

■ WHITEPAPER

Future Challenges in Logistics and Supply Chain Management

SCENARIO PLANNING FOR THE GENERATION OF FUTURE SUPPLY CHAINS

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Future market developments force companies to adapt their organization and structure of supply chains. Individualization, scarcity of resources and accelerated technological progress are only some of the factors posing new challenges to logistics and production in the process and manufacturing industries. Early adaption and reconfiguration of the supply chain is therefore crucial for companies to proactively manage challenges and use future developments as opportunities.

FUTURE CHALLENGES IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT

The publication series "Future Challenges in Logistics and Supply Chain Management" addresses current challenges, illuminates trends and focusses on novel technologies and business models.

The various volumes of the publication series present the future picture of an innovative industry that is designed and lived up to by research and practice.

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SCENARIO PLANNING FOR THE GENERATION OF FUTURE SUPPLY CHAINS

Research replaces crystal ball	1
Scenario Planning Techniques	2
Scenario Planning	2
Scenario Planning within NextNet	3
Creation of future projections	5
Future Scenario Generation	8
Resulting Macro Scenarios	8
Validation and Selection of the Scenarios	9
Scenario Narratives	11
ASPIRANT	11
DITHER	13
ENDANGER	14
Conclusion	17
Acknowledgement	17
References	18

SCENARIO PLANNING FOR THE GENERATION OF FUTURE SUPPLY CHAINS

Research replaces crystal ball

Future is influenced by several developments and often takes a different turn than expected. Those, hence, who have to make decisions for the future need orientation in the present, while considering different probable developments. Scenario building techniques allow for visionary thinking and to raise awareness of different future-alternatives, thus preparing for possible futures [1].

As the integration of future developments creates a reference point for the strategic orientation of a company, it is important to remain an objective view. Accordingly, scenario planning faced a growing interest on the interface to academia, public and private sector as well as policy-making. The use of scenario planning for making public policy decisions started in the 1950's for war game analysis at the Rand Corporation in the US [13]. Since then it has frequently applied to prepare a strategy for policy and companies.

The white paper describes a methodological approach for the generation of future scenarios. The approach refers to the methodology used in the EU research project NextNet that generates future scenarios for the logistics industry in 2030. It is based on political, economic, social, technological, legal and environmental (PESTLE) trends and market drivers. The generation of future scenarios integrate the process, manufacturing and logistics industries and thus form a cross-sector and cross-technology overview of future developments.

NextNet creates a cross-sectorial initiative at European level. With scenario planning, it proposes research and innovation priorities for the future of supply chains.



www.nextnetproject.eu

Scenario Planning sets the methodological framework for this work. The described methodology is based on a quantitative and qualitative approach, while close coordination and collaboration between production and logistics guides the underlying

scenario design. As a result, a set of macro scenarios are exemplary detailed to show different scenario settings. Those range from progressive developments of all PESTLE dimensions up to rather regressing or stagnating developments.

In the following, the chapters firstly describe scenario planning techniques and elaborate on the scenario planning used for this work. Secondly, the creation of projections and scenarios are explained that reflect on different future states of the setting for the manufacturing, process and logistics industry. The white paper closes with exemplary scenario narratives and possible effects on the supply chain.

Scenario Planning Techniques

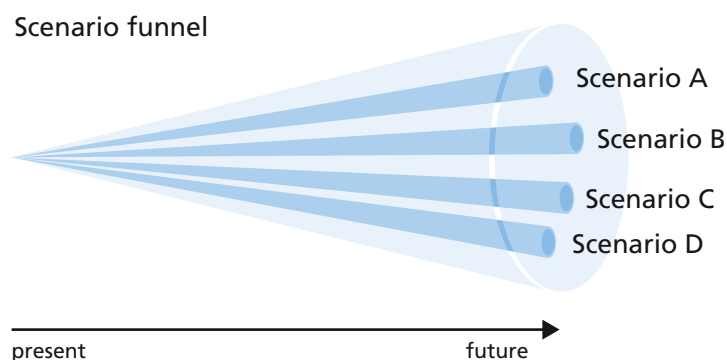
A scenario is a representation of a possible future situation in narrative form [10]. It portrays causal relationships that explain how, from the vantage point of the present, a particular future in a certain story setting has been obtained. Those generated scenarios and the combination of trends help organizations to prepare for future possibilities and to ensure an innovative and flexible development [1].

