current changing environment, optimal solutions found 6 months ago are no longer valid, as business conditions and market patterns are quickly changing. Our solution included a Digital Twin, which allowed us to keep pace with changing operating environments and enabled us to quickly derive optimal solutions as soon as new data was fed into the models generated.



Benefits:

This implemented approach, that contemplated 5 product categories, 46 factories, and 92 distribution centers to distribute products in 24 markets, enabled not only cost reductions, but also to keep track of evolving events during COVID 19's most difficult period and facilitate optimal decision making.



- ◆ Product category 1
- ◆ Product category 2
- ◆ Product category 3
- ◆ Product category 4
- ◆ Product category 5

2

Digital Twin of a new multi-user distribution center



Our client:

Leading importer and distributor of consumer goods.



Initial situation:

The client had designed a new multi-user logistics center, and prior to implementation required a simulation model to ensure proper functioning of the various functional and storage areas: from reception to goods dispatch, including yard logistics.



Miebach Consulting solution:

Initially, a realistic 3D simulation model of the center and its processes was created to identify bottlenecks, plan for staffing efficiently, reduce throughput times and increase overall productivity of the solution designed. Today, the model is being fed continuously with new information and thus used as a Digital Twin during ongoing operations to map changes in the process organization and in floor space use, to determine their effects on defined KPIs.



Benefits:

- This approach not only helped the client to review questions regarding planning and dispatching of customer orders, but also the potential of incorporating additional mandates in the logistics center.
- The Digital Twin of the center has allowed the evaluation of different variants and scenarios in a holistic approach as the basis for a continuous optimization process, acquiring diagnostic and prognostic information and findings, in order to mirror the most realistic and transparent picture of the current situation.
- The deliverable came in the form of a KPI dashboard, 3D visualization and 3D animation of the complete center which allowed for root-cause analyses, enabling the targeted detection of process weaknesses and their elimination.
- As a result, by increasing transparency, improving system knowledge, and identifying cause-effect relationships, the Digital Twin has enabled a continuous optimization of processes through effective evaluation and data-driven decision making.

Success Factors for Implementing Digital Twins and AI

Coming from our learnings and pitfalls while implementing, these are our top success factors:

1) **Implement a talent development strategy to ensure the right capability**

On one hand, the talent required to deploy these technologies is different from the one required to manage the traditional supply chain (in the same way that there are several branches of science that work with data but from different perspectives: mathematics, systems engineering, etc). On the other hand, business and supply chain acumen are also required for successful implementation. This fact needs to be thoughtfully planned upfront for any big technological implementation.

3) **Plan data sources and a thorough assessment of missing fields and how to get them**

It is a key activity for ensuring success and avoiding that the entire initiative is derailed with poor data. Obtaining a good set of data is often one of the biggest hurdles in this kind of initiatives, and the effort required is often underestimated.

2) **Scope the problem properly and ensure quick feedback loops of the results achieved**

This is necessary to allow the continuous improvement of the solutions implemented and to optimize the capture of business value.

4) **4. Manage change from the design of the solution**

These technologies are introducing quite a few changes within organisations. Lack of trust in the technological developments, fear of the ability for keeping it up-to-date, and a potential threat of job losses, are issues that need to be addressed from the start of any process. Change management needs to be planned in parallel and is not to be overlooked due to the prospect of integrating latest technology developments into already established and successful organisations.

Miebach Consulting recommendations

- ✓ The creation of comprehensive digital twins for complex systems and the application of AI to solve problems of all levels of complexity are options now economically viable, and they will become key to supply chain competitive advantage.
- ✓ What is most important is to start the journey: pick the right opportunities, set realistic expectations, assemble a capable team, and start gathering relevant data to initiate a pilot to gain confidence and proof the value of these applications within your organization.
- ✓ In Miebach Consulting we have been successfully deploying Digital Twins and AI Applications for the past decade and will be happy to discuss the situation of your supply chain and offer proposals for improvement.

Miebach Consulting: The Supply Chain Engineers

Miebach Consulting offers international supply chain consulting and engineering services in production and logistics in 24 offices worldwide. Our clients are medium-sized companies as well as corporations that want to improve and expand their competitive position with innovative logistics solutions.

The Miebach Group, founded in Frankfurt in 1973, today has office locations in Europe, Asia as well as North and South America. With over 380 employees, we are one of the leading international consulting companies for logistics and supply chain management. As a result, our clients get what we stand for: Supply Chain Excellence.

2020

- 24 offices worldwide
- 380 Employees

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