

Digital twin under the magnifying glass –

Nice gimmick or real game changer
for the supply chain?

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Whitepaper

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Triple Transformation study:

Digitalisation, sustainability and resilience as
guidelines for future-proof value chains



Digital twin under the magnifying glass – Nice gimmick or real game changer for the supply chain?

Whitepaper from

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as part of the BVL study

**Triple Transformation:
Digitalisation, sustainability, and resilience
as guidelines for future-proof value chains**

from the series

**TRENDS AND STRATEGIES IN LOGISTICS AND
SUPPLY CHAIN MANAGEMENT**

The digitalisation of the supply chain as a competitive factor

Status quo of digitalisation in the supply chain

Digitalising business processes has been a key challenge for companies for several years. However, it has not yet been introduced across the board, but it continues to grow in importance. Unsurprisingly, the trend towards digitalisation is therefore considered to be highly relevant and influential across all industries. While individual implementation projects have primarily focussed on the automation of processes and the management of data, a holistic transformation is still needed in most companies. Hardly more than a quarter of the companies surveyed as part of the BVL Trends and Strategies 2023 study can confirm that they have already completed an entire transformation in the area of digitalisation.

The complexity of supply chains continues to increase even today. Dense, interwoven networks with diverse interrelationships characterise logistics today. Despite companies' increasing interest in reducing this complexity, the influence of unpredictable crises has risen again in recent years. To counter these, companies have again had to integrate a variety of transport modes, additional services, and supplementary service providers.

For companies in any industry, keeping logistics costs under control is therefore becoming a feat of strength. The fundamental goal of controlling supply chains end-to-end fails due to the feasibility of manual processes - human responsiveness requires machine support at this point.

On the other hand, there is increasing pressure to act due to external restrictions and requirements: Customers expect their goods to be delivered on time, reliably, cost-effectively and, at best, in a sustainable manner. Regulatory framework conditions require the introduction of ESG-compliant production and transport measures. Those who cannot Deliver – In the truest sense of the word – will not only lose volumes but also customers. The concept of the digital twin offers suitable approaches to optimise the process of digital transformation, even under new requirements.

As part of the digital mapping of supply chain structures, the digital twin can serve as the basis for the comprehensive digitalisation of business processes.

Definition: What is a digital twin?

Although the term digital twin has become increasingly important in recent years, the use of the concept in the corporate world is nothing new. A digital twin is nothing more than a virtual version of objects, processes, or systems. The basis for this was provided as early as the 1960s by computerised simulation techniques, which were mainly used in government aerospace research projects due to high implementation costs. However, with an increasing reduction in the complexity of digital processes and with access to new digital tools and systems, the digital twin concept has also opened up for companies. In a modern context, the digital twin is, therefore, primarily used as a true-to-life image of a physical infrastructure to support ongoing operations and analyse internal data streams.

Potential in the supply chain

The use of a digital twin is also becoming increasingly popular in logistics. The aim for most companies is to drive forward the optimisation and control of business processes. The increasing need for flexibilisation and transparency in the supply chain is bringing the possible applications of the digital twin for logistics processes further into focus.

As core aspects of resilience, concrete approaches are emerging to strengthen the resilience of the entire supply chain. We refer to the full digitalisation of supply chains and their participants as a digital twin in the supply chain. This means that all processes are represented virtually and transparently in an interlinked manner, thus providing an optimal basis for organising the supply chain according to digital, sustainable and resilient aspects.

The application potential for improving manual operating processes in the context of the utilisation, operation, and maintenance of physical systems in warehouse locations is obvious. Also, dynamic processes can be digitally controlled. This includes, for example, picking and sorting in the warehouse, manoeuvring in the yard or organising multi-stage transport from overseas to the DC destination in Europe. A digital twin is able to make end-to-end processes fully manageable and transparent.

Despite the growing complexity of modern supply networks, which offer an unmanageable number of possible combinations and nodes, the digital twin succeeds in identifying and implementing cost-optimised solutions while taking individual restrictions into account.