Scenario planning has to be distinguished from prognosis as scenarios describe different possible states of the future without defining a single way. Hence, scenario planning is different from other future practices, such as projections, predictions and forecasts. It rather provides a set of possible ways forward but remains uncertainty based [13].

SCENARIO PLANNING

Scenario planning usually constitutes a process consisting of several workshops and work phases, where a larger group of participants – with the assistance of a smaller facilitating core team – develops a set of scenarios, which will then be edited by the core team into a final version of the narratives. Figure 1 shows different sets of scenarios each representing a bundle of future projections.

Figure 1:
Bundles of future projections



Scenario building techniques are part of scenario planning and contain powerful tools to identify contextual challenges and opportunities. The techniques highlight the implications of possible future systems and projects consequences of choices or policy decisions. For scenario building, two main approaches can be used to form future projections. The first approach, a deductive approach, requires experience from the scenario creator and often leads to preconceived images of the future that do not represent the entire scenario space. The other methodology uses an inductive approach. In an initial step, all possible combinations of future projections are taken into account and form different projection bundles. A second step subsequently reduces the amount of projection bundles by respective methods [8].

For the general understanding and communication of the scenarios to external as well as internal group members, the creation of scenario narratives is important. As scenarios are possible developments of the future, 'positive' as well as 'negative' scenarios need to be incorporated within the set of scenarios. Furthermore, it is necessary to draw a picture of the future that is distinct and rich in contrasts [10].

