Next generation Technologies for networked Europe

# D2.2: Report on future scenarios generation

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<td>Future scenarios generation</td>
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<td>Partner Responsible:</td>
<td>Saskia Sardesai, Josef Kamphues, Matthias Parlings (Fraunhofer IML)</td>
</tr>
<tr>
<td>Contributors:</td>
<td>Rosanna Fornasiero, Andrea Zangiacomi and Irene Marchiori (CNR-ITIA), Dimitra Kalaitzi and Aristides Matopoulos (ASTON University), Ana Cristina Barros, Kerley Pires, Pedro Campos, Pedro Senna, Vasco Amorim (INESC TEC), Victoria Muerza, Carolina Cipres, Mustafa Çagri Gürbüz (ZLC), Sébastien Balech (PNO)</td>
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# NEXT-NET Project Profile

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<th><strong>Project ID:</strong></th>
<th>768884; H2020-NMBP-CSA-2017</th>
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<td><strong>Acronym:</strong></td>
<td>NEXT-NET</td>
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<td><strong>Title:</strong></td>
<td>Next generation Technologies for networked Europe</td>
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Executive Summary

This report is the Deliverable 2.2 of the Next-net project. The aim of the project is to put in place a cross-sectoral and cross-technological initiative at European level to increase integration between production and distribution proposing research and innovation priorities for the future of supply chain. The Deliverable 2.2 focuses on the generation of a future scenario field considering the political, social, economic, technological, legal and environmental influences and changes until 2030. The result of the Deliverable 2.2 provides a basis to enable a match of the scenario field towards future supply chain scenarios.

The methodological approach of this work is guided by scenario prognostic and scenario-building. Several steps have been processed to achieve consistent and viable scenario fields involving both, all consortium partner and external experts. This includes following points:

- Definition of projections until 2030 based on megatrends and trends defined in D2.1
- Evaluation of the impact of the projections on the supply chain via a survey
- Evaluation of the impact of the projections on other projections via cross-impact matrix
- Creation of projection bundles and selection of consistent scenarios based on a cross-impact balance analysis
- Expert-Workshop to validate the scenarios and to quantify their overall impact on the supply chain and its probability.

As a result, twelve different consistent scenarios have been identified ranging from very positive developments of all PESTLE dimensions up to rather regressing or stagnating developments. Those scenarios reflect different future states of the macro setting for the manufacturing, process and logistics industry. Scenario narratives detail the exact scenario settings and explain possible effects on the supply chain. A discussion within a visionary workshop with experts selected six of those twelve scenarios based on its probability and impact on the supply chain.
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## List of Definitions

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<th><strong>Descriptor</strong></th>
<th>A descriptor is a renamed megatrend as to express a neutral heading for the future projections.</th>
</tr>
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<tbody>
<tr>
<td><strong>Future projections</strong></td>
<td>Also named development paths, future projections describe possible developments of a descriptor considering associated trends.</td>
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<tr>
<td><strong>Macro-Scenarios</strong></td>
<td>Macro-Scenarios are scenarios, which describe the environmental setting based on the PESTLE dimensions. Those macro-scenarios describe the setting within the PESTLE dimensions and hence the future industrial surrounding.</td>
</tr>
<tr>
<td><strong>Impact factor</strong></td>
<td>A factor that measures the impact of a future projection on the supply chain.</td>
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1 Introduction

This report on task T2.2 is part of the second deliverable in the series for industrial future scenarios for supply chains focusing on future projections. Work package 2 (WP2) aims to develop and assess future industry specific supply chain scenarios, which are shaped by various socio-economic, political and technological megatrends. The task 2.2 builds on the results from task 2.1 to formulate future states of the environmental setting for the manufacturing, process and logistics industry in 2030. The emerging macro-scenarios provide a framework for the following tasks to identify future supply chain scenarios. The task 2.2 has been worked on during the months of January to May 2018.

The task started with the development of possible future projections based on D2.1, moved to a cross-impact balance analysis of the projections and the evaluation of the impact of each projection on the supply chain along with a survey. The cross-impact balance analysis led to the development of consistent macro-scenarios. Along with an expert workshop, those scenarios have been validated and the experts judge the entry-probability of each macro-scenario.

Since the task in 2.2 has been focussing on the benefits of different scenario techniques, the deliverable 2.2 starts with a first introduction to scenario techniques in general and its approaches and shows its specific application within Next-Net.

The following chapter emphasised on the development of projections until 2030, which are based on the megatrends and trends of the Deliverable 2.1. This included the formation of neutral descriptors to provide a base for the projections. Those descriptors divide in several future development potentialities to describe the environmental setting of the industries and the world in general until 2030. Accordingly, it contains e.g. the political status, the development of the digital transformation or the impact of financial innovations in 2030.

In addition, the impact of each projection for 2030 on the structure of a supply chain has been guided by insights of experts via a survey. By filling this survey, the expert has delivered great value and has highly contributed to the quality of the scenarios. In addition, the insight of the survey provided a cross-sectoral perspective and each expert has been able to express industry-specific impact factors on the supply chain e.g. with regard to the supply chain structure and processes and IT settings, changes in business models or in terms of the product portfolio, revenue or staff. Thus, possible projections are assessed by the judgement of experts linking these factors to possible strengths and weaknesses of the European SCs.

The creation of consistent scenarios has been separated in several steps. Firstly, the influence of each projection has been evaluated in workshop rounds within the consortium and their expert partners. This approach supported discussions within each group and an agreement was reached which integrated different aspects of influence while still considering the one-to-one relation from one projection onto the other projection considering direct influence only. The influence factors have been cross-checked within a consortium workshop to ensure the
consideration of international views. With the means of a cross-impact balance analysis, the influence matrix provided effective sums. Those effective sums provided a quantitative approach to generate the set of macro-scenarios. The resulting set of 12 macro-scenarios are described in detail within the chapter “Scenario Narratives”.

The impact of each future projection on the supply chain was used to evaluate the combined impact of the resulting macro-scenarios. A workshop with experts supported the reflection of the resulting macro-scenarios and its evaluation with regards to its plausibility and probability. This reduced the number of macro-scenarios to six very probable macro-scenarios with a high impact. Those scenarios will be used as an input in task T2.3.
2 Scenario Techniques

Scenario planning faced a growing interest on the interface of academia, public and private sector and 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. The Rand Corporation soon became the centre for scenario thinking [218]. Herman Kahn intensively used the scenario techniques and described the development of scenarios as ‘one way to force oneself and others to plunge into the unfamiliar and rapidly changing world of the present and the future’ [115].

The development of scenarios can be separated into three main schools: 1) The normative, deterministic approach, which has been used by the school of La Prospective, 2) the social constructivist approach which has been developed by the Shell Intuitive Logics school, and 3) the rational, objectivist school which is based on cross trends impacts [218]. Within the latter school, a probabilistic modified trends methodology has been developed which incorporates the matrix-based methodologies Trend Impact Analysis and Cross Impact Analysis.

The approach used in Next-Net is closely related to the methodology as proposed by Gausemeier [86], which is based on the cross impact analysis. The methodology is in line with the rational, objectivist school based on cross trends impacts. The approach is used for the identification of correlations and causal impacts [4], which has been supplemented with qualitative methodologies, to enhance the plausibility of the scenarios.

2.1 Scenario Planning

A scenario is a representation of a possible future situation in narrative form [141]. It portrays causal relationships that explain how, from the vantage point of the present, a particular future in a certain story setting has been derived. Scenarios outline some aspects of the future for public [218] and in respect of private interests, too [4]. Those generated scenarios help organisations to prepare for possibilities and to ensure an innovative and flexible development [4].

A scenario has to be distinguished from prognoses 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 [218].

In general, scenarios provide a holistic and schematic methodology to describe possible future conditions. The methodology of scenario planning is specifically useful in the context of future statements with different levels of uncertainty. Often this results in several scenario sets while each set claims less confidence (in terms of probability) compared to results from traditional methods for future projections. Scenario planning is a basis for learning through strategic
conversation and it helps to build a consensus regarding certain and uncertain projections [218].

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 2-1 shows different sets of scenarios each representing a bundle of future projections.

Scenarios can be classified as normative, when they concern policy planning or they are descriptive, when they represent a range of likely future alternative events. In addition, they can be classified according to the topic (i.e. global scenarios or problem specific) and its level of aggregation (e.g. macro or micro) [4]. Boerjeson et al. distinguish three main scenario categories namely predictive, explorative and normative as shown in Figure 2-2. The predictive scenarios respond to the question "What will happen?“; the explorative scenarios are considering the question “What can happen?“; and the normative scenarios focus on "How can a specific goal be achieved?". T2.2 considers the explorative long-term horizon, aiming on the question: "What can happen?". According to Boerjeson et al. this category is further differentiated into external and strategic scenarios. External scenarios address the development of external factors. An actor, e.g. a company or a political unit, cannot influence external factors in contrast to internal factors which are controllable by the actor [20].

Figure 2-1: Bundles of future projections

Scenario funnel

Scenario A
Scenario B
Scenario C
Scenario D

present future
The literature for the development of scenarios are diverse and wide and there are many definitions, typologies and methodologies [62] with different utilities, strengths and weaknesses [4].

2.2 Benefits and challenges of scenario building

Scenario building techniques are a part of scenario planning and contain powerful tools to identify contextual challenges and opportunities. The technique highlights the implications of possible future systems and projects consequences of choices or policy decisions [4]. Scenario building is also a technique to allow for visionary thinking within a group or a company. In general, it raises awareness of different future-alternatives and prepares for possible futures. Scenario building confines complex elements together into a systematic, coherent and comprehensive manner [4].

Despite the benefits of using this technique, there are still challenges, which require consideration. While on the one hand the set of scenarios needs to represent the multiplicity and richness of plausible futures, agreements and consensus have to be achieved for the set of different future projections. In addition, several stakeholders with quite diverse worldviews provide a wide range of new ideas, which have to be combined in a set of scenarios. Furthermore, scenarios need to integrate and anticipate rare events, which can be achieved by several workshops with different participants. A strong challenge is to capture the uncertainty about the future in a small set of scenarios while still providing a set of scenarios which can be analysed and hence provide sufficient results [62]. The weak link between quantitative and qualitative scenarios is a challenge for the development of integrated scenarios. In order to promote the creation of more robust scenarios, it is recommended to integrate different approaches in scenario building [4].

2.3 Scenario Building Approach

The process of scenario building can be divided into three steps. In the first step, ideas are generated and data are collected. The second step is called integration, where parts are
combined into a whole. Both steps are reflected in Figure 2-1. Subsequently, in the third step, the preliminary scenarios are developed and the consistency of the scenarios is checked [20]. All relevant and finally selected scenarios should have a logical and consistent structure. Those selected scenarios need to be reflected on in terms of plausibility, relevance and implications of the scenario development. The picture of Figure 2-3 shows an example for the creation of future scenarios and the resulting recommendations or strategies how to handle them.

![Figure 2-3: Creation of future projections](image)

For the general understanding and communication of the scenarios, externally as well as internally, the creation of scenario narratives is of utmost importance. As scenarios are possible developments of the future, ‘positive’ as well as ‘negative’ scenarios need to be reflected within the set of scenarios. It is important to paint a picture of the future that is differentiated and rich in contrasts [141]. Figure 2-4 shows an exemplary set of scenarios. Meinert 2014 uses a picture to represent each scenario showing the most important setting within the scenario.

![Figure 2-4: Exemplary scenario naming and picture creation [141]](image)

While reflecting on the impact of each scenario, conclusions on how to prepare for, or even influence, the different alternatives identified in the scenario-building process, have to be drawn. Based on normative judgement, conclusions from these fictional scenarios are derived towards practical relevance. In the case of Next-Net, it reflects conclusions towards future supply chains. This will be part of the following deliverables D2.3 and D2.4.
2.4 Scenario Building within Next-Net

For Next-Net, the approach of Gausemeier has been selected for the scenario selection of the macro-scenarios. Those macro-scenarios describe the setting within the PESTLE dimensions and hence the future industrial surrounding. The Gausemeier approach belongs to the quantitative approaches and uses a cross-impact and consistency matrix to develop its 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; hence, it provides a way forward to deal with multiple futures. The approach of Gausemeier separates into four major steps: starting with the scenario-preparation, then a scenario-field-analysis, thereafter projections are created in the scenario-prognostic and it closes with the scenario-building to achieve the macro-scenarios [87].

The scenario preparation includes the definition of the scope and the timeline of the project. In addition, this step contains a decision-field-analysis, in which the current situation of the underlying project theme is assessed and the decision-field elements are defined (e.g. sorting according to PESTLE). Step two of the process is the Scenario-Field-Analysis. In this step, major influencing areas are identified and separated into steering areas, which can be influenced directly by the scenario user, and environmental areas, which are out of control of the scenario user. Thereafter, influencing factors are identified and described. Influencing factors specify the current status and future projections of the individual influence areas. An influence analysis is subsequently applied to mark relevant key influence factors of the scenario field. Those key factors are furthermore used in step 3, the scenario prognostics. This step determines the characteristics of the key factors and lists future projections. The result of the formulation and justification of the development potentialities provide the future projections. The final step refers to the scenario building where the scenario user finds a suitable combination of future projections. The scenario user assesses each suitable combination by means of a consistency and plausibility check. The scenario description explains the characteristics of the scenario and provides a narrative story for each selected scenario [87]. Figure 2-5 provides an overview on the distinct steps.
For T2.2, the Gausemeier approach has been used as a guideline. The first two steps have already been described in deliverable D2.1, which defines the use of the PESTLE approach for the decision-field-analysis with a timeline up to 2030, and provides an overview on the megatrend and trend analysis (please refer to https://Next-Netproject.eu/wp-content/uploads/2018/02/D2.1-Report-on-trends-and-key-factors.pdf).

Figure 2-5: Scenario Building according to Gausemeier [87]

<table>
<thead>
<tr>
<th>Gausemeier-Approach</th>
<th>Next-Net Approach</th>
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<tbody>
<tr>
<td><strong>Step 1: Scenario-Preparation</strong></td>
<td><strong>Step 2: Scenario-Field-Analysis</strong></td>
</tr>
</tbody>
</table>
| - Project description  
- Decision-Field-Analysis | - Identification of influence areas  
- Identification of influencing factors  
- Identification of key factors |
| **Step 3: Scenario-Prognostic** | **Step 4: Scenario-Building** |
| - Preparation of the key factors  
- Identification of the future projections | - Projection bundles  
- Prescenario-building  
- Future mapping  
- Scenario description |

Figure 2-6: Application of the Gausemeier methodology for Next-Net
Based on the megatrends, step three starts with the development of projections (kindly refer to Chapter 3 ‘Creation of Projections’). Those projections have been integrated into a cross-impact matrix to evaluate the influence of one projection onto others. Step four then started with the evaluation of the cross-impact balance analysis to cluster the projections. The open source software from the University of Stuttgart ‘Scenario Wizard’ has been used to conduct the cross-impact-balance-analysis (see Chapter 4 ‘Future scenarios generation’). In parallel, the impact of each projection on the supply chain has been evaluated via a survey (see Chapter 5 ‘Development of a Survey’). Consecutively, via application of the software, the analysis provided consistent and plausible macro-scenarios. Results of the cross-impact balance analysis and the survey are presented in Chapter 6 ‘Preliminary Results’. In the final step, a storyline for each macro scenario provide the scenario narratives (see Chapter 7 ‘Scenario Narratives’).

Chapter 8 evaluates the entry possibility of each scenario and its impact on the supply chain. In the Next-Net project, those final macro scenarios are used to describe the future setting of the environment within the PESTLE context. The following deliverable D2.3 will describe the possible supply chain scenarios.
The creation of the projections builds on the results of the deliverable D2.1. Figure 3-1 below shows the identified megatrends that are the basement of the descriptors and the headings of the future projections.

### Figure 3-1: Identified Megatrends from deliverable D2.1

#### 3.1 Methodology and Approach

The results of the deliverable D2.1 set the base for the creation of projections, which constitute developments into the future, specifically until the year 2030. The construction of the projections follows the scenario technique by Gausemeier. The analysis is based on the identified trends and megatrends, which are clustered according to the PESTLE (Political, Economic, Social, Technological, Legal and Environmental) dimensions.

PESTLE sets the framework for the structure of the following subsections of Chapter 3. Each subsection encompasses a so-called ‘descriptor’, which is based on a megatrend or trend. The decision whether a megatrend or trend is chosen as descriptor is subject to the nature of the respective megatrend/trend. In preference, the megatrend sets the descriptor. In some cases, when the megatrend has a positive or negative infliction, the megatrend has been reformulated to represent a neutral position, e.g. the megatrend “protectionism” has been renamed into “trade policy”. In other, rare cases, due to strong interdependencies of trends, trends from T2.1 have been re-arranged and assigned to a different cluster in this report. This has been the case e.g. with the trend ‘labour shortages’, originally assigned to demographic change. During the creation of projections, this trend has been clubbed with ‘increasing
demand for high-qualification jobs’, ‘merging skills required’ and ‘continuous learning culture’; 
trends associated to the megatrend knowledge based economy. The assignment of this trend 
to both megatrends are valid and in order to create dissimilar projections this re-arrangement 
was necessary.

Each descriptor is characterised by diverging projections. Projections express a certain future 
state of a descriptor and describe possible circumstances companies and societies might face. 
In some cases, a descriptor has a positive, negative and neutral projection. However, other 
possibilities for classification to obtain projections are also feasible.

While formulating the projections, several quality criteria require reflection. It is essential for 
each projection to be reasonable and conceivable [86], in the sense that a projection can be 
futuristic but needs to rely on valid arguments or requires justification by statistical 
developments. Furthermore, the projections have to fulfil following criteria:

- Plausibility – a projection needs to be plausible to the complete 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 
  projection within a descriptor.