On the one hand, holistic optimisation algorithms such as the simplex algorithm are used for this purpose, and on the other hand, the first approaches of artificial intelligence are used.

Numerous opportunities for leveraging a digital twin in logistics functions are readily apparent - but it is up to the companies to manage the implementation in a targeted manner. In order for the digital twin to deliver measurable added value for business processes and not remain the result of an internal digital unit's gimmick, the focus during implementation must be on a meaningful and appropriate format. In the future, it will be a challenge for companies to consider and ensure framework conditions such as data quality assurance, high model fidelity and the consistent quality of results in addition to the digital infrastructure. This is a highly complex process that requires a clearly defined approach.

The art of implementation in a company-specific context

"Health Check": Is a digital twin worth it?

As a service provider in the field of digital transformation, KPS has gained a comprehensive overview of the deployment options of digital twins in logistics. From this knowledge gained, it is possible to deduct a solution-oriented approach based on a tried and tested model. First and foremost, the need for a thorough analysis of internal company structures has emerged as essential when preparing the introduction and renewal of digital processes. In an environment with countless possible applications, it makes sense to define the strategic goal within a larger corporate context. In a so-called 'health check', a comprehensive analysis of the entire supply chain is carried out in order to discover any existing gaps in requirements and potential optimisation levers in a company-specific context.

Such an analysis is done by including the outside-in perspective of relevant logistics managers to ensure that also external developments are considered. Depending on the individual characteristics of value creation in the supply chain, appropriate measures are then derived to address the resulting challenges and opportunities. Finally, it is possible to define a customised implementation framework that takes into account the company's scope of action and determines if and when it is worth implementing a digital twin.

How do you create a digital twin?

Implementation follows the concrete definition of the objective. This not only focuses on the detailed design of individual parts of the supply chain but also makes it possible to define an appropriate scope for the entire implementation project. In the introductory phase of the digital twin, it is initially essential to deal with the basics of the digital twin in terms of analysing and evaluating information. As a first step, companies can focus on the basic implementation options for common optimisation levers in the area of intervention management, operational and maintenance interventions or investment projects. Further potential can be realised in a subsequent step by introducing continuous status monitoring and control in real time. Finally, companies should focus on the transition to

self-learning, intelligent systems. The various application options, which build on each other, therefore, require sensible bundling in the sense of a quickly deployable solution. Based on different observation horizons, differentiated implementation decisions, as well as advantages and disadvantages of different forms of the digital twin, can be made within a predefined framework. This results in a logical prioritisation and implementation sequence for the derived measures. The creation of a roadmap also helps to categorise the measures into a time horizon and to develop a digital twin as well as interdependent, subject-specific initiatives on a solid foundation.

Differentiated observation horizons

The aforementioned observation horizons can be divided into three overarching dimensions of the digital twin with different scopes and degrees of maturity. It makes sense to differentiate implementations according to their level of complexity and potential. As the next higher design level is often based on a solid foundation of the previous one, the complexity naturally increases successively. Accordingly, most of the implementation efforts realised to date are still at the initial design levels. At the same time, however, the potential of the digital twin is also growing in line with its complexity - because yet unexplored business areas offer numerous opportunities to benefit as a first mover from innovative applications of the digital twin. According to the current state of development, the observation horizons can be defined as follows:

1. Mapping of an individual logistics process (e.g. tracking delivery)
2. Networking of several components of the supply chain (e.g. internal warehouse processes including entry and exit points)
3. Development of an externally orientated network (e.g. complete supply network)

In the initial, first design level of a digital twin, the primary aim is to depict a singular infrastructure with the highest possible fidelity to reality. This can be the virtual form of a retail branch or a production facility, for example, but also includes rudimentary simulations of systems. The main objective here is to optimise internal processes and workflows.