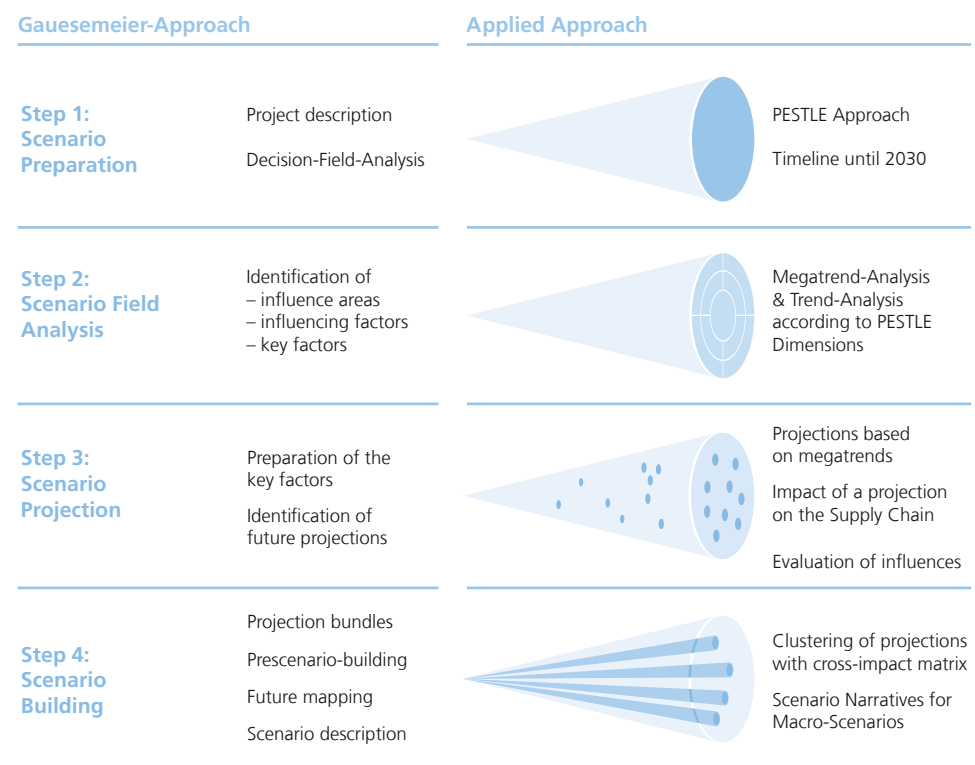
SCENARIO PLANNING WITHIN NEXTNET

The literature offers several approaches to generate scenarios. The approach used for this work is closely linked to a methodology proposed by Gausemeier [6]. It is based on a cross-impact analysis of future projections and is in line with the rational, objectivist school. The approach serves to identify correlations and causal impacts [1], and is complemented by qualitative methods, to enhance the plausibility of the scenarios. The resulting scenarios represent macro-scenarios outlining the future industrial surroundings based on a trend analysis along PESTLE dimensions. The Gausemeier approach belongs to the category of quantitative approaches and uses a cross-impact and consistency matrix to develop a set of scenarios. The major advantage of Gausemeier lies in its possibility to integrate several trends and megatrends as projections along with its way forward to reduce the amount of projection bundles to a few scenarios for a more detailed analysis [7]. Figure 2 provides an overview of the four steps of the Gausemeier approach and its specifications applied in the underlying case.

Step 1, Scenario-Preparation, comprises the definition of the scope and the timeline. In addition, it contains a decision-field-analysis. A timeline until 2030 and an analysis along the PESTLE dimensions is selected. Step 2 contains a Scenario Field Analysis that identifies and describes major influencing trends. Step 3 clusters the trends to state future projections. Those projections are integrated into a cross-impact matrix to form future projection bundles and thus preliminary scenarios. Step 4 evaluates the consistency of the scenarios via cross-impact analysis resulting in a

final set of macro-scenarios. As the cross-impact evaluation is a pure mathematical approach, its plausibility is then judged by experts. Accordingly, the probability of occurrence of each scenario and its impact on the supply chain needs to be evaluated by experts. Finally, a storyline for each macro scenario details the scenario settings and conveys the differences of each scenario to the decision making units. While reflecting on the impact of each scenario, conclusions have to be drawn on how to prepare for, or even influence, different alternatives. The following describes Step 3 and Step 4 in more detail.

Figure 2:
Application of Gausemeier
methodology for NextNet



Creation of future projections

The creation of future projections relies on previously identified trends and megatrends. The PESTLE dimensions set the framework and form subsections, each incorporating several so-called 'descriptors'. Descriptors express a neutral form of future topics and is characterized by diverging future projections. Future projections detail a certain future state of a descriptor and describe possible circumstances that companies and societies might face. Most commonly, a descriptor has a positive, negative and neutral future projection.

While formulating the future projections, several quality criteria need to be considered. It is essential for each projection to be reasonable and conceivable [6], in the sense that a projection can be futuristic but needs to rely on valid arguments or requires justification by statistical developments. Hence, the projections have to fulfil following criteria:

- Plausibility – a projection needs to be plausible to the scenario team.
- Dissimilarity – all projections have to be distinct to each other.
- Completeness – a set of projections within a descriptor has to provide a comprehensive set of possible developments.
- Relevance – each projection requires a check regarding its future relevance.
- Information content – each projection needs to add further value to the set of projections within a descriptor.

The number of projections per descriptor is not fixed and varies with every descriptor. Suitable projections must be distinct, so that the subsequent consistency check does not lead to many different evaluations, but rather to reasonable combinations of projections for consistent scenarios.

For each projection, a meaningful short statement for its characterization is specified along with a more detailed explanation and reasoning. The projections at hand have been created by the means of brainstorming sessions in groups while considering the underlying trends. To ensure validity, the projections are supported by literature. Moreover, experts have validated critical projections in workshops.