Consequently, the number of projections 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 characterisation is specified along 
with a more detailed explanation and reasoning. The projections have been created within 
brainstorming sessions by considering the underlying trends. To ensure validity, the 
projections are supported by literature. Furthermore, experts in workshops have validated 
critical projections.

### 3.2 Resulting overview on the projections

Figure 3-2 provides an overview of the resulting projections categorised according to the six 
PESTLE dimensions. The figure shows first the dimensions, then the descriptors followed by 
the distinct projections. The following sub-chapters explain, per dimension, the associated 
trends for each descriptor. This document reports a short summary per projection, only. A 
document with detailed description of the projections has been developed by the partners and 
is available upon request.
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Figure 3-2: Overview of the resulting projections per PESTLE Dimension
3.2.1 Political Dimension

3.2.1.1 Political Setting

Political setting describes the political activity in a society, the satisfaction level of the population and general risks that might affect a country. Associated trends are terrorism, conflicts and social unrest [30].

Following projections evolve:

<table>
<thead>
<tr>
<th>Political concord in Europe</th>
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<tbody>
<tr>
<td>We face a politically stable environment in Europe and border regions. Political friendship strengthens trading bonds and soft security regulations support trade. Governments are able to act and provide frameworks for the future. [14; 17]</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Constant development in Europe</th>
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<tbody>
<tr>
<td>Europe experiences an increase of political unrest in neighbouring states. Due to the increasing number of attacks and thefts, strong security measures and law enforcements are required to keep the trade safe. Governments are able to act and set frameworks for the future but political uncertainty increases. [164; 6; 183; 71; 187; 8; 108]</td>
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<table>
<thead>
<tr>
<th>Governmental collapse in Europe</th>
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<tbody>
<tr>
<td>Europe experiences strong uncertainty about political leadership. Economic growth is hampered by politically unstable environment i.e. social unrest and conflicts combined with terrorist attacks and political issues with border states. [1; 66; 16]</td>
</tr>
</tbody>
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3.2.1.2 Trade Policies

Trade policies describes the set of standards and regulations towards the trade of goods and services. Associated trends are quotas, import tariffs, different tax structures and subsidies [57].

Following projections evolve:

<table>
<thead>
<tr>
<th>Protectionism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade barriers, such as tariffs or import quotas, restrict the establishment of foreign competition and complicate logistics structures of importing companies. [118; 36; 45; 51; 97; 133; 12; 46; 210; 173; 123; 196; 28; 163; 121; 101; 63]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Free Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>A policy of open trade, existing trade agreements and lower trade barriers facilitate global trade. [118; 225]</td>
</tr>
</tbody>
</table>
3.2.1.3 Confederation

Confederation describes the federation of several independent states with the same interests in order to improve cooperation and to remove barriers. Associated trends are free movement and trade agreements.

Following projections evolve:

<table>
<thead>
<tr>
<th>Contended Union</th>
</tr>
</thead>
<tbody>
<tr>
<td>Political and economic decisions, such as subsidies and tax structures, are commonly agreed upon. Several state unions are forming in Asia, Latin America and globally. [224; 125; 180]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unstable Confederations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulties with common agreement on political and economic decisions between member states cause several countries to push for change and express their dissatisfaction. [137; 188; 89; 43; 94; 131; 193]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fragmentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confederations are characterised by disagreements and unrest. Borders are closed, which limits cross-border trade. [15]</td>
</tr>
</tbody>
</table>

3.2.2 Economic Dimension

3.2.2.1 Global Trade Shift

Global Trade Shift describes the changes in global trade due to emerging economies. Associated trends are economic growth in emerging economies, export growth, and investment flows.

Following projections evolve:
The pendulum shifts

China is currently the largest economy followed by India. Both E7 (China, India, Brazil, Russia, Indonesia, Mexico and Turkey) and the MINT (Mexico, Indonesia, Nigeria and Turkey) economies are larger than the G7 (US, Japan, Italy, UK, France, Canada, Germany). These economies attract foreign investment because they are strong candidates for rapid growth. Europe loses its status as net investor into the world economy. [228; 198; 74]

Steady Titans US & Europe

There is a steady gross domestic product (GDP) growth in Europe and the US in which export trading volume is high, and there is heavily investment into education and new technologies. [166; 198; 228; 74]

3.2.2 Global Corporate Structures

Global Corporate Structures describes the way a company is structured to serve a market. Associated trends are globalisation, glocalisation (combination of globalisation and localisation - the situation where international products are adapted to the local culture) and 'emergence of born-global firms'. [190]

Following projections evolve:

Think global, act local

Multinational companies adapt their product and/or service offerings to a growing number of markets. [120; 191; 142; 7; 135; 134; 96; 103]

Rise of born-global firms

The number of born global firms is growing, as digital technologies and e-commerce increase cross-border opportunities. Most of the small and start-up companies are 'born global', reaching buyers worldwide through the internet. [33; 140; 213; 184]

3.2.2.3 Digital Economy

Digital Economy describes the changing environment in which digitalisation is becoming more and more integrated into the business environment enabling new business concepts. Associated trends are sharing economy and from an economy of goods to an economy of services. [25]

Following projections evolve:
### Traditional economy persists

Companies are selling their products and services through the use of online platforms as well as the physical store locations. Governments are still treading the path of strengthening regulatory frameworks (e.g. data storage laws). [64; 47; 53; 229; 170; 232; 151; 130; 55]

### Platform economy

The digital economy permeates all aspects of society; helping people and companies to orchestrate, manage, and automate many of their daily activities (e.g. “virtual agents & brokers”). [172; 170; 186; 226]

### Pure traditional economy

Digitalisation has been growing over the last few decades; however, the need for confidentiality and privacy slow the diffusion and implementation of digital innovations across sectors.

### 3.2.2.4 Financial Innovations

Financial Innovations describes the development of financial instruments and payment systems over time used for lending, spending and borrowing of funds. Associated trends are digital currencies and cashless payment as well as the financial technologies (Fintech) revolution.

Following projections evolve:

#### Bank and Fintech collaboration

FinTech is evolving incredibly fast and at a pace that traditional banks struggle to emulate. However, people are sceptical and reluctant to assign their incomes into FinTechs. Thus, Fintechs and banks collaborate and banks remain an important element of the transactional infrastructure. [147; 174; 161; 19]

#### A world without banks

Digital technologies (e.g. smart contracts, cryptocurrencies) and smart ledgering enable the facilitation of business transactions and services without intermediary. [116; 93; 80; 107]

#### Big 5 are the banks of the future

The tech giants Google, Apple, Facebook, Amazon and Microsoft (GAFAM) have expanded fully into financial services and have usurped the traditional banking system. [147][182; 65; 79; 148; 149; 126; 56; 117]
3.2.3 Social Dimension

3.2.3.1 Demographic change

Demographic change describes the changes and tendencies of the population regarding age, gender, birth and death rate and migration. It also comprises longer and healthier life expectancy. Associated trends include ageing population boom in developed countries, young population boom in developing countries, migration flows, population boom in the developing countries, growing demand of resources (e.g. land). [27]

Following projections evolve:

<table>
<thead>
<tr>
<th>Ageing population and acceleration of disparities</th>
</tr>
</thead>
<tbody>
<tr>
<td>The world population is getting older and more and more fragmented. Due to the absence of a healthy redistribution of resources, a small part of the population owns a large majority of resources. A separation of wealthy and poor regions a growing number of conflicts arise. [203; 162; 129]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Awareness of inequalities and wealth redistribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>The disproportion between young and old in developed countries is equalised by the young population boom in developing countries. New forms of solidarity, social engagement and civil participation develop within the society supporting a fast integration of migrating young people. New systems of wealth redistribution reduces influence and power of rich and ageing minorities.</td>
</tr>
</tbody>
</table>

3.2.3.2 Urban living

Urban living discusses the way of living in the city or surroundings in modern environment or refurbished buildings, also studios and lofts. Associated trends are megacities and smart cities. [207]

Following projections evolve:

<table>
<thead>
<tr>
<th>Smart regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relocation of people living in cities to the countryside, with a large impact on transportation and commuting, development of home working and flexibility, unclogging urban areas.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Smart cities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cities become more and more populated to the cost of countryside. This results in the rise of megacities and growth of urban areas, proposing all the necessary to a connected society. Scarcity and accessibility of resources, poverty and excluded people will arise as priority challenges. [29; 165; 202; 231]</td>
</tr>
</tbody>
</table>
### 3.2.3.3 Consumption pattern

Consumption patterns describe the buying behaviour and the handling of the purchased goods or services. Associated trends are middle-class explosion, healthy diets and lifestyles, consumerism and change of purchasing patterns. [81]

Following projections evolve:

<table>
<thead>
<tr>
<th>Much and cheap</th>
</tr>
</thead>
<tbody>
<tr>
<td>General high consumption of cheap goods. Emphasis is on the quantity on the costs of the quality with research of the best price as the priority criteria. [119]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Consumption awareness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of goods becomes preponderant on the quantity and will be the decision criteria for consumption. Health and good living will become the major lifestyle and consumption of alcohol and tobacco will decrease and ecology criteria will be part of the decision process. Less but better consumption. [119; 169; 73; 171]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DIY Society</th>
</tr>
</thead>
<tbody>
<tr>
<td>People become strongly involved in the production process consumer goods. The DIY (do it yourself) concept is applied throughout an extending middle class. As a result, self-production of fashion, technological equipment and food become the standard. [221; 38; 144]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Individualised consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>The tendency towards individual living and small-sized families continues. Consequently, households shrink in size and do only comprise one or two generations. This development does not only affect the quantity demanded but also the way products are requested, purchased and consumed in each household. [13][2]</td>
</tr>
</tbody>
</table>

### 3.2.3.4 Customer orientation

Customer orientation describes a process and marketing orientation of a company with the aim of fulfilling the customer’s wishes and requirements. Associated trends are new customer relationship, new shopping experience and increasing customisation. [150]

Following projections evolve:
### Individualism – Focus on variety

Tailor-made solutions will become the rule as individuals want to display their singularity. This individual customisation will have a major impact on the production process, especially in the retail industry: personalised shopping experience. [58; 152; 192; 158; 45]

### Collectivism – Focus on the crowd

Buying behaviours are strongly influenced by influencers through social networks. Large groups of buyers can appear and disappear following the hype and companies will have to face with an immediate and strong demand of a large group for a specific good. [83; 102; 178]

### 3.2.3.5 Knowledge-based economy

Knowledge-based economy describes a society that attaches great importance to education, learning, information and knowledge. There is a high impact on the labour market. Associated trends are increase demand for high-qualification jobs; labour shortages; emerging skills required, continuous learning culture; change of communication patterns and reshaping the workplace. [155]

Following projections evolve:

#### Investments equalise the labour market

Digitalisation adopted by both the work force and the companies. Cross-disciplinary and creative profiles will be more and more demanded and lifelong learning will be widely adopted. Employers will have to cope with flexibility demands and will adopt an intercultural model. Relocation of high-tech industries in developed countries due to a high automatisation of processes. [156; 179; 26; 48]

#### Rapid changes cause unemployment

Automatisation of processes will lead to a growing unemployment rate: due to the disappearance of certain jobs. Inequalities will rise, with on one side working and wealth people (minority) and on the other side unemployed and poor people (large majority). [156; 179; 26; 132]
3.2.4 Technological Dimension

3.2.4.1 Digital Transformation

Digital transformation describes the changes associated with digital technology application and integration into all aspects of human life and society, e.g. to improve performance of enterprises or convenience of social life. [194]

Following projections evolve:

<table>
<thead>
<tr>
<th><strong>Rapid advancement of digitisation and digitalisation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Data intensive environment will offer new ways to monetise data streams, leading to the better customer services. Emerging technologies such as blockchain and advancements in artificial intelligence assist humans by undertaking autonomous planning and handling tasks. Digital transformation is strongly promoted by the government. Legal regulations throughout Europe are in line and keep pace with the dynamic context. [109; 136; 201; 122; 24; 175; 233; 49; 223; 18; 84; 85]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Obstacles restrain digital transformation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Only a selection of companies, mostly multinationals, can afford to implement available technology applications due to high costs and risk aversion. Challenges such as data ownership and data management issues, changes in customer expectations, lack of regulations, lack of acceptance due to privacy or data security concerns, changes in business models and the need for cultural and operational transformation will restrict a fruitful transformation. [22; 223]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Digital Stagnation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Further integration of available technologies is not considered to cause significant improvements in industry or social life and rarely can be justified in economic terms. New improvements of data storage or data analytics will not be expected. Concerns over ethics, personal privacy, unsolved data security issues and data sovereignty will stall or even backtrack the application of certain technologies. [18]</td>
</tr>
</tbody>
</table>

3.2.4.2 Autonomous Systems

Autonomous systems describe objects or devices that can act and make decisions independently, which has an immense impact on ways of working, particularly how people will collaborate with people, machines and virtual formats in entirely new ways.

Following projections evolve:
Dynamic development of autonomous technologies

Technology advancements (e.g. robots, drones and autonomous vehicles) progress at a rapid pace. Cyber-physical systems will play a key role and enable efficient control by exchanging data over the internet in real time. As automation replaces an increasing range of human tasks, we will rethink our ways of working and the types of skills that are required for the human workforce. [219; 18]

Innate reluctance to accept autonomous technologies

Challenges such as lack of profitability of components/solutions, high cost of sensors and lack of regulations will prevent a high degree of automation. Still, partly autonomous factories slowly become the standard in Europe, resulting in a shift from assistance of human activities to a more machine-centred environment. The work landscape will be reshaped, creating new ways of working. Users struggle to operate highly complex machines. [86; 18; 5; 157]

3.2.4.3 Alternative energy generation, storage and usage

Alternative energy generation, storage and usage illustrate how energy can be obtained and stored in sustainable ways. Moreover, it describes the usage of alternative energy for industrial, transportation and mobility purposes.

Following projections evolve:

Established electrification technologies and green systems

New power grid solutions overcoming technological limitations and creating smart grid environment with distributed energy generation and powerful storage systems. Sophisticated electricity control systems facilitate the effective use of renewable energy sources while cutting down operation costs of distribution generators. There are also environmental friendly and cost-effective battery storage and transport systems, e.g. fully established electric and hybrid vehicle systems. [138; 106; 110; 104; 78; 98; 99; 50]

Ongoing electrification and alternative energy endeavours

Green systems are used for power generation, energy storage and transportation, based on hydrogen power cells and biomass. These systems are applied in industrial and social sectors. Biomass has the potential to substitute fossil fuelled and traditional power generation. Green systems present theoretical benefits, still to be proven empirically. Electric and hybrid vehicles still have high associated costs and unclear regulations, hindering the proliferation of E-Mobility. For widespread solution, there is the need for an upgrade of the existing infrastructure. [138; 185; 127; 113; 99; 50]
3.2.4.4 Decentralised connection of information and physical devices

Decentralised connection of information and physical devices describes how companies cope with the masses of data and take advantage of the smart decentralised linkage.

Following projections evolve:

<table>
<thead>
<tr>
<th>Dominance of global players</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global players have significant resources in the form of brands, hard assets, customer relationships and global distribution data. The human-machine work environment increase the use of wearable devices, leading to information overload. Cyber-physical systems and digital transformation are efficiently managing and processing high volumes of generated data. Due to resource availability, global companies can implement these systems. Limited resources and fast technological development hinder smaller companies to catch up and compete with global players. [138; 185; 195; 42]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Start-ups and SMEs take up business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small and medium-sized enterprises (SMEs) and start-ups attack traditional markets through democratisation of technology, increased access to funding and entrepreneurial culture rise. While focusing on niche markets and lean organisational structures, SMEs efficiently deal with high volumes of data flow. This complements and counterbalances global digital players, especially through digital platforms, which provide global reach for SMEs and start-ups. [138; 185; 18; 37]</td>
</tr>
</tbody>
</table>

3.2.4.5 Disruptive production technologies

Disruptive technologies describe developments that bring revolutionary changes to social life and to the way companies understand and conduct business. In the context of production technologies, the concept of Industry 4.0 reflects this emerging pattern, encompassing the integration of different technologies into an autonomous, knowledge- and sensor-based, self-regulating production system.