The advanced, second configuration involves the digital networking of individual parts of the supply chain or digital twins of level 1. This can also mean the complete networking of the entire internal supply chain in an end-to-end solution. In this way, the flow of goods and transport routes can be controlled from a holistic perspective, leading to synergy effects and efficiency gains in several stages of the value chain.

The third level corresponds to the highest degree of maturity. It involves the cumulative merging of individual supply chains, including the upstream and downstream process steps (e.g. from suppliers and producers) and their systems. By integrating the participating service partners and their IT infrastructure into the digital mapping, a holistic logistics network is created. This ultimate form of collaboration offers the opportunity to exploit previously undiscovered potential in the supply chain, access additional resources and view your own organisation from a new perspective. By expanding into remote business sectors, cross-industry ecosystems can also be formed in the future. As soon as a majority of companies have developed their own digital twins in order to optimise the management of their own infrastructure, it makes sense to combine them in order to model cross-sectoral effects that could not be captured in individual systems. This will become increasingly important, particularly in view of the growing relevance of resilience in volatile business areas.

It depends ...

In this respect, 'digital twins' have immense potential to optimise internal and external corporate processes at different levels. However, the more extensive the planned deployment, the more it is necessary to consider process-accompanying and supporting technologies. This includes, for example, further development options such as the integration of artificial intelligence, which can independently recognise recurring patterns in its own processes. This is, however, only possible on the basis of extensive and high-quality data.

The fundamentals of digitalisation must, therefore, not be neglected in order to drive forward the learning process of new solutions at high speed and sustainably strengthen the security of the systems. This is the only way to create forward-looking and preventive structures as part of a holistic strategy and planning support.

Some of these use cases have already been tried and tested and, thus, serve as a suitable guideline for companies that are considering introducing a digital twin. The practical deployment options are illustrated below using specific case studies. Firstly, it is worthwhile to take a look at the fundamental framework conditions that arise for companies from current market movements. These can serve as initial focus topics for companies to meet new challenges in the supply chain. Subsequently, a real customer example is discussed on the basis of a practical use case, which shows the current status of the development of digital twins in the logistics area and offers the opportunity to draw on established best practices.

The final section of this whitepaper is dedicated to the question of how the further development of digital twins can be organised in the future. To this end, the regulatory system is becoming a central authority that is forcing further developments. On the basis of this holistic view of current and future relevant fields of action of the digital twin enables companies to gain a fundamental understanding of the procedure for implementing one.

General conditions: Tackling the challenges in the supply chain

The specific initial situation of companies varies greatly depending on market dynamics. Nevertheless, initial classifications of challenges can be identified across all industries. These open up an initial framework for action for companies to deal with the introduction of a digital twin.

Cost pressure and scarcity of resources

As a rule, processes that still have to be carried out manually to a large extent offer the greatest scope for challenges. New digital players are approaching these issues differently and increasing competitive pressure with greenfield solutions. Costs are also rising continuously, partly due to the battle for resources and employees.

In this situation, companies must actively address the continuous improvement of their internal processes to meet the growing cost pressure on the one hand and to maintain

their positioning on the other. Digitalised processes are able to effectively reduce the burden on resources and cost pressure at this point by highlighting efficiency potential and giving employees more time for value-creating activities. The same applies to the organisation and orchestration of business processes. In a world where dynamic movements are becoming the norm, supply chains regularly fail due to their sequential planning logic. A digital twin makes it possible to utilise financial and resource-related expenses in a time- and cost-efficient manner while dynamically taking external influences into account.

Responsiveness and resilience

Further challenges also arise in the planning context. In a volatile market environment, it is no longer enough to simply react to events and initiate mitigating measures. Companies want and need to act with foresight - and this requires the exhaustive evaluation and monitoring of digital data streams. Once a digital twin has been established for core processes, it can access a large amount of data that can be used as a basis for decision-making for future business models. The possible applications, therefore, range from optimising the status quo to the fact-based expansion of the systems. Access to real-time data and the link to the right inventory systems also make it possible to increase the organisation's reaction speed and minimise the impact.