Figure 3 provides an overview of the resulting projections categorized according to the six PESTLE dimensions. The figure shows first the dimensions, then the descriptors followed by the distinct projections. A detailed description of the future projections is available in "Alternative Development Paths for Supply Chains in 2030" [4].



Document "Alternative Development Paths for Supply Chains in 2030"

Figure 3:
Overview of the
resulting projections per
Dimension



Technological Dimension

Digital Transformation

- Rapid advancement of digitisation and digitalisation
- Obstacles restrain digital transformation
- Digital Stagnation

Autonomous Systems

- Dynamic development of autonomous technologies
- Innate reluctance to accept autonomous technologies

Alternative energy generation, storage and usage

- Established electrification technologies and green systems
- Ongoing electrification and alternative energy endeavours

Decentralized connection of information and physical devices

- Dominance of global players
- Start-ups and SMEs take up business

Disruptive production technologies

- Continuous exploitation of disruptive technologies
- Coexistence of conventional and disruptive technologies

Legal Dimension

Consumer Protection Laws

- Promotion of laws and full product transparency
- Legislation is lagging behind dynamic market development

Intellectual Property Laws

- Full security for inventors and data providers
- Low confidentiality for data and market participants

Social and Environmental Regulations

- Comprehensive regulatory framework
- Heterogeneous regulations

Environmental Dimension

Climate change

- Our planet is recovering
- Our planet on the brink

Environmental Resource Management

- Countering resource depletion
- Rise in depletion of natural resources

Future Scenario Generation

Different sets of future projections form scenarios. One of the techniques to form and to evaluate those scenarios is the Cross-Impact Balance Analysis (CIB). This scenario technique is one of the common applications using an inductive approach.

For the generation of bundles of different projections, future projections are plotted in the ordinate as well as in the abscissa of a matrix. Each combination of future projections is then evaluated by experts. When performing the evaluation, the evaluator assesses solely the impact of the future projection in the selected row on the future projection in the selected column. Hence, only direct impacts are considered. The following scale is considered for evaluation:



In general, a large number of projection bundles has to be examined. In such a case, the open simulation software ScenarioWizard 4.1.3 [12] can be applied for the evaluation and consistency check of the projection bundles.

RESULTING MACRO SCENARIOS

In the underlying case, about 63 million possible projection bundles had to be evaluated. Twelve consistent scenarios resulted after the consistency check conducted by the ScenarioWizard Tool. Two of the resulting scenarios show a progressive overall development and are characterized especially by a stable political and economic environment. A regressing overall development characterizes two further scenarios represented by a politically and economically unstable situation, as well as a lagging legislation and poor environmental conditions. All other scenarios can be classified in between, they show mixed developments.

Validation and Selection of the Scenarios

The previous chapters explained the way forward to achieve consistent scenarios. Those consistent scenarios are based on a quantitative approach and, hence, scenarios with interpretable and valid projection bundles are retrieved. A further step is now required to qualitatively evaluate the probability of occurrence of a scenario as well as the impact strength of the overall scenario.

An expert-workshop is a suitable method to fulfil this qualitative task. Regarding the topic for the creation of future scenarios, the selection of experts should be divers and from different industrial settings. For reasons of proper transfer of the content of the respective scenarios, a factsheet stating the characteristics of each scenario supports communication. For evaluation, experts estimate the probability of occurrence of each scenario and the potential strength of effects on necessary supply chain adaptations caused by the scenario. It is recommended to let the experts evaluate the scenario probability first, before asking for the potential strength of effects on the supply chain. A discussion round between the experts supports the argumentation that is necessary for the documentation of scenario narratives.

In a next step, a transfer of the assessment for each scenario into a probability-impact-matrix supports the overall distribution of the scenarios (displayed in Figure 5). The outcome of the assessment served to select scenarios which are probable and plausible and obligate a change to future supply chains.