Following projections evolve:
Continuous exploitation of disruptive technologies

Through Industry 4.0's concept and strategy, new disruptive technologies have been made widely available for production such as augmented reality, additive manufacturing, big data, cloud computing, cyber-physical systems, cyber security, smart robotics, simulation, and system integration. By applying these technologies, companies distinguish themselves from their competitors by offering more value to customers and cost reductions. Existing disruptive technologies are improved while additional solutions are being developed rapidly and continuously. [52; 220; 167; 35; 18; 112]

Coexistence of conventional and disruptive technologies

Conventional technologies and disruptive technologies co-exist with the latter being adopted by few application fields, due to diverse and complex technology adoption barriers. New market entrants compete in niche markets and provide solutions exclusively for small customer groups. The most disruptive technology applications’ rate of change is unpredictable given their balking progress, which may lead to dead ends. Small amendments to available technologies are used in the industry. [220; 40; 21; 145; 18; 112]

3.2.5 Legal Dimension

3.2.5.1 Consumer Protection Laws

Consumer protection laws describe regulations related to the rights of consumers and how these rights are implemented. [185; 39]

Following projections evolve:

Promotion of laws and full product transparency

The EU creates regulations to get consumers informed about the products they acquire, especially in food and pharmaceutical industries. Personal data are strictly protected and protection rules are applied to any company operating in the EU. [51; 164; 176; 11; 44]

Legislation is lagging behind dynamic market development

Regulations regarding sharing economy and digital market need to be developed. The lack of the regulations restrict the adoption of new services (e.g. Uber) and technological developments (e.g. Blockchain). Consumers are not aware of information regarding the products (e.g. properties, origins, manufacturing procedures. Regulations regarding personal data vary in the countries and are unclear. [176; 160]
3.2.5.2 Intellectual Property Laws

Intellectual property (IP) laws deal with the laws that inventors or developers face and describe how law can secure IP and their owners’ rights. [3; 100]

Following projections evolve:

<table>
<thead>
<tr>
<th>Full security for inventors and data providers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open innovation is driven by regulations which secure inventions (both technology and its application) satisfying all market participants. Data transfer is regulated by secure peer-to-peer data networks, where cross-company data exchange provides several benefits for the companies. [35; 168; 143]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low confidentiality for data and market participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP theft is a key challenge for inventors, designers and artists. Plans on IP protection are released, but not complied to. Patent expirations drive IP losses. The potentials of comprehensive and regular data exchange cannot be fully unlocked. Concerns focus on data sovereignty (enforcement of privacy and compliance regulations) and the ownership and application of country laws for digital data. [208; 168; 209; 153]</td>
</tr>
</tbody>
</table>

3.2.5.3 Social and Environmental Regulations

Social and Environmental regulations describe regulations that urge companies and societies to act in an environmentally friendly and ethical way. [3; 34][177; 154]

Following projections evolve:

<table>
<thead>
<tr>
<th>Comprehensive regulatory framework</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulations on emission, greenhouse reduction and waste and resource management are available and applied in companies. Independent external parties assure the communication of reports on Corporate Responsibility resulting in full transparency and valid information. Clear emission and greenhouse reduction targets set by EU legislative are forcing companies to comply with environmental laws and report on carbon emissions regularly. [206; 95; 92; 124; 41; 10; 68]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heterogeneous regulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standards and widely accepted regulatory frameworks are missing in Europe and worldwide. Carbon intensive companies and specific industries relocate in countries (European/ non-European) with less strict environmental requirements. [33; 10]</td>
</tr>
</tbody>
</table>
3.2.6 Environmental dimension

3.2.6.1 Climate change

Climate change can be defined as a “a change in global or regional climate patterns, started from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels”. [159]

Following projections evolve:

<table>
<thead>
<tr>
<th>Our planet is recovering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid improvements in energy efficiency and a greater share of zero- and low-carbon energy supply reduce and maintain global warming at an environmentally acceptable rate. Governments enact effective measures to mitigate climate change and protect populations. [181; 70; 204; 90; 75; 189; 111; 69]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Our planet on the brink¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rising atmospheric CO₂ concentration leads to rising temperatures as time passes, which are crucial signs for continued climate change. Continuous CO₂ emissions are the major sources of total global greenhouse gas emissions. Air, water and soil are polluted overall at a faster rate than they can recover from pollution. Climate-related disasters are escalating causing huge economic damage. [181; 70; 211; 61; 204; 90; 75; 200]</td>
</tr>
</tbody>
</table>

3.2.6.2 Environmental Resource Management

Environmental resource management is the management of the interaction and impact of human activities on the environment with the aim to secure and improve the state of an environmental resource and to maintain ecosystem integrity by considering ethical, economic and scientific variables.

Following projections evolve:

¹ Name is from „The Global Risks Report 2018, 13th Edition“
### Countering resource depletion

With the advancement of technologies, subsidised renewable resources become more competitive and progressively replace conventional systems. Sophisticated recycling technologies and enhanced resource efficiency limit the depletion of resources to a minimum as well as slow down waste increase. These improvements contribute to circular economy endeavours and reduce the risks to human and ecological health and curtails the degradation of urban and natural landscapes. [181; 70; 211; 61; 204; 90; 75; 200]

### Rise in depletion of natural resources

Ever-increasing global population, economic growth and demand for resources from affluent consumers highly contribute to severely ongoing depletion of resources for humankind as well as industries. For example, highly populated countries face severe issues related to water scarcity or completely lack access to water. Also solid, hazardous and e-waste have a severe global impact: waste-management systems are costly and therefore insufficiently used by the recycling industry. [32; 128; 9; 146; 227; 205; 54; 212; 77; 59; 222; 60; 234; 105; 67; 76; 230; 197; 139; 72]
4 Future scenarios generation

Based on the results of the previous chapters, this section is about the generation of future scenarios. For this purpose, methodologies, procedure and results are presented.

4.1 Approach Scenario Building

For scenario building, two main approaches can be used to form projection bundles (PB) out of the resulting future projections from the previous chapter. The first approach, a **deductive approach**, requires a lot of experience from the scenario creator and often leads to preconceived images of the future that do not represent the entire scenario space. Within this approach, the scenario creator chooses or prefers certain future projections and various combinations of future projections are intuitively assumed to be suitable or are not further examined. The other methodology uses an **inductive approach**. In an initial step, all possible PBs are taken into account. A second step then reduces the amount of PBs subsequently by suitable methods [88]. For the reduction of the PBs the internal consistency plays an important role. The general procedure according to Gausemeier/Fink is shown in Figure 4-1.

<table>
<thead>
<tr>
<th>Descriptors</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>B: Capability to be innovative</td>
<td>B1: High capacity  B2: Only few new ideas</td>
</tr>
<tr>
<td>C: Digital Economy</td>
<td>C1: Digital Transformation  C2: Digital Impediment</td>
</tr>
</tbody>
</table>

**Figure 4-1: Achievement of consistent projection bundles**
As a part of the scenario building, the consistency analysis has gained considerable importance. This method is not only understandable to experts, but also does justice to the complexity of a multitude of interactive impacts.

Gausemeier et al. use a combination of different methods to filter out the consistent projection bundles (scenarios) in their approach. The consistency analysis is the core of the procedure. By using this method, a set of future projections is assessed to check, which future projections can occur together. For this purpose, the future projections are compared in a matrix and evaluated in pairs for their consistency. There are different approaches to rate the consistency matrix. All conceivable projection bundles that contain inconsistent pairings are sorted out. Depending on the choice of the consistency hurdle, only the highly inconsistent or the moderately inconsistent pairs are prohibited. The remaining bundles are considered as suitable scenarios. [88]

Its simple comprehensibility and its potential to work through a complex network of interdependent factors make consistency analysis an attractive compromise between simplicity and analytical depth, and a kind of standard for scenario analyses with moderate formalisation. However, the consistency analysis also has disadvantages. Practise has demonstrated that the consistency analysis does not sufficiently limit the space of possibilities. For this reason, further methods such as cluster analysis are necessary. However, the main disadvantage lies in the lack of consideration of causal information, which is also a reason for the insufficient limitation. [216]

Another method that can be used to reduce projection bundles is the cross-impact analysis developed by Theodore Jay Gordon and Olaf Helmer in 1966 [91]. Similar to a consistency analysis, a cross-impact analysis assesses the relationships between the most important factors in pairs. In contrast, cross-impact analysis does not assess the coincidence of two future projections, but the direct effect that the occurrence of one future projection has on the other. Cross-impact analyses therefore work with causal information [216]. Depending on the method, the impact assessment is carried out in the form of probabilities or, similar to consistency analysis, by qualitative assessments on an ordinal scale. The evaluation takes place in the conventional forms of cross-impact analysis by quite mathematically created simulations or calculations. This has given cross-impact analyses the reputation of oversized mathematisation among qualitatively oriented scenario analysts.

In order to avoid the problematic circumstances and use the advantages of these methodologies, the Cross-Impact Balance Analysis was developed under the leadership of Dr. Weimer-Jehle at the University of Stuttgart.

### 4.2 Cross-Impact Balance Analysis

Next-Net developed the scenarios using the methodology of Cross-Impact Balance Analysis (CIB). This method is used for structured analysis of impact networks. CIB utilises qualitative
insights into the individual relationships between the factors of the network and constructs consistent images of its overall behaviour [235].

The scenario technique is one of the typical applications of CIB. When creating scenarios, developments in many different fields (e.g. economic, political, social or technological developments) often need to be investigated. For the individual fields there are often ideas about the scope of possible developments. However, the development of consistent scenarios requires identifying which combinations of these variants are promoted by the network of interrelations between them. This systemic synthesis of individual disciplinary information into consistent overall images as part of a scenario analysis can be performed by using CIB.

CIB is a generalisation of the consistency analysis for causal information. Due to the greater analytical depth, it has a larger data requirement and places higher demands on methodological understanding than consistency analysis, but remains much simpler and more transparent than the conventional cross-impact analysis. The procedure for developing scenarios using cross-impact balance analysis is explained below. [215; 214; 82]

4.2.1 Preparation of the Cross-Impact Balance Analysis

For the development of future scenarios, the following phases are conducted:

4.2.1.1 Identification of influencing factors (Descriptors)

First, all relevant influencing factors, framework conditions and target variables are determined. These are called descriptors. Descriptors for Next-Net were identified in Chapter 3.

4.2.1.2 Identification of variants of influence factors (Future projections)

In Phase 2 the essential qualitative variants of each descriptor are elaborated. These are called future projections. The future projections of a descriptor should be mutually exclusive and qualitatively represent the realm of possibility. Similar to the descriptors, the future projections for Next-Net are elaborated in Chapter 3.

4.2.1.3 Judgement of the influences by the experts

Using the future projections, a matrix was set up in which the future projections are plotted in the ordinate and in the abscissa. The resulting CIB matrix can be seen in Figure 4-2. This matrix was sent to the partners for the assessment. Due to the high number of evaluations to be carried out, the individual descriptor areas (political, economical, social etc.) were divided among the partners, so that each area was evaluated twice. When performing the evaluation, it is important to assess the impact of the future projection in the selected row on the future projection in the selected column. Furthermore, only direct impacts must be considered. Compared to the consistency matrix, the CIB-matrix must be filled in completely (not only half-sidedly) in order to be able to express the causality of the relationships. The procedure is also shown in Figure 4-2. The evaluation was carried out considering the following scale:
Figure 4-2: CIB-Matrix for the judgements

-2 = **strong impeding influence**, i.e. future projection A.1 has a strong inhibiting influence on future projection B.1. A common occurrence in a scenario has to be argued.

-1 = **moderate impeding influence**, i.e. future projection A.1 has a moderate inhibiting influence on future projection B.1.

0 = **neutral or independent influence**, i.e. the future projection does not affect the other.

1 = **moderate supporting influence**, i.e. future projection A.1 has a light supporting effect on the future projection B.1. Both future projections may well occur in a scenario.

2 = **strong supporting influence**, i.e. the future projection A.1 has a strong supporting effect on future projection B.1. In case future projection A.1 occurs in a scenario, also future projection B.1 can be expected to be in the same scenario.

Two different matrices result from the collected judgements, which are consolidated and processed for further evaluation. The consolidation is carried out using upscaling. This means that the target matrix consists of the sum of the individual judgement matrices. This extends the range of judgement to -4 to 4. Upscaling has no influence on the later evaluation, but allows a differentiated evaluation. After consolidation, further steps are taken with the help of a spreadsheet program to eliminate possible dissent and comprehension errors. A dissent exists if the direction of the impact is different for the matrices to be consolidated. The affected cells are marked. Furthermore, the cells in which a difference >1 is detected are also marked. In a workshop, the affected cells will be compared and aligned.
4.2.2 Development of future scenarios with the Cross-Impact Balance Analysis

To generate the scenarios the CIB uses the inductive approach described in chapter 4.1. First all possible combinations of future projections are formed into projection bundles. These are then checked for consistency. Due to the large number of projection bundles (63,700,000) to be examined, the open simulation software ScenarioWizard 4.1.3 is used for the evaluation and consistency check of the projection bundles. The ScenarioWizard was developed by Dr. Weimer-Jehle and his team as part of his work on the ZIRUS (Stuttgart Research Center for Interdisciplinary Risk and Innovation Studies) for the computer-aided modelling of CIB scenarios.

In the cross-impact balance analysis consistency and plausibility checks are carried out using the impact scores, which are calculated for each future projection by selecting the rows (future projections) that belong to the analysed projection bundle and then calculating the column sum. The impact scores can now be examined for each descriptor of the projection bundle. All impact scores of a descriptor are also called impact balance. This is shown in Figure 4-3.

Each projection bundle is checked for the CIB consistency principle. The CIB consistency principle requires that for each descriptor exactly the future projection is selected in which the sum of the influences of the other descriptors refers most strongly. This is the future projection with the maximum sum within the impact balance of the descriptor. If this is not the case for a descriptor, the corresponding assumption made in the scenario is considered implausible, since more or higher weighted arguments speak in favour of another assumption (future projection) [216].

![Cross-Impact-Matrix](image_url)

**Figure 4-3: Example CIB consistency calculation**
According to the CIB consistency principle, the scenario assumption must also be the maximum impact score within an impact balance. In projection bundle 1, this specification does not apply to any of the three impact balances. All descriptors (colored in red) show a clear difference between the scenario assumption and the maximum impact score. From a logical perspective, the statement of the projection bundle’s is: “In an environment of free world trade and a high innovative capacity of people, the chance of a stagnation of the digital transformation process seems more likely than the continuation of the digital transformation”.

According to the CIB method, this scenario is inconsistent and will therefore not considered anymore. With projection bundle 2, all maximum values of the impact scores correspond to the scenario assumptions. This projection bundle is consistent according to CIB.

The descriptors and the respective future projections must be defined in the program. An overview of the descriptors and future projections is shown in Figure 4-4. Subsequently, the consolidated evaluations of the experts are entered in the program.

The ScenarioWizard offers various evaluation options for determining the consistent projection bundles (scenarios). The option utilised in the explained example above is called "strong consistency". This option returns only scenarios in which the scenario assumption always corresponds to the highest impact score. Therefore, there is no better impact score for another future projection [215]. Within Next-Net, the evaluation with strong consistency results in only
five scenarios for a given minimum distinction of three descriptors that are very similar. The qualitative analysis of the resulting scenarios shows that they only reflect the extreme areas of the scenario space and are very similar. With regard to the further investigation, it is important to create scenarios that are more diverse.

To increase the scenario diversity of the resulting scenarios in order to cover a wider scenario space, it is possible to loosen the consistency principle with the selection option “Maximum inconsistency”. This means that a scenario is considered consistently if none of its future projections in the impact balance is more than a predefined value behind the highest impact score of the impact balance [217]. Within NexNet, this option was selected and a maximum inconsistency of three was allowed. The selection in the program is shown in Figure 4-5 and results in 100 scenarios, which have to be reduced further.

Figure 4-5: ScenarioWizard Evaluation Options

Therefore, another evaluation option called “Selection manager” is used which is integrated in the ScenarioWizard. While in the first step the consistency value of the projection bundle was the decision criterion, the criterion of novelty is used to further reduce the scenarios in the second step. The novelty value of scenario A compared to scenario group G is defined as the minimum distance that scenario A reaches in relation to all scenarios of group G. The distance between two scenarios is the number of descriptors in which different future projections are set in the scenarios. In this way, all scenarios that are very different from another are arranged at the beginning of the sequence. Later in the sequence, the scenarios, which differ only slightly from the scenarios already listed earlier in the sequence follow.

The Selection Manager offers two options, which are shown in Figure 4-6. On the one hand, a desired number of scenarios can be specified as a result. On the other hand, it is possible to specify the minimum distance of the scenarios. Both options are based on the same heuristics, which is briefly explained below.
At the beginning of the heuristic, the two scenarios with the greatest distance to each other are selected. Then the scenarios with the highest novel value, i.e. the highest distance to the already selected scenarios, are selected step by step. If there are several scenarios with the same distance, the scenario with the smaller inconsistency is selected. This approach can be described as a simplified form of the approaches developed by Carlsen et al. [31] and Tietje [199].
5 Development of a Survey for an impact evaluation

A survey was prepared, conducted and evaluated within task T2.2. The goal of the survey has been to validate the projections developed in the previous section by asking experts to give their opinion and potential additional elements on the impact of a respective projection on the supply chain and to provide their insights on possible effects on the supply chain. The findings of the survey served the interpretation of the respective impacts on the supply chain within one scenario as well as it supported the handover to task 2.3.

The survey has been set up according to the descriptors and projections developed in Chapter 3 subdivided by the respective PESTLE dimension. Within the survey, two main questions have been asked per projection:

1. How might the respective projection impact the supply chain processes of your industry in 2030?
2. Please provide one or more outcomes/changes for your business and supply chain (e.g. SC structure or processes, business model, product portfolio, revenue, staff, IT) that will result from the respective projection.

While for the first question a quantitative scoring was asked and a scale from 1 (no impact) to 5 (strong impact) was proposed, for the second question qualitative answers were collected.

Due to its length, the survey has been split into three parts each grouping two dimensions according to their interrelation. Therefore, the three following, separate surveys resulted:

- Political and Economic dimension ([SURVEY POLITICAL AND ECONOMIC])
- Social and Environmental dimension ([SURVEY SOCIAL AND ENVIRONMENTAL])
- Technological and Legal dimension ([SURVEY TECHNOLOGICAL AND LEGAL])

Figure 5-1 shows an exemplary overview of the set-up of the questions within the web-interface. The first part explains the respective descriptor, e.g. Digital Transformation, and shows the associated projections. An explanation of the projection succeeds followed by the two questions described above. Limesurvey Version 2.65.0 has been used to prepare and conduct the survey.
Survey on the Supply Chain of the Future - Technological and Legal Dimension

Technological Dimension - Digital Transformation

Digital transformation describes the changes associated with digital technology application and integration into all aspects of human life and society, e.g. to improve performance of enterprises and convenience of social life. Associated trends include Big Data Analytics, artificial intelligence, cloud-based computer systems and blockchain.