Human factor

Last but not least, people are reaching their limits in the changing world of work. Whether they are physically or mentally challenged, the limitations often restrict companies in the seamless and error-free execution of business-critical processes. These processes or even individual process steps can be handled differently by digitalising them. For example, by using artificial intelligence, the execution of repetitive tasks can be automated, which

relieves the pressure on the employees. The digital twin of these processes provides the basis for this. Nevertheless, there are also situations, especially in the face of unpredictable developments, which require human judgment. For example, while the digital twin succeeds in quickly evaluating a large amount of information and identifying correlations, it will generally be up to the human workforce to interpret this information in a targeted

manner and make corrections where necessary. In a coordinated interplay, the company can effectively expand its own expertise, optimise processes, and gain a decisive competitive advantage in dealing with new, unknown circumstances.

Practical example: The 'digital warehouse' as a lighthouse project

Concept: Holistic approach from the producer to the shop

Once the company has recognised that it makes sense to represent several processes in a networked system in its own application context, it is important to find the right approach for implementation and to realise this in a lean procedure at high speed. An anonymised project and practical example illustrates how a comprehensive solution in the form of a digital twin was developed on the basis of internal requirements from day-to-day business.

A leading textile retailer was faced with the challenge of supplying the various branches of an extensive Eastern European network as efficiently as possible. A digital twin was, therefore, to be created for the distribution centre responsible for that region. The requirements were manifold and varied: Large storage quantities of up to several million items require short throughput and storage times in the textile market, but the systems must also be able to handle very high volumes. In addition, real-time material flow control from the warehouse to the stores was to be improved in order to better control the availability of goods and to identify possible obstacles in distribution.

Realisation: Well planned is already a winner

In a multi-stage process, existing systems and processes at the distribution centre were first largely digitised on the basis of a comprehensive analysis. This included, for example, the automation of item labelling and the virtual transfer of warehousing processes. This step provided a substantial basis for further implementation, as it was the only way to ensure the cost-efficient planning and execution of processes that are crucial to the resilience of the supply chain. The digital representation of the physical infrastructure was then modelled realistically. In addition to the actual four walls of the warehouse, the yard, including the car park and handling areas, was also taken into account. The newly gained transparency about work processes and the real-time view of the operating areas enable an optimised use of the space. Changes to the storage systems and allocations can be displayed and modelled more easily.

Finally, the digital twin was integrated into the existing IT landscape. To this end, supporting SAP integrations and applications were used to create the interface between the digital world and the employees' real workspace. This is the only way to enable employees to intervene in digitalised processes in a value-creating way in the long term. This completed the implementation of a digital twin as an image of a dedicated infrastructural unit. Building on this, the horizon could be extended once again and the extent to which the depth of added value could be increased for other parts of the supply chain was determined. As the supply of shops is closely linked to the export of goods, the link to third-party systems was identified as an optimisation lever. A universal interface to both in-house and external digital solutions was created to ensure the synchronisation of incoming and outgoing data streams and to increase the exchange of and access to relevant information.

Results: Cost efficiency, transparency, perfect utilisation of space

The result is a digital twin of a distribution centre that has been helping to increase efficiency and optimise business processes at various levels since day one. As part of transport management, every movement within the virtual environment can be monitored and controlled via an application in the real working environment. Conversely, any interventions in the real environment are made equally traceable and transparent. The organisation of goods and their assignment to pallets is carried out completely digitally with an interface to automated processes in the warehouse. Overall, this enables

the cost-efficient planning of inbound and outbound transports as well as optimised control of transport orders to participating service companies. With regard to the overall orchestration of the supply chain, the example results in various advantages for the company: Firstly, strategic business management is simplified. Digitalised processes and the visualisation of the physical infrastructure generate validated, usable findings, which in turn enables much faster, fact-based decision-making. Secondly, employees gain a high degree of process empowerment through unrestricted access to new infor-

mation and data, which in turn enables them to increase internal value creation. Finally, external synergies are created by sharing data and information from a large number of intelligent systems thus exponentially increasing learning effects.