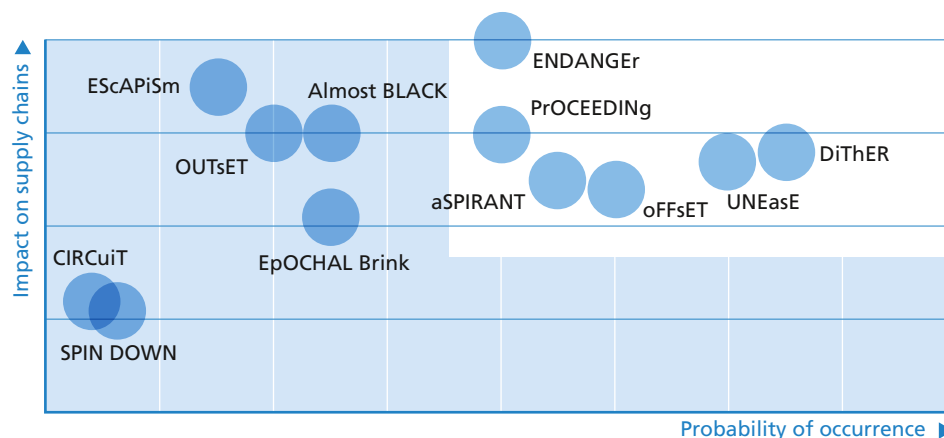


Figure 5:
Overview on the assessment of the
scenarios and scenario selection

As recommended by the literature, the amount of scenarios has to be restricted to allow a thorough further analysis with detailed scenario narratives. Bradfield et al. recommend a scenario set of 3 to 6 scenarios using a quantitative approach combined with an expert judgement [3]. The final number of selected scenarios highly depends on the amount of considered future projections and their uncertainties [1]. As Figure 5 shows, the assessment resulted in six scenarios that force a strong to medium change on the supply chain and have a rather high probability.

The figure can be read as follows: As each column represents one scenario, the rows denote the chosen projection for each descriptor within the scenario. Projections are sorted according to PESTLE dimensions. To facilitate reading, each dimension is represented by a different color shade. In total, each scenario consists of 22 future projections. The similarity of the selected projections determines, as far as possible, the arrangement of the scenarios. The following chapter elaborates on a narrative for each scenario that serves to explain the dynamic interaction of the projections.

Figure 6:
Overview on the projections
of the selected scenarios

	aSPIRANT	PrOCEEDIng	oFFsET	DiThER	UNEaSE	ENDANGER
Political Setting	Political concord in Europe		Constant development in Europe			Government collapse in Europe
Trade Policies	Free Trade			Protectionism		
Confederation	Contented Union		Unstable Confederations	Fragmentation		
Global Trade Shift	Steady Titans US & Europe		The pendulum shifts			
Global Corporate Structures	Rise of born-global firms	Think global – act local				
Digital Economy	Platform economy		Pure traditional economy	Platform economy	Traditional economy persists	
Financial Innovations	Big 5 are the banks of the future	Bank and Fintech collaboration	Big 5 are the banks of the future	Bank and Fintech collaboration		A world without banks
Demographic Change	Awareness of inequalities and wealth redistribution			Ageing population and acceleration of disparities		
Urban Living	Smart Regions	Smart Cities				
Consumption Patterns	Consumption Awareness	DIY Society	Much and Cheap	DIY Society		Much and Cheap
Customer Orientation	Collectivism – Focus on the crowd	Individualism – Focus on variety	Collectivism – Focusz on the crowd	Individualism – Focus on variety		Collectivism Focus on the crowd
Knowledge-based Economy	Investments equalise the labour market			Rapid changes cause unemployment		
Digital Transformation	Rapid advancement of digitalisation		Obstacles restrain digital transformation			
Autonomous Systems	Dynamic development of autonomous technologies		Innate reluctance to accept aut. tech.	Dynamic development of aut. tech.	Innate reluctance to accept aut. tech.	Dynamic development of aut. tech.
Altern. energy generation; storage & usage	Established Electrification Technologies and Green Systems		Ongoing elec. & altern. energy endeavours	Est. Electr. Techn. & Green Systems	Ongoing electrification and alternative energy endeavours	
Decentralised connection of information & devices	Dominance of Global Players	Start-ups and SMEs take up business	Dominance of Global Players	Start-ups and SMEs take up business		Dominance of Global Players
Disruptive Production Technologies	Continuous exploitation of disruptive technologies		Coexistence of conventional & disruptive tech.	Continuous exploitation of disruptive tech.	Coexistence of conventional & disruptive tech.	
Consumer Protection Laws	Promotion of laws and full product transparency		Legislation is lagging behind dynamic market development			
Intellectual Property Laws	Full security for inventors and data providers		Low confidentiality for data and market participants			
Social and Environmental Regulations	Comprehensive regulatory framework		Heterogeneous regulations			
Climate Change	Our planet is recovering		Our planet is on the brink	Our planet is recovering	Our planet is on the brink	
Environmental Resource Management	Countering resource depletion		Rise in depletion of nat. resources	Countering resource depletion	Rise in depletion of natural resources	