Following development paths were:

- Rapid advancement of digitisation and digitalisation
- Obstacles restraining digital transformation
- Digital stagnation

Figure 5-1: Exemplary structure of a question set

The focus group for the survey was on experts within the area of supply chain management from the process and manufacturing industry and logistics. The distribution of the survey followed different methodologies, either via personal approach, personal email contact or via newsletter. In addition, a post regarding the survey has been placed onto the Next-Net homepage. The answers have been achieved either via a one-to-one discussion or via anonymous entry via web link. The results have been kept anonymous.

Several experts were approached via a special newsletter including an introduction to the Next-Net project, further logistics experts have been approached via general newsletter and
about 310 experts were contacted via personal email. The approach via newsletter had the advantage of promoting the project large circle of experts.

A total of 200 experts answered a part of the survey and 62 of them completed it in all its sections, shared among European countries.

<table>
<thead>
<tr>
<th>Title</th>
<th>Partial answers</th>
<th>Full answers</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
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<td>20</td>
<td>66</td>
<td>30%</td>
</tr>
<tr>
<td>Survey on the Supply Chain of the Future – Political and Economic Dimension</td>
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<td>25</td>
<td>81</td>
<td>31%</td>
</tr>
<tr>
<td>Survey on the Supply Chain of the Future – Social and Environmental Dimension</td>
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<td>17</td>
<td>53</td>
<td>32%</td>
</tr>
<tr>
<td>Total</td>
<td>138</td>
<td>62</td>
<td>200</td>
<td>31%</td>
</tr>
</tbody>
</table>

Table 5-1: Answer rate for each of the three public surveys

Figure 5-2 shows a country wise distribution of the answers. Most of the answers were received by Portugal, followed by Italy and then UK and Germany.

Figure 5-2: Completed surveys sorted according to Country

With regard to the industry, the answers from the survey were attained by a good distribution over different sectors. Most of the answers were accomplished by experts from discrete manufacturing and process industry. Figure 5-3 depicts the distribution over the different sectors.
Figure 5-3: Completed surveys sorted according to industry
6 Preliminary results

6.1 Results of the cross-impact-balance analysis

Within Next-Net, all scenarios with a minimum distance of five are used for further processing. Out of the approximately 63 Mio. possible projection bundles, the calculation of the ScenarioWizard results in twelve scenarios. As presented in Figure 6-1, the first two of the scenarios show a positive overall development and are characterised especially by a stable political and economic environment. In contrast, the two upper right scenarios show a negative overall development characterised 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. Each scenario has been given a name according to its development. Figure 6-2 displays the scenarios and the configuration of the projection. The similarity of the selected projections determines, as far as possible, the arrangement of the scenarios. Figure 6-2 is to be read as following: Each column represents one scenario. The rows denote the chosen projection for each descriptor within the scenario. The projections are sorted according to the PESTLE dimensions while each dimension is represented by a different colour. In total, each scenario consists of 22 future projections. Chapter 6 offers a detailed narrative for each scenario providing an overview on the interplay of the projections.

Figure 6-1: Overview on the general development of the twelve selected scenarios
## Figure 6-2: Overview on resulting scenarios

<table>
<thead>
<tr>
<th>aSPIRANT</th>
<th>PROCEEDING</th>
<th>OFFSET</th>
<th>EQOCHAL Brink</th>
<th>SPIN DOWN</th>
<th>CIPoET</th>
<th>GUSSET</th>
<th>DITHER</th>
<th>Almost BLACK</th>
<th>UNEaS</th>
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<th>ENDANGER</th>
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<tbody>
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<td>C1: Demographic Change</td>
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**Notes:**
- **aSPIRANT:** 49
- **OFFSET:** PrOCEEDINg
- **EQOCHAL Brink:** SPIN DOWN
- **CIPoET:** GUSSET
- **DITHER:** Almost BLACK
- **UNEaS:** ESpAddr
- **ENDANGER:** 49
6.2 Findings of the survey

The results of the survey can be used twofold. First, the survey provides an impact factor for each future projection. Hence, the results of the survey supported the exemplification of the impact on the supply chain for each projection within a respective scenario. Figure 6-5 shows the resulting impact factor for each projection of the scenario. The future projections have been sorted according to the PESTLE dimension and its descriptor. As one impact factor belongs to every projection, the respective factor is located in the columns right to the projections. Each of the columns represents one of the scenarios as retrieved from the cross-impact balance analysis.

The explanations of the effects of a future projection on a supply chain are content of the second part of the survey. Whenever an expert expected an impact, major changes have been named. The respective input has been categorised according to three main dimensions of the supply chain, which are: i) its structure, this also includes the design and location decisions, ii) its processes, be it administrative and operational processes, and iii) its resources in terms of human resources, material, machines and costs [114]. Excerpts of those results are described within the scenario narratives in Chapter 7. Further in this project, the two following tasks within this work package, T2.3 and T2.4, will use this important input.
### Figure 6-5: Resulting impact factor on the supply chain per projection within a scenario

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Descriptor</th>
<th>Impact on Supply Chain</th>
<th>AGRIM</th>
<th>PROCEEDING</th>
<th>OFFSET</th>
<th>EPOCHAL Birth</th>
<th>SPIN DOWN</th>
<th>CIRCUIT</th>
<th>OUTLET</th>
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<th>Almost BLACK</th>
<th>UNEVE</th>
<th>UERGSP</th>
<th>ENABLI</th>
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<td>Political Concord in Europe</td>
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<td>Constant development in Europe</td>
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<td>Government collapse in Europe</td>
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<td>Individualised Consumption</td>
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<td>Customer Orientation</td>
<td>Individualism - Focus on variety</td>
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<td>Collectivism - Focus on the crowd</td>
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<td>Digital Transformation</td>
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<td>Digital Stagnation</td>
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<td>Autonomous Systems</td>
<td>Dynamic development of autonomous technologies</td>
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<td>Inadequate reluctance to accept autonomous technologies</td>
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<td>Alternative energy generation, storage and usage</td>
<td>Established Electricisations and Grain Systems</td>
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<td>Ongoing electrification and alternative energy endeavours</td>
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<td>Decentralised connection of information and physical devices</td>
<td>Dominance of Global Players</td>
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<td>Start-ups and SMEs take up business</td>
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<td>Disruptive Production Technologies</td>
<td>Continuous exploitation of disruptive technologies</td>
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<td>Coexistence of conventional and disruptive technologies</td>
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<td>Consumer Protection Laws</td>
<td>Promotion of laws and full product transparency</td>
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<td>Legislation is lagging behind dynamic market development</td>
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<td>Intellectual Property Laws</td>
<td>Full security for inventors and data providers</td>
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<td>Low confidentiality for data and market participants</td>
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<td>Social and Environmental Regulations</td>
<td>Comprehensive regulatory framework</td>
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<td>Heterogeneous regulations</td>
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<td>Environmental</td>
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<td>Our planet is recovering</td>
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<td>Our planet is on the brink</td>
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<td>Countering resource depletion</td>
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<td>Rise in depletion of natural resources</td>
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7 Scenario Narratives

The following chapters narrate the arising scenarios in detail. Each scenario contains a separate scenario that starts with a first overview on the main characteristics of the scenario and states the respective future projections. A detailed description of the interplay of the projections follows. The scenarios are arranged as presented in Figure 6-2 according to the similarity of their projections and the overall development. Figure 6-2 also displays the names of each scenario. The following subchapter illustrates the impacts on the supply chain resulting from the survey results. For this, the supply chain impacts resulting from the survey are categorised according to structure (or design), processes and resources (in terms of human, material, machines and costs) [114]. Each subchapter closes with a short conclusion on the special characteristics of the scenario and its distinction towards the other scenarios.

7.1 “aSPIRANT” - Strong Partnership enables homogeneous frameworks allowing a sustainable ANd Technological development.

The characteristics of the scenario can be summarised with the following aspects:

- Harmonious future with a collectivist-style society
- Stable political and economic environment with widely established digitalisation
- Environment for a sustainably prospering social, technical and economic development homogenously developing throughout Europe
- Global enterprises and tech start-ups are the economic winners

Those characteristics result from the interaction of the individual future projections comprised in the scenario as shown in Table 7-1.

| Harmony in Europe, widespread free trade, stable alliances |
| USA & Europe hold their ground, 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 |

Table 7-1: Elements of the scenario

The following subchapter explains the interaction of the respective elements in further detail.
7.1.1 Description of the scenario

A stable political and economic environment within the EU and neighbouring countries characterises this scenario. Free trade agreements of European countries with other economic unions support and facilitate the exchange of goods. Europe remains strong in exports and intensifies the role as a net investor in the world. This is further supported by the upcoming economic development of the MINT countries. At the same time, new competitors emerge from different parts of the world. Born-global firms export their products or services within a couple of years after their founding and export high percentages of their total production. This is particularly noticeable within a fast developing digital economy. The developments of collaborative platforms enable an easy share and utilisation of resources. New digital business models emerge in many different sectors such as in the leisure, fashion or cosmetic industry.

New service categories like the FinTech Services innovate complete industrial sectors. Within this setting, companies establish their own payment systems along with growing Fintech start-ups, similar to the current payment service Alipay by Alibaba. Trusted third party services develop their own digital currencies, taking over the “traditional” way of paying. As global companies are the pioneers in the fields of digital transformation and cyber-physical systems, this puts them into a powerful position where they are in control of high volumes of generated data. Big companies with a global reach hence determine the new payment logic. Smaller and local companies struggle with the efficient management of information overload since neither enabling technologies nor the required expertise are available.

A high pace of technological development hinder smaller companies to catch up and compete with global players. The digital economy permeates all aspects of society; helping people and companies to orchestrate, manage, and automate many of their daily activities (e.g. “virtual agents & brokers”).

As social networks strongly influence the buying behaviour, companies have to adapt quickly on a large scale. Still, the consumer in the EU is very consumption aware and pays attention on the origin of and ingredients of products as well as its recycling options. This mind-set also reflects in people moving to the countryside. Since the suburban living offers a higher quality of life, people accept a longer journey to work. The technological developments allow flexible forms of work. Either way, fast transportation and innovation in the mobility sector are supporting this lifestyle, also for the increasingly older generation. To ease the demographic inequality of an ageing population in Europe, migration is supported. New concepts support fast integration and is sustained by social engagement. An effective wealth re-distribution ensures social stability.

The political and economic settings support technological developments, allowing SME’s and start-ups to participate in the global arena. Emerging technologies such as advancements in artificial intelligence (AI) assist humans by undertaking autonomous planning and handling tasks. Since many physical and intellectual tasks are increasingly being taken over by technical developments in automatisation and autonomisation, the overall need for labour decreases. White-collar tasks change from decision-making to supervision of AI based
decision-making systems. An increased exploitation of these technologies leads to a highly automated and autonomous environment. Coupled with the ability to share and act upon the associated data and derived insights, new service- and production-related business opportunities will arise for global players as well as start-ups. Suppliers of disruptive technologies experience exponential growth rates. Existing disruptive technologies are improved and additional solutions developed in a rapid and continuous manner. These technologies not only increase the degree of freedom in manufacturing processes but also allow more efficient and effective work processes.

Simultaneously with developments within the technological area, regulations are maintained updated. There are clear regulations for handling of data, thus creating transparency and IP-security. Along with a comprehensive regulatory framework, it supports new inventions. Regulations towards full product transparency support sophisticated recycling technologies. Together with an enhanced resource efficiency, this limits the depletion of resources to a minimum as well as it slows down waste increase.

Since fossil fuels are depleting and becoming more expensive as time goes by, renewable generation, transmission and distributed energy resource systems are becoming even more relevant as substitute for future generations. At the same time, new power grid solutions and grid transformations overcome technological limitations of a traditional power grid and create a smart grid environment with distributed energy generation and powerful storage systems. The time for product development and rollout is minimised.

7.1.2 Impact on the supply chain

The interplay of the projections has different effects on the structure, processes and resources of a supply chain. This scenario touches all three of these aspects of the supply chain. Based on the insights gained in the survey, the scenario might have the following effects on the supply chain. The points mentioned constitute a selection of points mentioned in the survey.

Regarding the supply chain structure, the harmonic political and economic development most probably provide better conditions for strategic agreements across several states. On the other hand, the fast technological development and development of new production technologies affect the structure of the supply chain. New business models can be necessary both to handle the ecological development and the digitalisation advances to increase respectively the capacity to manage the types and quantities of waste as well as to make more agile the supply chain structure.

Process wise, the political harmony combined with contented unions result in smoother and faster cross-border supply chains. With regard to the digitalisation and the use of platform strategies, new digital processes are required to respond to the technology enabled faster information flow. Digitalisation also 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 are frequently required to fulfil the new and rapidly advancing laws.
In terms of resources, the advancements in digitalisation and new process technologies can affect the amount of resources required for R&D. On the one hand, the fast development makes a significant effort on R&D necessary, on the other hand the political and economic harmony leads to easier access to specific materials and components. In addition, new employment is required for dealing with recycling and reusing processes across the globe.

7.1.3 Scenario summary and comparison

Overall, Scenario ‘aSPIRANT’ describes a very harmonious picture of the future with a stable political and economic environment. The economy is influenced by a consumer who pays close attention to his consumption behaviour and enjoys a quite live in the suburban region. The political and economic setting allow for a quick adaption of legal regulations. This allows new technologic developments to rise significantly. Big companies are the first to profit from this rather ideal setting, though, as they can provide resources for the fast development of technologies and their adaption.

Scenario ‘aSPIRANT’ described above has similarity to Scenario ‘PrOCEEDINg’. Both are based on a politically as well as economically stable environment. Similarly, the future projections of the legal and environmental dimensions are the same. As the scenario differs in several social aspects as well as in terms of the actor, who makes use of new technologies, this scenario requires further attention.

7.2 “PrOCEEDINg” – Political coherence, disruptive technologies and individualised consumerism facilitate an innovative business development.

The following summary characterises the overall scenario setting:

- Harmonious picture of the future
- Customers act responsibly but highly individualistic and live in smart megacities
- Stable political and economic environment with prospering medium sized businesses and start-ups, which can adapt well to local markets
- Social, technical and economic development are progressing parallel and set a homogenous framework in a highly digitised world

Those characteristics result from the interaction of the individual future projections comprised in the scenario as shown in Table 7-2.
### 7.2.1 Description of the scenario

In a politically stable and economically flourishing environment, Europe remains a strong net investor in the world with significant investments in upcoming technologies. People attach relatively lower importance to property values taking advantage of the growth of the sharing economy, which is facilitated by the existence of collaborative exchange platforms enabling an easy share and utilisation of resources (hubs, terminals, etc.).

These platforms support also the Do-it-yourself society wherein self-production of fashion, technological equipment and food become the standard. Individuals want to receive a personalised shopping experience. The answer of global companies towards this consumption aware and variety-focused customer is the adaption of their structures towards a “glocal” approach. Accordingly, companies respond flexibly to local customer needs in order to remain on regional and local markets. Global companies hence compete with local players by recognising differences in local taste and custom. At the same time, those global companies adapt their product and service offering to a growing number of markets. The development of smart megacities facilitates the distribution of goods, mainly for DIY-Products.

Simultaneously, digitalisation is becoming more and more integrated into the business environment and permeates all aspect of society such as the finance sector. The FinTech sector is evolving fast and at a pace that traditional banks struggle to emulate. However, people are sceptical and reluctant to solely assign their economic activity to FinTech companies. Thus, Fintechs collaborate with Banks that remain an important element of the transactional infrastructure.

Existing disruptive technologies are improved and additional solutions developed in a rapid and continuous manner. These technologies not only increase the degree of freedom in manufacturing processes but also allow more efficient and effective work processes. Coupled with the ability to share and act upon the associated data and derived insights, new service-

<table>
<thead>
<tr>
<th>Table 7-2: Elements of the scenario</th>
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<tbody>
<tr>
<td>Harmony in Europe, widespread free trade, stable alliances</td>
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<tr>
<td>USA &amp; Europe hold their ground, digital platform economics, mix of banks and FinTechs established, global companies operate locally</td>
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<td>Social balance, adjusted labour market, living in smart cities, strong consumption individualisation (DIY, variant diversity)</td>
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<tr>
<td>Digitalisation and Industry 4.0 widely implemented, electrification and ecologicalisation far advanced; start-ups and SMEs push disruptive developments</td>
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<tr>
<td>Legislative keeps pace with technological development; offers appropriate regulations</td>
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<td>Climate protection successful, resource wastage curbed</td>
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and production-related business opportunities will arise especially for start-ups. Emerging technologies such as artificial intelligence (AI) assist humans by undertaking autonomous planning and handling tasks. White-collar tasks change from decision-making to supervision of AI based decision-making systems. The resulting knowledge-based labour market is characterised by cross-disciplinary, creative profiles and lifelong learning. In combination with the developments in autonomisation, the overall need for labour decreases.

Those efficient work processes contribute to reduce the overall energy requirement. The technological developments allow for renewable energy generation, transmission and distributed energy resource systems are becoming more prevalent. At the same time, new power grid solutions and grid transformations overcome technological limitations of a traditional power grid and create a smart grid environment with distributed energy generation and powerful storage systems.

Most importantly, the politically proactive environment allows for a rapid and early update on regulations mostly simultaneously with developments within the technological area. Also, laws towards data privacy and data exchange provide clear legal environment for all economic participants. Regulations towards full product transparency support sophisticated recycling technologies and allow for a setting for circular economy. Together with enhanced resource efficiency, this limits the depletion of resources to a minimum while slowing down waste increase.