Regulation: child's play with the digital twin?

The regulatory imperative

In addition to increasing process efficiencies, digital twins are also highly relevant due to changing external restrictions. In particular, the Supply Chain Due Diligence Act (LkSG) places clearly regulated requirements on the supply chain, which urges logistics players to act. As part of the due diligence obligations regarding the respective practices of the individual members of the chain, the first question that arises is how to create complete transparency in the supply chain. A digital twin seems predestined to create precisely this transparency by means of a dynamically adaptable mapping of the supply chain. However, as effective as this mapping is in bringing together relevant regulatory information, its functionality for the implementation of corresponding preventive measures remains limited if it remains purely a data storage system. The focus here is on the sustainability of processes and proof of compliance with ethical and social standards. Far-sighted companies recognise this as the right starting point for incorporating digitalisation trends in a targeted manner in order to act in a compliant manner in terms of sustainability and also

achieve synergy effects for greater resilience. Hence, the digital twin is becoming increasingly important for companies to ensure compliance and operability in harmony.

The pinnacle of transformation

Yet, getting there is no child's play - a digital twin in a single unit is severely limited in its application possibilities. That means it also harbours an imperative to deal with the strategic orientation of a networked IT infrastructure in the future, which takes into account diverse markets and service providers. Modern supply networks with their interlinked service providers and transport routes are subject to the strong influence of changing framework conditions, which in the worst case can lead to total cancellations. The formation of partnerships and joint collaborations offer obvious options for utilising alternative routes and sourcing and ensuring a high level of flexibility in the supply chain. The digital twin can support preventive action and the integration of partner systems. The aspect of technical implementation remains indispensable here: Inter-

operability is the buzzword of the hour. In order to effectively merge and guarantee the ability of a digital twin to act, it is first and foremost important to set up and expand own digital systems to a functional standard. The sooner the better - digitalisation does not stop here. New challenges await in the future. Companies should therefore see the Supply Chain Act as a means to their own end of building a functional, digital foundation to manage further transformation processes in the future.

The digital twin as an enabler of the 'triple transformation'

Current trends and developments are leading to great pressure to act within logistics. The expectations placed on the players along the supply chain to find suitable answers to emerging requirements are constantly increasing. This means a fundamental shift in their own understanding of their role – from efficiency-orientated implementers to innovative designers and solution providers. This opens up new opportunities to expand one's own business model and to develop complementary products and services. Flexibility and speed are becoming key design elements of functional supply chains in volatile retail environments. As a result, they are increasingly transforming into dynamic supply networks. This requires a rethinking in the strategy and management of organisations. Decision-makers need to ask themselves key questions: How will our operating model change? Which markets and supply networks will be relevant in the future? Where can I expand or supple-

ment value-creating new business models? What opportunities do the existing infrastructure and IT systems offer and do they need to be adapted to support long-term changes?

A digital twin of the supply chain, therefore, offers a suitable starting point for meeting the challenges of the 'triple transformation' with its trends of digitalisation, sustainability, and resilience. As these are all driven by external influences, it is up to the companies themselves to counteract them with effective measures and strategies. A digital twin is able to manage these volatile currents. In addition to the implementation of individual measures, a holistic digital system offers the opportunity to efficiently control overarching processes, and align with external market movements. However, there will also be a constant need for expansion in the transformation of the entire value chain. However, a mature digital twin that takes different per-

spectives into account can be a solid foundation for a future-oriented and competitive transformation of your own organisation. In addition to optimising internal processes, this enables companies to act in compliance with the law in a highly regulated environment, to influence external business areas and to demonstrate sustainability to customers. A well-thought-out roadmap, experienced service partners, and established best practices in the industry help to prioritise and successfully implement the new IT strategy.



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The management summary of the main study "Triple Transformation: Digitalisation, sustainability and resilience as guidelines for future-proof value chains" and other white papers can be downloaded at www.bvl-trends.de.

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