Scenario Narratives

The scenario narratives cover a description of the scenarios ASPIRANT, ENDANGER and DITHER. The criteria for the selection of those three scenarios are firstly based on their very different future states for the manufacturing, process and logistics industry and secondly on common developments within the scenarios. The scenario ASPIRANT has similar characteristics as PROCEEDING, both representing very progressive developments of all PESTLE dimensions. The scenario ENDANGER is representative for rather regressing and declining developments with the highest potential pressure of change on the supply chain. Both are hence described in further detail. The scenario DITHER can be classified as in-between similar to the scenarios UNEASE and OFFSET. As it has the highest estimated probability of occurrence among all scenarios, the scenario DITHER is narrated below. For further information on the descriptions of other scenarios, the reader is referred to additional publications within the NextNet context (see www.nextnetproject.eu).

Each scenario narrative contains the main characteristics at first, followed by a short description and the possible impact on the supply chain.

“ASPIRANT”-STRONG PARTNERSHIP ENABLES HOMOGENEOUS FRAMEWORKS ALLOWING A SUSTAINABLE AND TECHNOLOGICAL DEVELOPMENT.

ASPIRANT – General Setting

ASPIRANT represents a rather positive view on future developments in all dimensions. The characteristics of the scenario can be summarized with the following aspects:

- Social balance is influenced by social media communities
- Stable political and economic environment with a widely established digitalization
- Sustainably prospering environment for a homogenous social, technical and economic development throughout Europe
- Global enterprises and tech start-ups are the economic winners

A stable political and economic environment within the EU and its neighboring countries sets the basis for this scenario. This political and economic setting allows for a quick adaption of legal regulations. In addition, a fast and wide development of digitalization empower a good economic development. The economy is influenced by consumers who pay close attention to their consumption behavior and enjoy a quiet live in the suburban region.

This structure enables new technological developments to rise significantly. Big companies are the first to profit from this rather ideal setting as they can provide resources for the fast development of technologies and their adaption, followed by the tech start-ups which complete the industrial sectors with new service categories like Fintech Services.

Figure 7 comprises the individual future projections for the scenario:

Figure 7:
Elements of the scenario

	Political concord within EU, widespread free trade, stable alliances
	US and EU act as global trade leaders, digital platform economics, tech-giants dominate financial sector, globalised companies benefit
	Sustainable consumer behaviour and social balance, adjusted labour market, living in smart regions
	Digitalisation, Industry 4.0 and „green systems“ far advanced; predominantly large enterprises push disruptive developments
	Legislative keeps pace with technological development; offers appropriate regulations
	Climate protection successful, resource wastage curbed

ASPIRANT – Effects on Supply Chain

Regarding the supply chain structure, the harmonic political and economic development provides better conditions for strategic agreements across several states. At the same time, the fast technological development and development of new production technologies affect the structure of the supply chain. New business models are necessary both to handle the ecological development and the advances in digitalization to efficiently handle the increase in variety. Respectively, the capacity to manage the types and quantities of waste requires a more agile and circular supply chain structure.