### 7.2.2 Impact on the supply chain

The interplay of the projections has different effects on the structure, processes and resources of a supply chain. This scenario touches all of these aspects of the supply chain. Based on the insights gained in the survey, the scenario might have the following effects on the supply chain. The points mentioned constitute a selection of points mentioned in the survey.

Global and multinational supply chains in the framework of this scenario will have to adapt their structures towards a regionalised setting. Technological advancements and the legal frameworks allow for new, fast and responsive supply chains, which are able to react quickly to changes in customers’ needs. Effects on structure and processes also come along with requests towards a circular economy or at least regulations towards resource efficiencies.

From a process perspective, disruptive technologies will provide holistic planning algorithms for the whole supply chain. This use of predictive analysis will translate into better forecasts, improved efficiency and hence reduced or at least more predictive lead times. Therefore, the associated supply chain costs will decrease (e.g. through more efficient risk management). Additionally, the request for more variety will reflect on processes with a higher focus on product customisation activities.

Technologies mentioned above will also denote a shift from labour intensive operations to automated tasks including decision making on logistics and operations. Moreover, technology can also provide low carbon solutions that will affect supply chains positively.
7.2.3 Scenario summary and comparison

Overall, Scenario positively describes a very harmonious picture of the future with a stable political and economic environment. The economy is influenced by a consumer who wants tailor-made solutions while living in smart cities. As political and economic setting allow for a quick adaption of legal regulations, this allows new technologic developments to rise significantly. Start-ups and SMEs are the first to profit from this rather ideal setting, while focusing on niche markets and lean organisational structures. A do-it-yourself society with strong customer awareness causes multinationals to use a “glocal” approach.

Scenario ‘PrCEEDING’ as described above has similarities to Scenario ‘aSPIRANT’. Both are based on a politically as well as economically advancing environment. The banking system remains stable while Fintechs are establishing as competitors. Similarly, the development paths of the legal and environmental dimensions are the same. As the scenario differs in several social aspects like the do-it-yourself society combined with a demand for individualised products and goods and a market that is open towards start-ups and SMEs, this scenario requires further attention.

7.3 “oFFsET” - Free trade enables political and social development whereas fragmentation hinders technological and environmental change.

The scenario can be characterised with the following aspects:

- Europe continues to develop steadily in political and economic terms
- Collectivistic, social-balance seeking society
- Spread of technological innovations is somehow thwarted, partly because of inadequate legislative frameworks
- Ecological problems and scarcity of resources are intensifying

Those characteristics result from the interaction of the individual future projections comprised in the scenario as shown in Table 7-3.
7.3.1 Description of the scenario

The world has to deal with severe environmental problems. The CO₂ emissions are increasing around the world and there are the major sources of total greenhouse gas emissions. Even though in some countries the level of emission slightly declines, the atmospheric CO₂ concentration and the global temperature rise new warning peaks. The most visible consequences are the continuous escalation of climate disasters and the increasing in the air, water and soil pollution. Climate change is combined with a severely ongoing depletion of natural resources along with the ever-increasing global population. For example, the overall demand for water is still above available supplies so that highly populated countries face severe issues related to water scarcity or completely lack access to water. In addition, there is an increasing production of solid, hazardous and electronic waste, whilst the recycling rate remains low and countermeasures to avoid high waste are not well implemented or, in most of the countries, there is a lack of ambitious policies for waste and recycling management. These environmental issues are reinforced by the growing consumerism. Customers around the world are more interested about the quantity than the quality of products and the behaviour in purchasing is influenced by the crowd.

There is an increase in the global goods exchange partly due to open boarders and reduced import and exports tariffs. These policies can help the creation of trade agreements not only between European countries but also among non-European ones. Even though economic trade agreements develop, political agreements become unstable and in particular, in the European Union efforts are required to keep the confederation together. Another factor, which affects the planet’s ecosystems, is the expansion of urban areas; the emergence of megacities is amplified by the migration flow from countryside to the cities. Along with the increasing urbanisation in some areas of world, large poverty areas and integration of minorities have to be dealt with.
Moreover, population in developing countries is rising strongly and all these factors conduct to a worsening of environmental conditions. Nevertheless, there are some ongoing countermeasures: the use of renewable energy resources and smart grid solutions are promoted by the better connectedness and efficiency of smart cities and also in the industrial sector. Green systems used for power generation, energy storage and transportation, such as hydrogen power cells and biomass, are progressively applied. But, standard mutual roadmaps and common policies are missing; for this reason, solutions for smart power grids or E-mobility develop slower than expected.

The lack of ambiguous legislation is a problem that does not influence only the potential solution for the environmental issues but it is influencing and sometimes impeding the adoption of new services and other important technological development that could improve the society and businesses. The lack of regulations and the need for a cultural transformation are the barriers for a digital transformation not only in respect with the social and economic dimensions but also with the technological one. The digital transformation of industries is slowing down due to high costs of implementation and retention; only occasionally some technologies are successfully implemented such as autonomous systems but only a selection of companies, mostly multinationals, can afford to implement available digital technologies and this results in a coexistence of conventional and disruptive production technologies.

Thus, there is a dominance of global players that become the pioneers in the fields of digital transformation and cyber-physical systems; global players have significant resources such as brands, hard assets, customer relationships, global distribution data and many years of institutional know-how to harness the digital transformation. The global players will be the main actors also in the financial innovations: the big 5 IT companies (Google, Apple, Facebook, Amazon, Microsoft) offer their own financing to facilitate seamless payment between both people and devices: credit card companies and technological companies join forces and establish new technical payment standards including biometric identification procedures.

7.3.2 Impact on the supply chain

The interplay of the projections has different effects on the structure, processes and resources of a supply chain. This scenario touches upon all these three aspects of the supply chain. Based on the insights gained in the survey, the scenario might have the following effects on the supply chain. The points mentioned constitute a selection of those mentioned in the survey.

The rise in depletion of resources disrupt the business continuity of manufacturing companies that try to reuse and better design their product in order to reduce the material bill and the expense of disposal. Thus, sustainability issues demand big changes in several areas in the supply chain e.g. purchasing process, waste disposal and landfilling. Some companies may also relocate their plants to access resources or avoid the barriers of regulations. For instance, the CRC Energy Efficiency Scheme (CRC) is a mandatory government scheme in the UK that leads large private sector organisations to become more energy efficient in order to reduce
their CO₂ emissions. However, as the regulations are not homogeneous and do not exist in all countries, companies in other parts of the world will implement less changes in terms of sustainability development.

From a process perspective, companies are trying to re-use and recycle their product but the manufacturers of technologies for recycling are struggling to sustain their business model. Councils will be also unable to sustainably manage their waste due to the rising number of people living in urban areas, which demands also more centralised distribution centres. Greater waste generation will require greater supply chain involvement. Companies can also utilise lean process to drive cost reduction. Technological advancements have also brought the cost of some renewables down to near-parity with conventional sources; however, they are still bound to system constraints and may bear additional costs, which can render them unprofitable. The ‘much and cheap’ consumption pattern requires lean and efficient process settings to reduce logistics costs.

New business models will also be created with new forms and shapes of IoT deployments driven by the big players i.e. Google, Apple, Facebook, Amazon, Microsoft – GAFAM. However, there is uncertainty around business protection, security and fraud detection. Despite these barriers, the new technological advancements allow the supply chain administration to be simplified and thus, supply chains can work smoothly with less cost and better customer satisfaction.

### 7.3.3 Scenario summary and comparison

Summarised, political and economic development continues with high uncertainty according to current developments; the ecological problems and scarcity of resources are intensifying because climate protection targets are not achieved, the pollution of air and water is increasing and resources are more and more insufficient. Spread of technological innovations is somehow thwarted, partly because of inadequate legislative frameworks. The lagging of heterogeneous regulations obstructs also the digital transformation of economy and society characterized by consumerism and collectivism.

Scenario ‘oFFsET’ described above has similarity to Scenario ‘EPOCHAL Brink’. The development paths of the legal, political and environmental dimensions are the same. The most relevant differences between the two scenarios are related to the economic dimension and the technological one. While in the scenario ‘EPOCHAL Brink’ the acceptance rate of new digital business models is lower than expected but some new digital instruments (financial and technological) have achieved the public domains in scenario ‘oFFsET’ the increasing number of cyber security issues obstruct the digital economic transformation and create new barriers to accept the autonomous technologies.
7.4 “EpOCHAL Brink” - Economic and Legal Changes Lag and the Planet goes on the Brink.

The characteristics of the scenario can be summarised with the following aspects:

- Mixed picture of the future with positive and negative developments
- Political and economic developments with high uncertainties combined with stronger social disequilibrium
- In the unstable environment it is not possible, to bring digitalisation to an orderly development, which is why major enterprises are profiting primarily
- Ecological problems and scarcity of resources are intensifying

Those characteristics result from the interaction of the individual future projections comprised in the scenario as shown in Table 7-4.

| Political uncertainty in Europe, widespread free trade, instable alliances |
| Asia is the economic pace setter, tech-giants dominate financial sector, globalised companies benefit; |
| Aging society with demographic and social disparities, high unemployment, living in smart cities, “much-and-cheap” consumption influenced by the collective |
| Digital transformation is slowing down due to cost and retention, autonomous systems established with coexistence of conventional systems, further efforts for electrification and alternative energies |
| Legislation falls behind technological development, heterogeneous regulations and low levels of trust in data privacy and market regulation |
| Climate protection targets are not achieved, strong pollution and scarcity of resources |

Table 7-4: Elements of the scenario

The following subchapter explains the interaction of the respective elements in further detail.

7.4.1 Description of the scenario

The world has to deal with severe environmental problems. The CO₂ emissions are increasing around the world and are the major sources of total greenhouse gas emissions. Even though in some countries the level of emission slightly declines, the atmospheric CO₂ concentration and the global temperature rise, reaching new warning peaks. The most visible consequences are the continuous escalation of climate disasters and the increasing in the air, water and soil pollution. The climate changes are combined also with a severely ongoing depletion of resources for humankind as well as industries; the ever-increasing global population, economic growth highly contribute to damage the natural resources of our planet. For example, the overall demand for water is still above available supplies so that highly populated countries face severe issues related to water scarcity or completely lack access to water. Along with this situation, the world is increasing the production of solid, hazardous and electronic waste. This has a strong negative global impact also caused by the increase of
consumerism for which the customers around the world are more interested about the quantity than the quality of products. In addition, the recycling rate remains low and countermeasures to avoid high waste are not well implemented or, in most of the countries, laws and policies for waste and recycling management are not strong enough. Moreover, there are vague regulations and sometimes a lack of legislative clarity in several countries that make it difficult to promote worldwide a sustainable development for the humankinds and the Earth. These dangerous environmental issues are reinforced by different factors coming from other dimensions. The fast increment of the consumerism is an effect of the increase in the global goods exchanges due to the lack of restrictions like import and exports tariffs. These policies can help the creation of trade agreements not only between European countries but also among non-European ones. This influence negatively the delicate balance of natural resources and increase the CO$_2$ emissions. Another factor affecting the planet's health is the increase of urban areas resulting in physical growth of cities, megacities caused by the migration flow from countryside to the cities. Along with the increasing urbanisation in some areas of world, large poverty areas and integration of minorities have to be dealt with. Also due to disparities between the wealthy (where the older population is increasing) and poor regions, with a no re-distribution of resources are increasing; moreover, population in developing countries is rising strongly and all these factors conduct to a worsening of environmental conditions. Nevertheless, there are some ongoing countermeasures: the use of renewable energy resources and smart grid solutions are promoted by the better connectedness and efficiency of smart cities and also in the industrial sector, green systems used for power generation, energy storage and transportation, such as hydrogen power cells and biomass, are progressively applied. Lack of agreements between countries for R&D laws result in a slow adoption for smart power grids. The same problem arises for the E-mobility: this technology could decrease the emission of CO$_2$ and reduce the greenhouse effect but its proliferation is arrested by the lack of standard roadmaps and common policies and the lack of a systematic upgrade of the infrastructure. The lagging in legislation is a problem that does not influence only the potential solution for the environmental issues but it is influencing and sometimes impending the adoption of new services and other important technological development that could improve the customer life and the performance of industry. This lack of regulations and the need for a cultural transformation are the barriers for a digital transformation not only in the social and economic dimensions but especially in the technological one. In fact, only a selection of companies, mostly multinationals can afford to implement available digital technologies and this results in a coexistence of conventional and disruptive production technologies (with even a development for example of autonomous systems). In this way, there will be a dominance of global players that become the pioneers in the fields of digital transformation and cyber-physical systems; global players have significant resources such as brands, hard assets, customer relationships, global distribution data and many years of institutional know-how to harness the digital transformation. The global players will be the main actors also in the financial innovations: the big 5 IT companies (Google, Apple, Facebook, Amazon, Microsoft) offer their own currencies
to facilitate seamless payment between both people and devices: credit card companies and technological companies join forces and establish new technical payment standards including biometric identification procedures. If from one side, there is a common adoption of these digital financial instruments, from the other side the consumers continue to shop in a conventional way because political concerns limit the development of the digital transformation of the economy and the traditional way is upheld due to fear of data misuse and legal. In fact, the consumers are more and more worried about data privacy since the regulations related to the processing of personal data are unclear especially in cross-border information flow. But there is another digital instrument which achieves the public acclaim: it is the idea of sharing instead of owning assets with an increasing use of online platforms and peer to peer service. This influences the customer behaviours in purchasing: as reported at the beginning, the middle class is characterised by high consumption. The digital generation uses the Internet for the purchase and price comparison of different goods always trying to achieve a reduction in price. Moreover, the digital natives attach great importance to the opinion of their friends and role models from social networks.

7.4.2 Impact on the supply chain

The interplay of the projections has different impacts on the structure, processes and resources of a supply chain. This scenario touches all of these aspects of the supply chain. Based on the insights gained in the survey, the scenario might have the following effects on the supply chain. The points mentioned constitute a selection of those mentioned in the survey.

As one of the main points, market contraction will broadly affect the supply chain. With the rise of protectionism, the flow of goods between continents and countries gets affected. New partnerships must be created and this will globally transform the supply chain as it is known today. Indeed, the lack of cooperation will lead to duplication of some networks and this will affect the efficiency of the supply chain. Additionally, business within Europe will decrease and it will be necessary to go to other locations, impacting the structure of the supply chain. Production process will also be transformed and in consequence, new design of the supply chain processes is required combined with the emergence of new business models.

The scarcity of natural resources will have the broadest impact on the supply chain resources. There will be less and less resources that can be used for the supply chain, it will not be the priority to send goods from one point to another. Digitalisation and the emergence of the 5 big IT companies as the future banks will lead to a complete transformation of our approach to business. In addition, technological developments for smart materials will enable to use dematerialised material. This might result in a reduction in transportation.

7.4.3 Scenario summary and comparison

Overall, Scenario 11 describes a controversial picture of the future with some positive and negative factors. Political and economic environment are in a situation similar to the one we
have now and the main change in the economic dimension is the rise of the big 5 as banks of the future. The health of our planet is increasingly affected negatively by several factors and the political and economic setting does not allow a quick adaption of legal regulations which is still lagging behind the ongoing digital development. New technologic developments rise only along certain dimensions but not in a harmonious way. Big companies are the first to profit from this setting, though, as they can provide resources for the fast development of technologies and their adaption.

Scenario ‘EPOCHAL Brink’ described above has similarity to Scenario ‘oFFsET’. The development paths of the legal, political and environmental dimensions are the same. The most relevant differences between the two scenarios are related to the economic dimension and the technological one. While in the scenario ‘EPOCHAL Brink’ the acceptance rate of new digital business models is lower than expected but some new digital instruments (financial and technological) have achieved the public domains in scenario ‘oFFsET’ the increasing number of cyber security issues obstruct the digital economic transformation and create new barriers to accept the autonomous technologies.

7.5 “SPIN DOWN” – Slow evolution of current situation and Political INsecurity result in Digital Obstruction With damaged Nature.

A general summary for this scenario is presented in the following:

- Political and economic uncertainties are further increasing
- Speed of digitalisation and technological development is slowing down, traditional industries continue to assert their selves
- The different developments benefit SMEs and start-ups
- Ecological problems and scarcity of resources are intensifying

Those characteristics result from the interaction of the individual future projections comprised in the scenario as shown in Table 7-5:

| Political uncertainty in Europe, alliances dissolve, widespread free trade
| Asia is the economic pace setter, global companies act local, political uncertainty leads to a system without Banks based on crypto-currency and traditional goods exchange
| Social balance, adjusted labour market, living in smart cities, strong consumption individualisation (DIY, variant diversity)
| Digital transformation slows down due to cost and retention, autonomous systems are only occasionally successful, coexistence of conventional and disruptive technologies, further efforts for electrification and alternative energies; start-ups and SMEs benefit from technology development
| Legislation falls behind technological development, heterogeneous regulations and low levels of trust in data privacy and market regulation
| Climate protection targets are not achieved, strong pollution and scarcity of resources
The following subchapter explains the interaction of the respective elements in further detail.