In terms of processes, the political harmony combined with contented unions result in smooth and fast cross-border supply chains. With regard to the digitalization and the use of platform strategies, new digital processes are required to respond to the technology enabling faster information flow. Digitalization provides holistic planning algorithms for the whole supply chain. Along with the fast adapting legal development within this scenario, a revision of the supply chain processes is frequently required to fulfil the new and rapidly advancing laws.

With regard to resources, the advancements in digitalization and new process technologies necessitate a significant effort on R&D. In addition, new employment is required for dealing with recycling processes across the globe to successfully support upcoming innovations.

“DITHER”-THERE IS DIGITAL AND TECHNOLOGICAL DEVELOPMENT BUT NOT ENOUGH TO COMPETE GLOBALLY.

DITHER – General Setting

The scenario DITHER entails a mixed view on future developments and emphasizes on the technological rise. This scenario is characterized by following specifications:

- Political environment changes towards protectionism, start-ups are profiting due to the support of technological development
- Continuous development and integration of new technologies regardless of retention towards digitalization
- Good acceptance of autonomous systems in Europe even though it results in high unemployment and social disequilibrium
- Promotion of ecological and sustainable development of products

Within this scenario, there are several conditions that are favorable to economic development in Europe, such as the continuous exploitation of disruptive technologies, the dynamic development of autonomous technologies or the establishment of electrification technologies and green systems. Still, the digital development is obstructed by stringent legal regulations, data management and privacy issues. Moreover, an increasing unemployment results out of the application of autonomous technologies. This accelerates social disparities and create political and economic dissatisfaction which also expresses in a shift in economic power from EU and US towards Asian and MINT countries (Mexico, Indonesia, Nigeria and Turkey). Although there is constant political development in Europe, the enclosed political environment of the world leads to a policy of protecting domestic industries against foreign competition. Some countries decide to put their own needs first and prefer to leave European Union. The banking sector, meanwhile, is able to find a good division of products with upcoming Fintech companies. Due to the localization of markets, small companies are able to use upcoming technological advancements to establish within defined local areas.

The different future projections of this scenario are shown in Figure 8.

Figure 8:
Elements of the scenario



Constant development in Europe, closed economic area, collapse of alliances



Asia drives the economic development, global companies act local, digital platform economics, mix of banks and Fintechs established



Aging society with large disparities and high unemployment, strong consumer individualisation Do-it-yourself (DIY), living in smart cities



Digitalisation obstructed by cost and retention, increased use of autonomous technologies, electrification and ecological systems are well advanced, start-ups benefit from the evolving technology industry, which is continuously progressing



Legislation falls behind technological development, heterogeneous regulations and low levels of trust in data privacy and market regulation



Climate protection successful, resource wastage contained by technology development

DITHER – EFFECTS ON SUPPLY CHAIN

The interaction of the future projections has several impacts on the structure, processes and resources of a supply chain. Future supply chains need to be more resilient due to an unstable situation and limitations in terms of global purchasing considering the rising protectionism. In this setting, it is necessary to build strong local supply chains with regional partnerships. Nevertheless, the personalized production and further partnerships with DIY entities require an end-to-end tracking of the supply chain that encourages further aspects of circular economy, thus opening a way of resource re-utilization. The advancement in autonomous technologies leads to changes at process level with a focus on new ways to automate non-added value activities of the supply chain. Companies and politics need to consider that technological changes can cause unemployment, hence, strategies to reallocate staff along the supply chain need to be defined. This is all the more important as disruptive changes create new production and service processes. In addition, supply chains increase their revenue from data and set up lean processes with secure transactions provided by the collaboration between banks and Fintech companies.