7.5.1 Description of the scenario

The political situation in this scenario is shaped by the future projections “Constant development in Europe”, “Free trade” and “Fragmentation”. We hence face an uncertain future in Europe, where the situation is slightly evolving towards social insecurity and less privacy freedom due to the terrorism threat. Imports and exports of goods are easily achieved due to trade agreements with European and non-European countries. However, disagreements between European countries are emerging and some of them are leaving the Union. Despite the free trade policy, less global cooperation between the countries exist and multinationals adapt to the individuals demand of local products. The economic setting is globally changing, with a takeover of the economic leadership by China and current emerging countries, such as India, Brazil, Russia, Indonesia, Mexico and Turkey. European exports decrease due to a more localised production, translated in the fact global companies are producing goods and services adapted to the local markets and consumer needs. Multinationals are able to understand the local particularities and will then extend their dominant position. Digital economy reaches a peak due to many privacy concerns, and digital products are not replacing hardcopies (e.g. books). Physical goods remain the reference, whereas the entertainment industry continues on the path of digitalisation. Privacy concerns lead to the rise of smart ledgers, contracts and cryptocurrencies. Despite the reluctance of digitalisation, the ascension of this technology drastically reduces the influence of banks and individuals are able to manage themselves their own money and investments. Rebalancing of resources among the population is influenced by the development of new economies and appears to be a necessity. This is accompanied by a new wave of rural exodus, followed by a growth of cities. Technologies improvements will lead to further transformation into smart cities, with a more efficient use of resources, despite growing areas of poverty. Lack of trust on digitalisation and more awareness regarding consumption patterns influences individuals to build and customise their own products. Social and ecological footprints of goods are taken into account before any purchase. Customisation and personalisation of the different solutions gains greater importance for customers, triggering and reinforcing a do-it-yourself economy, which supports a rise in start-up companies. Individuals will be more inclined to create their own company and despite the existence of multinationals, start-ups and SMEs will be the backbone of the economy. This is due to a better access to technology and a more entrepreneurial spirit. This development supports that disruptive technologies are introduced to the market, although conventional technologies are still present. Companies adjust to changing market demands entailing a permanent training of employees to be the norm. Indeed, companies strongly encourage lifelong learning and reorientation of careers. Legal regulations reduce the field of use of analytics and only multinationals will have sufficient resources and knowledge to use them wisely. Autonomous technologies continue their development, but due to their costs and lack of trust those technologies are not widely used. Alternative and green energies are more
and more adopted and electric vehicles replace current cars. Additive manufacturing and robotisation, when combined with the digitalisation, encourage the emergence of new technologies but this does not fully replace the existing solutions. This strong and extensive pool of start-ups and SMEs change the market fast and the governments face difficulties to adjust regulation and policies in time. Additionally, a harmonisation of laws between all countries or within different industry segments is restricted, allowing disparities to remain. Data and IP are not completely secured, which incurs in difficulties regarding ownership and thefts. European countries will adopt consistent regulations, but standards may not be adopted worldwide. The lack of environmental regulations will promote the concentration of atmospheric CO2, global rising temperatures and natural disasters. This constitutes the main challenges for the future, since climate-related disasters will cause insecurity and important damages throughout the world. Resources continue their depletion due to the ever-increasing demand. Demand for water will stay very high, as well as the one for petroleum, which will remain as the most important source of energy.

7.5.2 Impact on the supply chain

The interplay of the projections has different impacts on the structure, processes and resources of a supply chain. This scenario touches all of these aspects of the supply chain. Based on the insights gained in the survey, the scenario might have the following effects on the supply chain. The points mentioned constitute a selection of those mentioned in the survey.

Regarding the supply chain structure, the macro influences caused by shifting global power towards emerging countries will most likely drive organisations to change businesses, incurring on the creation of centres of excellence and operational activity on these developing countries. Also, these changes will modify current strategies and structures of the supply chain, such as supply chain core processes being relocated to emerging countries. In combination with the rise of free trade, tariffs may decline, which will influence final sourcing and production location decisions. However, with the planet being dangerously close to the environmental breakdown and the growing depletion of natural resources, there will be great need for structural and process changes with additional efforts to conserve resources and minimise carbon emissions.

The constant development in Europe brings uncertainty into perspective, while the combination with fragmentation will result in higher costs and a slower supply chain, both considered harmful with respect to the supply chain process. Given that Start-ups and SMEs will take up business, incurring on lagging legislation due to the dynamic market development, supply chain processes will become more complex and the network may be considered not trustworthy. On the other hand, the perspective of a free trade environment will simplify supply chain administration and reduce costs, while supporting digitalisation and e-commerce. The presence of smart cities may contribute in a positive fashion for the last mile transportation
and will require an adaptation from the part of process logistics to connect and integrate on the smart grid environment.

Resource wise, the shift of power for emerging countries combined with a local approach will increase the need for staff recruitment through common ways of labour, such as widespread network and the sharing of information. Also, the awareness of inequalities, wealth distribution and investments aimed at equalising the labour market may serve as key factors on staff motivation, as well as improving data acknowledgement and sharing, bringing greater insight into more efficient technologies especially when concerning waste management. Moreover, this aspect will aid on the search for changes in structure that may help to identify alternative sources and resources, which may counterbalance the increasing depletion of natural resources.

7.5.3 Scenario summary and comparison

Scenario ‘SPIN DOWN’ describes a slow evolution of the current situation. The political setting tends to be less stable with the final emergence of new economies and the take-over of new actors. Economies will keep the same basis; digitalisation will not be widely adopted. Individuals will take over some initiatives and will have more influence locally. Cities will continue to grow and will constitute the core of the economy. Repartition of resources will be balanced and entrepreneurship will be encouraged and regulations will try to catch up with the innovations and new technologies. The changes in labour market will be accompanied and will result in more flexibility and lifelong learning as a rule. Exploitation of natural resources will continue and will result in more frequent natural disasters.

7.6 “CIRCuiT” – New business concepts support climate Protection while slow legislation REstrict TechnOlogical developments.

This scenario features the following main aspects:

- Political environment is changing towards protectionism, which benefits global players and corporations
- Digitalisation and Industry 4.0 are not gaining ground, due to the unstable environment and unsolved legislative framework conditions
- Social disequilibrium with high unemployment
- Ecological problems and scarcity of resources are mainly resolved by technological innovations

Those characteristics result from the interaction of the individual future projections comprised in the scenario as shown in Table 7-6:
The following subchapter explains the interaction of the respective elements in further detail.

### 7.6.1 Description of the scenario

We face an uncertain political future in Europe, where the situation is slightly evolving towards social insecurity and less privacy freedom due to terrorist threats. Taxes on imports and exports of goods are set up between European and non-European countries. Geographical barriers, trade barriers and regulatory issues will complicate the logistics structure. Consequently, disagreements between countries inside common unions will arise. The economic setting is globally changing, with a takeover of the economic leadership by China and current emerging countries (India, Brazil, Russia, Indonesia, Mexico and Turkey). European exports decrease due to a more localized production, translated into the fact that global companies are producing goods and services adapted to the local markets and consumer needs. Multinationals are able to understand the local particularities and will then extend their dominant position. Digital economy cannot advance mainly due to privacy concerns, and hence hardcopies (books for instance) dominate the market. Physical goods remain the reference, whereas the entertainment industry continues digitalisation. However, big and dominant IT companies will develop their banking and financial services and will step by step replace the traditional banks. The technological innovations and the collection of data reinforces the position of these companies and new services are developed. The population continues to grow older and this ageing trend affects the resource repartition. Indeed, the ageing population has the will to keep their standards of living and politically, a redistribution of resources is not encouraged. The world continues to be split into wealthy and poor regions. Individuals seek a better quality of life and technological innovations lead to relocation within countryside. Cities will remain important but due to flexibility of work conditions, individuals are willing to accept longer journeys to live in suburban areas with a higher quality of life. Lack of trust within digitalisation influences individuals to build and customise their own products. Social and ecological footprints of goods are taking into account before any purchase. Customisation and personalisation of the different solutions will take more and more
importance for the customers. A shift towards customised products is triggered and reinforced with the DIY economy. At the same time, a further development towards a knowledge based economy causes a growing rate of unemployment. The decision-making process is gradually replaced by supervision of AI and interactions within robots and machines become predominant. Due to unclear regulations though, only multinationals have sufficient resources and knowledge to use data analytics wisely. Required expertise will be rare and concentrated within a couple of multinationals. Conglomerates continue to arise and there will be a concentration of resources. Regarding further technological developments: On the one hand, investments into autonomous technologies are hardly done due to their costs and lack of trust. Factories adopt this technology slowly and step by step. Additive manufacturing and robotisation beside the digitalisation encourage the emergence of new technologies but this does not fully replace the existing solutions. In addition, alternative and green energies are slowly adopted and partly electric vehicles replace current cars. The emergence of new technologies and the influence of multinationals and several stakeholders result though in a timid change in regulation and policies. Data and IP are not completely secured and ownership and thefts will still be problematic. Additionally, regulations are not harmonised between all countries and disparities will remain. European countries will adopt consistent regulation but standards may not be adopted worldwide. More efficient use of resources will be encouraged throughout the world and this contributes to the economic growth. Efficient and more rational use of natural resources and more efficient technologies result in a mitigation of the climate change and global warming. Renewable resources are adopted and replace conventional systems. New approaches towards recycling support a circular economy.

7.6.2 Impact on the supply chain

The interplay of the projections has different impacts on the structure, processes and resources of a supply chain. This scenario touches all three of these aspects of the supply chain. Based on the insights gained in the survey, the scenario might have the following effects on the supply chain. The points mentioned constitute a selection of those mentioned in the survey.

In a protectionist scenario, new taxes will be imposed therefore hindering trade in global supply chains. Supply chains will be thus structured to act locally, for both supply and distribution. Additionally, new business models will be created with new forms and shapes of digital deployments driven by big players. Indeed, the revenue stream associated with the supply chain will pivot from asset control to data control.

From a process perspective, movements of goods will be slower and more complicated leading to increased costs, increased inventory and therefore lower profits.

Regarding the use of resources, protectionism will also make it more difficult to source commodities from abroad. On the other hand, mitigation of climate change will lead to easy access to resources, reducing cost and time to procure. However, supply chains may face lack of available workforce due to migration issues.
7.6.3 Scenario summary and comparison

The scenario ‘CIRCuiT’ emphasises on a slight change in the political setting: protectionism will arise and will contribute to foster the dominance of global players and conglomerates. Economies will keep the same basis; digitalisation will not be widely adopted. Multinationals will dominate the economy and will own the main future innovations. Resources will not be equally shared and a minority part of the population will exploit majority part of the resources. Individuals are willing to leave big cities in order to acquire a better quality of life. Unemployment will rise due to the labour market transformation and automatisation will take a decisive step. Innovations and technological progresses will result in the emergence of renewable sources of energy, which will fully contribute to the mitigation of climate change and global warming.

7.7 “OUTsET” – Fragmentation ObstrUcts the global Economic and Technological development.

The characteristics of the scenario can be summarised with the following aspects:

- Contrasting development under political uncertainty and protectionism, which benefits global companies and corporations
- Digitalisation, Industry 4.0 and autonomisation are being rejected, only in the financial sector dominate innovative payment methods the market by the global tech giants
- Sustainable consumer behaviour and smart cities require new standards and regulations for the ecological use of resources

Those characteristics result from the interaction of the individual future projections comprised in the scenario as shown in Table 7-7.

<table>
<thead>
<tr>
<th>Element of the scenario</th>
</tr>
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<tbody>
<tr>
<td>Political uncertainty in Europe, closed economic area, collapse of alliances</td>
</tr>
<tr>
<td>Asia is the economic pace setter, tech-giants dominate financial sector, traditional economy persists, global companies act local</td>
</tr>
<tr>
<td>Sustainable consumer behaviour and social balance, labour market compensated by migration and investments, customer expects diversity of variants, living in smart cities</td>
</tr>
<tr>
<td>Digitalisation stagnates, introduction of autonomous systems prevented, electrification and ecologicalisation far advanced; especially major enterprises benefit from the use of IoT, coexistence of conventional and disruptive technologies</td>
</tr>
<tr>
<td>Outdated, inhomogeneous legislation, low data privacy</td>
</tr>
<tr>
<td>No ecological agreements, heavy pollution and scarcity of resources</td>
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</tbody>
</table>

Table 7-7: Elements of the scenario

The following subchapter explains the interaction of the respective elements in further detail.
7.7.1 Description of the scenario

In Europe, the political stability worsens due to an increase of the uncertainty and the continuous disagreements and unrest of the confederations. Borders are closed and free movement and trade agreements are very limited since several countries are applying tariffs and import quotas, which restrict the establishment of foreign competition and complicate logistics structures of importing companies.

The political situation is affecting the economy. Europe loses its status as net investor in the world economy due to a decrease in Europe’s exports as the individual markets tend to produce locally. International products are adapted to the local culture in which they are sold. Local companies are further involved in the production and selling process in order to enable country specific adjustments and therefore, domestic production is being reintroduced into the country. The increase in wages in previously low-wage countries, as well as the cost of shipping and custom fees, make local production attractive again.

Even though the scenario depicts a “lack of openness”, there is an “open window” towards the development in financial instruments and payments systems. In this sense, credit card companies and technological companies join forces and establish new technical payment standards. This fact leads companies to establish their own payment systems. In addition, a growing number of trusted third parties, especially tech giants arise, developing their own digital currencies taking over the “traditional” currencies. This represents the only one example of the development of digital technologies in fact, use of digital technology applications and storage facilities has reached its peak and a further integration of available technologies is not considered to cause significant changes or improvements in industry or social life and rarely can be justified in economic terms. Moreover, there are still cybersecurity issues (e.g. privacy, data sovereignty), which impede the development of the digital economy and stall or even backtrack the application of certain technologies. A few companies only, mainly global players, attempt to promote digital transformation further but are struggling with a lack of compliant regulations and political support. The delayed implementation of new laws represents a problem also in the field of consumer protection because consumers do not have all required information on products, while there is a spread consumption awareness with particular attention to the origin and composition of products as well as its recycling options. There is preference of quality over quantity in the consumption pattern and in local products. Moreover, people are aware of their role as “individuals” and demand tailor-made solutions and personal shopping experiences.

People tend to move to the city for living because of the services it offers; this leads to the physical growth of cities. The increment of people makes it necessary to focus on the urbanisation and integration of minorities and the application of regulations and new solutions for the use of resources to decrease their depletion. In addition, it is necessary to face the worsening climate conditions and possible solutions come from the intensive implementation
of new power green system and electric technologies to improve the renewable energy generation and create a smart grid environment with powerful storage systems.

Comprehensive data exchange via conventional business platforms, especially with potential competitors, is a challenge since core data and business secrets are exposed and liability regulations are missing in case of infringement. Hence, the potentials of comprehensive and regular data exchange cannot be fully unlocked.

7.7.2 Impact on the supply chain

The interplay of the projections has different impacts on the structure, processes and resources of a supply chain. Based on the insights gained in the survey, some possible effects of the scenario are the following: supply chains will be less open and more fragmented, there could be a duplication of assets across the European region, leading to more inefficiency in the supply chain due to the increase of protectionism and the disaggregation of the confederations. To overcome these limits, supply chain models shall be more resilient and easy to reconfigure because it is required to change the corporate frameworks to adapt to local legal and market conditions (the supply chain has to support the “0 km”). There will be a risk of higher bureaucracy and complexity and the movements of goods will be slower leading to increased costs, increased inventory in the SC and therefore lower profits. Due to the problems and lagging of accurate legislation for data security the supply chains could become more untrusted.

7.7.3 Scenario summary and comparison

Overall, Scenario ‘OUTsET describes a future full of contrasts with a stable but closed and individual political environment. Economy is characterised by uncertainty and consequently with the political setting, global firms adapt to local markets. Digitalisation is still far from being integrated into the business environment, although innovative payment systems are adopted in daily life. Individuality and growing cities urge to adopt standards and regulations for the use of resources, which are still missing.

Scenario ‘OUTsET described above has similarity to Scenario ‘Almost BLACK’. Both are based on a closed and individual political environment. In addition, the development paths of the legal and environmental dimensions are the same. Differences are related to the social and technological development paths.

7.8 “DiThEr” - There is Digital and Technological development but not Enough to compete globally.

A general overview of the scenario is provided by the following characteristics:

- Political environment changes towards protectionism, combined with technological development especially start-ups are profiting
Continuous development and integration of new technologies – retention regarding digitalisation
Autonomous systems are well accepted in Europe, but result in high unemployment and social disequilibrium
Ecological and sustainable development of products is promoted

Those characteristics result from the interaction of the individual future projections comprised in the scenario as shown in Table 7-8.

| Political uncertainty in Europe, closed economic area, collapse of alliances |
| Asia is the economic pace setter, global companies act local, digital platform economics, mix of banks and FinTechs established |
| Aging society with large disparities and high unemployment, strong consumer individualisation (DIY, variant diversity), 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 |

Table 7-8: Elements of the scenario

The following subchapter explains the interaction of the respective elements in further detail.

### 7.8.1 Description of the scenario

The development in Europe is constant but the overall global political violence is slightly increasing. The rise in the political development uncertainty led to political unrest in neighbouring states and disagreements between confederations. This situation promotes policy of protecting domestic industries against foreign competition entailing several trade policies such as geographic barriers, tariffs, import quotas or other restrictions on the imports of foreign competitors. These lead to complications in the logistics structure and some companies withdraw from the market. The EU is going into crisis due to the economic situation and several countries are putting their own needs first, while leaving the confederation.

The economic growth in Europe is shrinking, due to a decrease in Europe’s exports, since the current markets produce locally. The economy in Brazil, Russia, India, China and South Africa (BRICS) slowed down and Mexico, Indonesia, Nigeria and Turkey (MINT) are the new emerging economies. Despite its growth slowdown, China overtake current economies and overcomes Europe as net investor into the world.

In terms of business, the predominant structure considers the adaptation of international products to local and cultural preferences. There is an increase in demand for customisation and consumption awareness. The preferences of consumers are do-it-yourself
(DIY) products, especially for the middle class that considers ecological and social aspects when consuming goods and services. Circular economy models are reinforced by companies and adopted to encourage closure of the materials cycle through better design of components, recycling and reusing, while mitigating the environmental impact.

Although consumers are more aware of their purchase, legislation is lagging behind, due to new business models and the rapid technological development of companies. Because of this lack in legislation, consumers do not have all requested information on products, their properties, origins or manufacturing procedures.

The advances in technology, such as additive manufacturing, automation, the dynamic development of autonomous technologies and cyber physical systems make production of products with specific adjustments cost-effective, both for global players and SME’s. Companies try to postpone their production until the latest point possible to allow individual customisation, while the exploitation of disruptive production technologies promotes design-driven manufacturing processes and precise control in industry. Due to these conditions, the time for product development and rollout is minimised. Even though this technology advancement creates new jobs, emerging skills are required and the re-employment of workers becomes difficult. In particular, robots and autonomisation take over manual and white-collar tasks: the unemployment rate increases and this contributes to social and political unrest.

The digital transformation supports a fast-developing digital economy, which is well received by people. The digital transformation is supported mainly by multinationals that can afford technology applications, due to high costs and risk aversion. Companies in general have some obstacles, such as stringent legal regulations, difficulty to evaluate their digital state of the art, challenges of data ownership, data management, lack of acceptance due to privacy or data security concerns. There is also the problem of data security and comprehensive data exchange via conventional business platforms, because core data and business secrets are exposed, and liability regulations are missing in case of infringement. The problem with regulations also regards social and environmental issues, where more efforts must be made in order to encourage further countries into developing respective policies and promoting sustainable development. In terms of innovation management, although there are plans for IP protection, they are not carried out and IP theft is a key challenge for inventors.

Companies and especially multinationals promote new business models in further sectors, innovating many industries and allowing new business-to-business (B2B) and business-to-consumer (B2C) relations. These conditions facilitate the collaboration between banks and FinTech start-ups, the promotion of better customer interactions and the development of new financial services that are accessible from anywhere via mobile apps.

The favourable development of technology and digitalisation has effects on the environmental development as it enables a reduction of low-carbon energy supply, efficient practices in agriculture, and maintaining global warming at an environmentally acceptable rate. The development also contributes to longer and healthier lives in developed countries, especially
D2.2: Report on future scenarios generation

for the wealthier people. More and more people leave the countryside to live in cities. The investment in smart cities and internet of things (IoT) lead to comforts, like access to free wi-fi in public spaces, increase in online shopping, delivery of goods at home, growth in the use of renewable energy on a large scale (wind turbines, solar panels), flexible and efficient electricity infrastructure and use of hydrogen systems. People in poor regions do not participate in the improved living conditions and the population is rising strongly because of an increasing birth rate. The worsening living conditions, scarcity of resources, problems with air pollution, clear water capacities and waste management lead to a considerable dissatisfaction within the communities. All these conditions contribute to a growing number of conflicts.

7.8.2 Impact on the supply chain

The interplay of the projections has different impacts on the structure, processes and resources of a supply chain. Based on the insights gained in the survey, the scenario might have the following effects on the supply chain: the future supply chains should be more resilient due to the unstable situation and limits in terms of global purchasing due to protectionism. For this reason, it is necessary to structure strong local supply chains with regional partnerships. Nevertheless, personalised production could increase complexity in managing the downstream supply chain such as an increase of shipping and the possibility to track the complete supply chain end-to-end online. This furthermore encourages an end-to-end tracking of the supply chain in terms of circular economy. The advancement in autonomous technologies could lead to changes at process level with the need to study new ways to automate non-added value activities of the supply chain. Companies should take into consideration that rapid changes can cause unemployment, which might be combined with the need to define strategies to reallocate staff along the supply chain. In addition, with secure transactions provided by the collaboration between banks and Fintech companies, the supply chains could increase the revenue from data.

Moreover, continuous exploitation of disruptive production technologies could lead to establishment of new production processes along the supply chain or new services (i.e. manufacturing as a service).

7.8.3 Scenario summary and comparison

Overall, Scenario ‘DiThER’ is defined by a shift in economic development from Europe and US to MINT countries. There are some conditions that are favourable to economic development in Europe, such as the increasing influence of digital transformation, the dynamic development of autonomous technologies, the establishment of electrification technologies and green systems, the continuous exploitation of disruptive technologies and investment in smart cities. Still, the digital development is obstructed by like stringent legal regulations, data management and privacy issues. The increase of unemployment, due to autonomisation, and the acceleration of disparities create political and economic unrest. 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.

Scenario ‘DiThER’ has similarities with scenario ‘UNEasE’. Both are based on the same political, social and legal conditions. The difference in the economic dimension is that the scenario ‘DiThER’ is based on a big influence of digital transformation in economy, while scenario ‘UNEasE’ considers that traditional economy persists.

7.9 “Almost BLACK” – Barriers, Lack of investments, Average economic growth and Collapse of Alliances in Europe.

The characteristics of the scenario can be summarised with the following properties:

- Political uncertainty and collapse of the European Union leads to isolation
- Remote economic growth in which only major enterprises benefit from new technologies through access to necessary resources
- Acceptance of autonomous systems and large proportion of sharing economy
- New legislation is necessary to promote Industry 4.0, there is need for practical approaches to data storage and analysis

Those characteristics result from the interaction of the individual future projections comprised in the scenario as shown in Table 7-9.

| Political uncertainty in Europe, closed economic area, collapse of alliances |
| Asia is the economic pace setter, digital platform economics, tech-giants dominate financial sector, global companies act local |
| Strong social inequality especially in cities, high unemployment, individualism drives DIY; DIY is made possible by disruptive technologies, living in smart cities |
| Digitalisation obstructed by cost and retention, but increased use of autonomous technologies, further efforts for e-mobility and alternative energy sources; especially major enterprises benefit from the use of IoT and disruptive technologies |
| Outdated, inhomogeneous legislation, low data privacy |
| No ecological agreements, heavy pollution and scarcity of resources |

Table 7-9: Elements of the scenario

The following subchapter explains the interaction of the respective elements in further detail.

7.9.1 Description of the scenario

The political situation in this scenario is shaped by the development paths “Constant development in Europe”, “Protectionism”, and “Fragmentation”. We face a politically stable but insecure environment in Europe and border regions. Countries apply tariffs or import quotas restricting the establishment of foreign competition and complicate logistics structures of
importing companies. In line with this, several countries are leaving the confederation. The borders are closed and free movement and trade agreements are very limited.

The political situation is affecting the economy. Europe loses its status as net investor in the world economy due to a decrease in Europe’s exports as the current markets produce locally. International products are adapted to the local culture in which they are sold. Local companies are further involved in the production and selling process in order to enable country specific adjustments. In addition, domestic production is being reintroduced into the country. The increase in wages in previously low-wage countries, as well as the cost of shipping and custom fees, make local production attractive again. Companies follow the market demand and primarily offer. The development of a more collaborative platform at country level enables an easy share and utilisation of resources. New business models emerge in further sectors such as in the leisure, fashion or cosmetic industry; expanding up to new service categories, like the FinTech Services, which innovates complete industrial sectors. Within this setting, companies establish their own payment systems along with growing Fintech start-ups, similar to the current payment service Alipay by Alibaba. Trusted third party services develop their own digital currencies, taking over the “traditional” way of paying. Global players have significant resources such as brands, hard assets, customer relationships, global distribution data and many years of institutional know-how to harness for their digital transformation. Only a selection of companies, mostly multinationals, can afford to implement available technology applications due to high costs and risk aversion. As global companies are the pioneers in the fields of digital transformation and cyber-physical systems, this puts them into the position to efficiently manage and process the high volumes of generated data. The big companies with a global reach hence determine the new payment logic. Smaller and local companies struggle with the efficient management of information overload since proper technologies or the required expertise are not available. A high pace of technological development hinders smaller companies to catch up and compete with global players.

Consumers do not have all required information on products, their properties, origins or manufacturing procedures and conditions. This fact drives them to become strongly involved in the production process of consumer goods. The do it yourself (DIY) concept is applied throughout an extending middle class. As a result, self-production of fashion, technological equipment and food become the standard. In line with this, people are aware of their role as “individuals" and demand tailor-made solutions and personal shopping experiences. In addition, they tend to move to the city for living because of the services it offers; this leads to the physical growth of cities. The world population is getting older and more fragmented. Due to the absence of healthy redistribution of resources, a small part of the population owns a large majority of resources. The ever-evolving world of work creates new demands on workers. In consequence of the digitisation, the education process needs a revision to prepare the youth for new technology and emerging workforce requirements.

An increased exploitation of technologies leads to a highly automated and autonomous environment. Coupled with the ability to share and act upon the associated data and derived
insights, new service- and production-related business opportunities will arise for global players as well as start-ups. Suppliers of disruptive technologies experience exponential growth rates. Existing disruptive technologies are improved and additional solutions are developed in a rapid and continuous manner. These technologies not only increase the degree of freedom in manufacturing processes but also allow more efficient and effective work processes.

Green systems used for power generation, energy storage and transportation, such as hydrogen power cells and biomass, are progressively applied in industrial and social sectors. Biomass energy has the potential to become a viable substitute for fossil fuelled and traditional power generation. In transports, liquid biofuels are the primary renewable energy source. The main constraint regarding improvements in renewables and transports is the lack of policy support.

Governments promote digital transformation, but fail to implement compliant and cross-border regulations, dealing with the practical use of storage and analytics technologies. Digital transformation penetrates some industrial sectors and social areas stronger than others. Comprehensive data exchange via conventional business platforms, especially with potential competitors, is a challenge since core data and business secrets are exposed and liability regulations are missing in case of infringement. Hence, the potentials of comprehensive and regular data exchange cannot be fully unlocked. Standards are widely accepted, and regulatory frameworks are missing in Europe as well as worldwide. Rising atmospheric CO₂ concentration and rising temperatures are observed; new peaks are reached as time passes and are crucial signs for continued climate change. Continuous CO₂ emissions are the major sources of total global greenhouse gas emissions. Although CO₂ emissions of some European and non-European countries will slightly decline, the decrease is not significant enough to compensate the overall global increase. Together with ever-increasing global population, economic growth and demand for resources from affluent consumers highly contribute to severely ongoing depletion of resources for humankind as well as industries.

7.9.2 Impact on the supply chain

The interplay of the projections has different impacts on the structure, processes and resources of a supply chain. This scenario can be harmful for the supply chains in Europe and justifies new strategies to overcome the challenges. Based on the insights gained in the survey, the scenario might have the following effects on the supply chain. The points mentioned constitute a selection of those mentioned in the survey.

In this scenario, the protectionism and fragmentation possibly create difficulties to the supply chain. Considering the structure of supply chains, changes are required to reach customers abroad, since restrictions on boarders create issues. It is probable that the supply chain core processes will shift to new countries since business within the EU grow to be more difficult.
In terms of supply chain processes, the fast developments towards sharing and digitalised economy forces new ways to orchestrate the processes both up and downstream.

These conditions might lead to increased costs, increased inventory in the SC and therefore lower profits. This scenario can also harm the availability of appropriate resources, since the access to raw material will be aggravated and it will be more difficult to source commodities from abroad. More routes to a market and new customers have to be addressed. New business models might be created, on the one hand driven by the big players that will have more resources and conditions to overcome the challenges.

Combined with the general circumstances within this scenario, the overall barriers and lack of investment have an effect on profits.

7.9.3 Scenario summary and comparison

Overall, Scenario ‘Almost BLACK’ describes a future with a stable but closed and individual political environment. The economy is characterised by a retained growth, where global companies have access to resources and possibility to adopt digital transformation. However, it still is necessary the establishment of regulations dealing with the practical use of storage and analytics technologies. Green systems are progressively applied in industrial and social sectors. However, regulations are still missing regarding a better use of resources.

The scenario ‘Almost BLACK’ has similarities with the scenarios ‘DiThEr’ and ‘CIRCuiT’. With both scenarios parts of the projections are shared, hence a mix of both scenarios would result in ‘Almost BLACK’.

7.10 “UNEasE” – UNstable political sEtting and power shifting hinder the technological and Environmental development.

This scenario includes the following main aspects:

- Growing political and economic uncertainty because of collapsing alliances, high unemployment and increasing social disparities
- Megacities and the economic focus on BRIC & MINT prohibit ecologically balanced development
- Outdated legislative and retention of digitalisation, Industry 4.0 and automation are causing a traditional development of the economy

Those characteristics result from the interaction of the individual future projections comprised in the scenario as shown in Table 7-10.
7.10.1 Description of the scenario

The political environment in Europe is unstable under this scenario; however, this unsteadiness is decreasing due to security enforcements, especially regarding terrorist attacks. The security regulations and enforcements bring about higher levels of protectionism, which increases geographic and economic barriers. The unstable environment supports separatists’ objectives, and political fragmentation becomes both a reality and concern, since it can drive EU into crises with several countries leaving the confederation.

The lack of stability aids BRICS and MINT countries to develop and become the most important economic players, with special attention to China’s leadership. The Chinese investments on economy and export markets further support China to overcome Europe as world’s net investor, which is also supported by Europe’s continuous exports decrease as the current markets produce more locally. Customer orientation focusing on variety and, therefore, businesses emphasise individualism that provides enough local demand so that multinational companies can compete with local players through differentiation of tastes and customisation. This individualistic focus creates also an incentive for SME’s and start-ups to thrive as they are able to make specific product and service adjustments, while also capitalising on local marketing strategies.

The rise of SME’s and start-ups has legal and political concerns, due to the innate characteristic of dynamic markets created by the introduction of new business models. This hinders legislation development and increases the development of heterogeneous regulations. Also, start-ups of the financial sectors are competing with traditional banking institutions by focusing on digital processes and innovation, which enables better customer interactions. This is achieved through services which are accessible through mobile apps and the use of smart contracts, which enables seamless payments without intermediaries. Moreover, Fintech companies are providing venture capital based on digital currencies. However, there is a persistency of traditional economy due to the fear of data misuse by new
business models, creating obstacles that restrain digital transformation. Even though sharing process is encouraged on a consumer level, peer-to-peer services are affected by legal and political regulations that hinder sharing in the business-to-business (B2B) environment. Therefore, digital economy thrives mainly due to business-to-consumer (B2C) business model, with B2B tiers 2 and 3 levels of the supply chain heavily relying on traditional business concepts. Also, the do it yourself (DIY) concept becomes the norm, due to technological developments, such as 3D-printing and rise of sharing economy. Self-production of fashion, technological equipment and food become standards, whereas non-self-produced products are mostly purchased from other DIY-individuals, on a local basis. Manual tasks are taken over by technical developments and automatisation which increase the difficulty for re-employment and demand faster educational growth by skilled workers. Automated and partly autonomous factories are progressively becoming the standard in Europe. This contributes to employees being feared of their jobs, while also being demotivated and frustrated, eventually adopting a negative attitude towards emerging advanced technologies. Moreover, since whole industries are affected by the automatisation, there is an increase on income disparities and ageing population, given that there will be a shift to big portion of rich working people and a big portion of not working poor people. However, the coexistence of conventional and disruptive production technologies is still remains, given technological adoption barriers such as legal constraints and workers’ resistance. Performance improvements through digital transformation are mostly implemented by a selection of multinational companies, since these can cope with the high costs and risk aversion inherited on the process. Challenges of data ownership and data management must be addressed in order to realise the business potential of digital transformation endeavours, which are often faced with lack of acceptance on the consumer part, due to privacy or data security concerns. This further supports a lagging legislation, being the priority for regulations and consumer protection laws in Europe. The lack of liability regulations in case of infringement provides the environment for core data and business secrets exposure. Hence, comprehensive and regular data exchange are hindered, being uphold by data sovereignty concerns, which are related to the enforcement of privacy and compliance regulations. Moreover, laws and regulations for securing IP rights do not apply on certain countries, which results in profit loss and IP theft, hence being a challenge for inventor, designers and artists. Another challenge is IP loss due to patent expiration, which enables certain industries, such as the pharmaceutical, to enter new markets. Legislation issues reach out to the environmental dimension, where heterogeneous regulations become the norm. The shift of political dominance to emerging countries aided by the presence of heterogeneous regulations supports a steady increase of natural resources depletion. Highly populated countries face severe issues related to water and resources scarcity. Prospering economies such as MINT and BRICS boost residential and industrial energy demand, while retaining petroleum as the largest source of energy, despite increasing oil prices. This context supports climate-related disasters, such as permafrost decrease and
floods caused by rising global sea levels, which escalate leading to huge economic damage and food insecurity, while also hindering the availability of drinking water. Incentives regarding on going electrification endeavours, which focus on green systems used for power generation, energy storage and transportation, are increasing, especially with the rise of electric and hybrid vehicles. Despite smart power grids incentives, their development is slower than expected, with researches being conducted on a variety of technologies to accelerate the rate of shift in the energy mix and improve energy efficiency regarding electricity generation, storage and distribution. Renewable energy is still under development, which contributes to natural resource depletion, especially on the energy sector. With more people leaving the countryside towards cities, the physical growth of cities will be prominent, leading to emerging megacities. These megacities have advanced communication and sensor infrastructure, which are used for the development and establishment of smart cities. However, smart cities require vast amounts of energy output, which are based on renewable energy resources and smart grid solutions.

7.10.2 Impact on the supply chain

The interplay of the projections has different impacts on the structure, processes and resources of a supply chain. This scenario touches all the above aspects of the supply chain. Based on the insights gained in the survey, the scenario might have the following effects on the supply chain. The points mentioned constitute a selection of points mentioned in the survey.