“ENDANGER”-EUROPEAN DISINTEGRATION AND PROTECTIONISM LEAD TO GEOPOLITICAL, SOCIAL, ENVIRONMENTAL, LEGAL, TECHNOLOGICAL AND ECONOMIC ISSUES THAT AFFECT COMPANY’S SUCCESS.

ENDANGER – General Setting

The ENDANGER scenario displays a dystopic future. Future developments are rather instable and there is a lack of technological development.

The following aspects summarize the features of this scenario:

- Political instability and collapse of the European Union leads to isolation
- Autonomous systems lead to high unemployment
- Strong social inequality and consumption of mass-market products
- Direct financial system with ledgering supports traditional goods exchange
- Little to no technological or social development

The scenario describes an unstable political environment that causes social and economic issues. This incorporates a shift in trade and hence a shift of Gross Domestic Product from advanced economies towards emerging market economies. The economy in Europe is influenced by a consumer who pays close attention to low cost products and quantity instead of quality. The political and economic framework restrict a quick adaption of legal regulations; thus, there are obstacles that restrain a smooth digital transformation – only a few big companies can take a leading role in managing and processing high volumes of data. Customers do financial transactions without intermediary means; hence, classic banking services are becoming obsolete. Crypto-currency supports a traditional exchange of goods. The political instability leads to a stagnating and non-homogeneous legislation limiting the development of emerging technologies.

Figure 9 displays the different future projections of this scenario:



Figure 9:
Elements of the scenario

ENDANGER – EFFECTS ON SUPPLY CHAIN

As this scenario describes an instable and stagnating development, it affects the supply chain in a number of ways. This starts with a constrained public investment into logistic hubs, e. g. ports. In addition, the fragmented market causes a shift towards local supply chains, thus raising costs for each segregated supply chain. New local hubs need to be set up and several new supplier partnerships have to be formed. Duplication of assets across the European region imply inefficiencies and new barriers and taxes are expected. As the political and economic situation is instable, it affects the resilience of supply chains, global and local supply chains alike. Depending on the set up of ‘a world without banks’, wherein financial processes are handled from individual to individual via an independent cryptocurrency, it might lead to faster payment processes and therefore to a higher financial solvency.

The changes on supply chain processes imply a rise in complexity to manage processes and resources. The scenario settings lead to higher bureaucracy and movements of goods get slower with duplicated handling steps. Future economic developments require a reorganization as international supply chains face difficulties in maintaining relationships with suppliers. Accordingly, the access to resources and commodities are affected and resource scarcity remains an issue. A fast development of autonomous systems provides a solution to efficient process design in distribution. As customers focus on cheap products, lean processes are dominating to achieve corresponding cost reductions. New business models are required to handle the steering of autonomous systems and the increasing complexity. The economic and political development has an effect of reducing competition, but will lead to restrictions regarding economies of scale.

Conclusion

The techniques for scenario building provide a good approach to derive and evaluate future developments. They enable a broad view on the future and support to prepare a strategy for probable but also unexpected events. This whitepaper presents a scenario technique to identify macro scenario settings for future supply chains. The applied methodology within this whitepaper guides through the process to evaluate different future developments and to create scenarios in an objective way. The resulting macro scenarios describe future political, economic and social developments supported by technological advancements, legal framework settings and environmental protection.

The approach for the creation of macro scenarios finds its base in a mixed quantitative and qualitative scenario technique. On the basis of future trends and market drivers, a range of possible developments build future projections. The combination of different future projections represent a scenario. An approach via cross-impact balance analysis was considered as suitable to maintain consistency and plausibility, while paying respect to a wide range of different developments. Out of the several million possible combinations of future projections, twelve scenarios were considered as consistent and suitable. Each represents a mixed perception of the future. A detailed description of three representative scenarios specify their most important characteristics and related impacts on the supply chain.

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