Regarding the supply chain structure and resources, the growing uncertainty and political instability in Europe as well as the shift of economic power to emerging markets urgently leads companies to rethink supply chains, as there will be barriers for free flow of goods. Disruption of supply chains is increasing with longer waiting times at border crossings and the potential for corruption to become more widespread. Companies are also finding that there markets are contracting and logistics costs are escalating thus move to strategies such as right-shoring which is the combination of onshore, nearshore and far-shore. Thus the supplier location will play a crucial role to minimise costs, access resources and minimise environmental impacts. Firms that had identified low cost Asian suppliers began to realise labour cost increases however, accessibility to resources such as REEs make these suppliers non-substitutable. Business model shift with more emphasis on waste disposal and landfilling of these resources and other scarce natural resource impacting the structure of the supply chains. Companies will try to fine new alternative materials such as solar can help reduce energy cost to the business.

Apart from supply chain reconfiguration, companies face a process reconfiguration. However, the high costs of the technologies, customer concerns regarding privacy and cyber security issues (e.g. lack of IT specialised people) make the adoption of new technologies slower and restrain digital transformation. Thus, supply chain needs to revise its own processes to move from the traditional supply chains toward a connected, smart, and highly efficient supply chain
ecosystem. Moreover, there will be higher number of SMEs and start-ups such as FinTech companies. For supply chain, these companies act as an intermediary in facilitating transactions and facilitate both the supplier and the company to improve their working capital, which means greater liquidity in scheduling and disbursing payments.

7.10.3 Scenario summary and comparison

Scenario ‘UNEasE’ is based around the growing political and economic unsteadiness in Europe. There is a shift of power from established global leaders, such as U.S. and Europe, to MINT and BRICS emerging countries. Start-ups and SME’s may find some room for rise, due to the focus on local and individualistic consumption patterns, as well as the DIY society characteristics. Although there is an incentive for increase of smart cities, this development may be obstructed by obstacles restraining digitalisation, while also contributing for negative environmental impacts such as the rise on natural resources’ depletion and atmospheric pollution, due to the focus on emerging countries and the megacities emergence. The focus on emerging countries leads to legislation concerns around increasing dynamic markets, the rise of environmental heterogeneous regulations, and low confidentiality of data and market participants.

Scenario ‘UNEasE’ shares much resemblance with scenario ‘DiThER’. Both are based on the same political, social and legal characteristics. On the other hand, there are some major differences between these scenarios. Regarding economic aspects, Scenario ‘UNEasE’ presents a world where traditional economy persists, while scenario ‘DiThER’ is based on the influence of rapid and wide digital transformation. The technological dimension is the most distinguishing, where three characteristic differences are observed. Scenario ‘UNEasE’ considers the on-going electrification, whereas Scenario ‘DiThER’ is based on established electrification endeavours. Moreover, there is a reluctance in acceptance of autonomous systems on Scenario ‘UNEasE’, while Scenario 6 considers a dynamic development of autonomous systems. Lastly, the coexistence of conventional and disruptive technologies is seen on Scenario ‘UNEasE’, while the continuous exploitation of disruptive technologies can be observed on Scenario ‘DiThER’. The environmental dimension is completely different on these scenarios. While Scenario ‘DiThER’ presents a world where natural resources depletion is decreasing and the planet is on the way towards recovering, Scenario ‘UNEasE’ provides the exact opposite image, where there is an increase on depletion of natural resources and the world is on the brink regarding pollution.

7.11 “EScAPISm” - European diSintegration and governmental collapse with Technological development.

The characteristics of the scenario can be summarised with the following properties:

- Political instability and collapse of the European Union with open borders
- Digital platforms and sharing economy support a system of direct exchange of goods
D2.2: Report on future scenarios generation

- New technologies are resources for self-help; DIY promotes start-ups
- Start-ups stimulate the further development of innovative, cost-effective ideas

Those characteristics result from the interaction of the individual future projections comprised in the scenario as shown in Table 7-11.

| Political instability in Europe, widespread free trade, collapse of alliances |
| Asia is the economic pace setter, global companies act local, political instability leads to a traditional goods exchange based on crypto-currency. |
| Strong social inequality especially in cities, individuality drives self-creation and start-ups, closing the gap in the labour market, life in smart cities |
| Digitalisation obstructed by cost and retention, but increased use of autonomous technologies, e-mobility and alternative energy sources benefit from previous research; low IP-Protection allows start-ups to further develop new technologies |
| Outdated, inhomogeneous legislation, low data privacy |
| No ecological agreements, heavy pollution and scarcity of resources |

Table 7-11: Elements of the scenario

The following subchapter explains the interaction of the respective elements in further detail.

7.11.1 Description of the scenario

This scenario describes the rise of political instability and social unrest (e.g. terrorist attacks) in the member-states of the European Union, on the one hand, and the rise of the economy of formerly emerging countries, such as Indonesia, Mexico, and Turkey that have surpassed the EU member-states in terms of GDP.

Regarding global trade, it has flourished through elimination of trade barriers. Companies offer services and products to local markets by acting as local players. Glocalisation is supported by the fast-developing digital economy along with an extension of business models for on-demand streaming services, such as Amazon, Spotify, and for sharing assets, such as Airbnb and Uber. Smart ledgers also transform the way that people and organisations handle transactions and enable the facilitation of services without intermediary. However, new services (e.g. Uber) and technological developments (e.g. Blockchain) are restricted due to blurry or non-existent legislation.

Based on this digital transformation and the new technological developments such as 3D-printing the DIY concept is enabled which in turn facilitates personalised purchases. As a result, self-production becomes the standard. Cyber-physical systems also play a key role for autonomous systems in the industrial environment. An increased exploitation of these technologies leads to a highly automated and autonomous environment that handles the issue of labour shortage. These new service- and production-related business opportunities arise for global players as well as for start-ups. More specifically, there are many small- and medium-sized enterprises (SMEs) and start-ups attacking traditional markets, due to the
democratisation of technology, the increased access to funds, and a rising entrepreneurial culture. SMEs and start-ups are willing to relinquish the control of the IP in order to be part of the right networks that help them prevail. Start-ups stimulate the further development of innovative and cost effective ideas.

Moreover, smart devices are progressively connected over the internet of things, enabling cyber-physical systems to become common use in all sectors. More and more people move to smart cities with free Wi-Fi in all public spaces, where people shop online, and goods are delivered to their home within hours. In this regard, commoditised sensors and actuators provide both rich context and precise control to an almost limitless range of use cases. However, the potentials of comprehensive and regular data exchange cannot be fully unlocked due to the concerns around privacy and compliance regulations.

Regarding regulations, there are also vague environmental regulations and a lack of legislative clarity in several European countries, which force carbon intensive companies and specific industries to relocate to other European countries or to regions outside Europe with less strict environmental requirements. Furthermore, climate-related disasters (e.g. permafrosts, floods due to rising global sea level, droughts or wildfires) escalate and cause huge economic damage and food insecurity. Natural resources are scarce as resources are still extracted at the same (or even faster) pace and international regulations are not homogeneous.

7.11.2 Impact on the supply chain

The interplay of the projections has different impacts on the structure, processes and resources of a supply chain. This scenario touches structure and processes of the supply chain. Based on the insights gained in the survey, the scenario might have the following effects on the supply chain. The points mentioned constitute a selection of those mentioned in the survey.

The technological progress, especially the development of autonomous systems, within the scenario allows for supply chain processes that are more efficient. Availability of sensors and their connectivity lead to monitor every aspect of the chain, and then detect bottlenecks and discrepancies. Full tracking of deliveries and orders prevent a majority of frauds and losses. Still, the strong fragmentation leads to higher costs and a slow supply chain through effects on the lead-time and increased inventory within the supply chain.

The rebalance of the economy towards emerging countries affect the structure of the supply chain. In case exports are kept on a high level, deliveries have to be sent all around the world without being oriented towards developed countries. Furthermore, the scarcity of resources will also change the structure towards decarbonised technology and renewable energy.

7.11.3 Scenario summary and comparison

Overall, Scenario 5 describes an unstable political environment with environmental and legal issues. There is a trade shift from advanced economies towards emerging market economies.
Digital economy is well-received by people who are strongly involved in the production process of consumer goods; thus, the companies offer customised products. There are many small- and medium-sized enterprises (SMEs) and start-ups attacking traditional markets, due to the democratisation of technology, increased access to funds and a rising entrepreneurial culture.

Scenario ‘EScAPISm’ described above has similarities with Scenario ‘ENDANGEr’. Both scenarios are based on a politically unstable environment. The development paths of the legal and environmental dimensions are the same too. The scenarios differ in the economic aspect namely ‘Free trade’ and ‘Digital transformation’. Moreover, several social and technological aspects strongly differentiate this scenario (i.e. ‘DIY Society’, ‘Individualism - Focus on variety’, ‘Investments equalise the labour market’, ‘Start-ups and SMEs take up business’ and ‘Continuous exploitation of disruptive technologies’).

7.12 “ENDANGEr” - European disintegration and protectionism lead to geopolitical, social, environmental, legal, technological and economic issues that affect company’s success.

The features of this scenario. The characteristics of the scenario can be summarised with the following aspects:

- 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 ledging supports traditional goods exchange
- No technological or social development

Those characteristics result from the interaction of the individual future projections comprised in the scenario as shown in Table 7-12.

| Political instability in Europe, protectionism, collapse of alliances |
| Asia is the economic pace setter, global companies act local, political instability leads to a traditional goods exchange based on crypto-currency. |
| Strong social inequality especially in cities, aging society with large disparities and high unemployment forces to consumption of cheap mass-market products, life in smart cities Digitalisation obstructed by cost and retention, but increased use of autonomous technologies, e-mobility and alternative energy sources benefit from previous research; dominance of multinationals inhibits further development of new technologies |
| Outdated, inhomogeneous legislation, low data privacy |
| No ecological agreements, heavy pollution and scarcity of resources |

Table 7-12: Elements of the scenario

The following subchapter explains the interaction of the respective elements in further detail.
7.12.1 Description of the scenario

This scenario describes an instable political and social environment in Europe, while, in the meantime, countries, such as Mexico, Indonesia, and Nigeria, have recorded important growth in terms of GDP. Protectionism rises everywhere and companies face several tariffs, import quotas, and trade barriers. The aforementioned political and economic setting leads to “glocalisation”. Companies, especially from Europe, get culturally close to consumers from the emerging economies in order to respond flexibly to local customer needs and to penetrate regional and local markets. Multinational companies compete with local players by recognising differences in local taste and custom.

Companies individualise their products, but focus on larger groups of customers as social networks strongly influence the buying behaviour. New business models and digital innovations, such as cloud-based voice services, rise and allow companies to enter new markets/countries. Costumers use the Internet to purchase and compare the price of different goods, and always try to achieve a reduction in price. Everyone makes financial transactions autonomously on the internet; hence, classic banking services or notary services are becoming obsolete. However, the traditional way is upheld due to the fear of data misuse and legal and political concerns. The political instability leads to a stagnating and non-homogeneous legislation limiting the development of emerging technologies. These issues are forming a world in which digitalisation is obstructed by retention while only main global players, that have significant resources, can afford to implement available technology applications due to high costs and risk aversion. Thus, in this new reality, several obstacles make it difficult for SMEs to develop; and as big companies dominate the business landscape, this inhibits further development of new technologies, in which SMEs play a crucial role.

Contrary to the restriction on digitisation, autonomous technologies are progressing at a rapid pace, especially with regards to robots, drones, and autonomous vehicles. The ever-evolving world of work also creates new demands on workers. Manual tasks are increasingly being taken over by technical developments and automatisation, e.g. robots. Since whole industries are affected by the autonomisation, the overall rate of unemployment rises. The ratio shifts towards a big portion of rich, working people and a big portion of non-working, poor people, causing a strong social disparity and social unrest, which force customers to consume cheap mass market products.

Companies also adapt their business structure by taking into account the high population growth and that more and more people leave the countryside to live in megacities, which lead to rising atmospheric CO₂ concentration and resource scarcity. Renewable energy technologies, driven by climate change, fuel security, and other motives, provide more and more of our electricity, for standard and widely accepted regulatory frameworks are missing worldwide. Green systems are used for power generation, energy storage, and transportation, such as hydrogen power cells and biomass in industrial and social sectors. Despite all of the efforts, high associated costs and unclear regulations hinder a proliferation of E-Mobility, especially in rural areas. Furthermore, solutions for smart power grids are developing slower
than expected. Regarding resource scarcity, ever-increasing global population, non-homogeneous environmental and waste legislations and protectionism highly contribute to severely ongoing depletion of resources for all industries. For example, rare earth elements (REEs) are increasingly used in a myriad of sectors to produce e.g. electric vehicles and wind turbines. China has dominated rare earth mining since the 1990s, extracting 85 to 95% of the world’s REEs from large clay deposits in the country’s south. Thus, companies are dependent on China which tend to restrict their exports affecting the availability and continuous supply of REEs.

7.12.2 Impact on the supply chain

The interplay of the projections has different impacts on the structure, processes and resources of a supply chain. As this scenario describes an instable and stagnating development, it affects the supply chain in a number of ways. The survey provides several changes, such as a constrained public investment into logistic hubs, e.g. ports. The fragmented market causes a shift towards local supply chains, which raises costs for the 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 in the supply chain and new barriers and taxes are expected. As the political and economic situation is unstable, this effects the resilience of supply chains, global and local supply chains alike. Depending on the steering and the initial process settings, a world without banks, wherein financial processes are handled from individual to individual, might lead to faster payment processes and therefore to a higher financial solvency. In contrast to this, this effects political and economic institutions.

The impact of this scenario in process is also worrisome, because the complexity to manage the process and resources can lead to higher bureaucracy, and movements of goods will be slower and more complicated. The economic developments require a re-organisation of the process flows. International supply chains will face difficulties in maintaining relationships with suppliers. Accordingly, the access to resources and further commodities are affected and resource scarcity remains an issue. As customers focus on cheap products, lean processes are dominating to achieve corresponding cost reductions. At the same time, the advancements of autonomous systems provide autonomous transportation in parts of the supply chain causing a respective adoption of the processes. With regard to the set-up of local supply chains, the fast development of autonomous systems might provide a solution to design efficiently. In any case, new business models are required to handle the increasing complexity and the steering of autonomous systems.

The economic and political development will have the effect of reducing competition, but leads to restrictions regarding economies of scale; hence, together with the focus on cheap products, this leads to a reduction in the profit margin.
7.12.3 Scenario summary and comparison

Overall, Scenario 9 describes an unstable political environment that causes social and economic issues. The development ‘global trade shift’ incorporates a shift in trade, export growth, and Gross Domestic Product (GDP) growth from advanced economies towards emerging market economies. In addition, the economy is influenced by a consumer who pays close attention to quantity and not quality and to low cost products. The political and economic setting does not allow for a quick adaption of legal regulations; thus, there are obstacles that restrain to a smooth digital transformation and only worldwide-established companies can take the leading role in managing and processing high volumes of data.

Scenario ‘ENDANGER’ described above has similarities to Scenario ‘EScAPISm’. Both scenarios are based on a politically unstable environment. The development paths of the legal and environmental dimensions are the same too. The scenario differs in the economic aspect, namely ‘Protectionism’ and ‘Traditional economy persists’. Moreover, several social and technological aspects strongly differentiate this scenario (i.e. Much and Cheap, Collectivism - Focus on the crowd, Rapid changes cause unemployment, Dominance of Global Players and Coexistence of conventional and disruptive technologies).
8 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 required though, to evaluate qualitatively the entry probability of a scenario as well as the impact strength of the overall scenario.

Therefore, an expert workshop, conducted at the Fraunhofer IML in Dortmund, supported both steps, the evaluation of the entry probability and of the impact strength of the scenario. The workshop furthermore served as a validation of the scenarios. A very careful selection of the participants ensured an efficient and thorough validation of scenarios and assortment of those scenarios that require further attention in the upcoming tasks. The range of participants included senior management and C-level manager from the process, manufacturing and logistics industry.

For the preparation of the workshop, a factsheet of each scenario delivered the necessary details for each scenario (see Figure 8-1). The factsheet contained the name and a summary of the characteristics of the scenario and displayed the main projections per PESTLE dimension. The second part of the factsheet depicts the coordinates for the evaluation of the scenario. On the x-axis, the experts evaluate the entry probability of a scenario; the y-axis displays the expected potential pressure for changes on the supply chain caused by a scenario.

Figure 8-1: Factsheet of Scenario OUTsET
The following framework conditions were considered during the assessment:

- Introduction to a scenario by a project team member
- Discussion with experts on the features of the scenario to make them confident about it and to validate it
- Individual evaluation of the scenario with regards to the time horizon until 2030
- Individual evaluation of the scenario with regards to the potential effects on the supply chain in terms of changes in structure, processes and resources.

As a result, experts validated each scenario; they estimated the entry probability and assessed the expected necessity to change the supply chain for each scenario. Figure 8-2 shows exemplary the result of the assessment by the experts for one scenario. Each expert provided his/her opinion first for the entry probability and then for the effects on the supply chain. The provided input was stated with a marking point. The boxplots show the distribution of the experts’ opinion. The green dot states the agreed evaluation of the overall assessment of the scenario.

![Figure 8-2: Evaluation of the scenario by the experts](image.png)

A transfer of the assessment for each scenario provided an overall distribution of the scenarios within a probability-impact-matrix. Figure 8-3 displays the results in the matrix. As recommended in literature, the amount of scenarios have to be restricted to allow a thorough further analysis.
As for the further work in Next-Net, it is important to consider the most probable and plausible scenarios with a major pressure of change on the supply chain, a selection of the scenario was based on the outcome of the assessment. The final selection of the scenarios depends highly on the amount of considered future projections and their uncertainties [4]. Bradfield et al. (2013) recommend a scenario set of 3-6 scenarios, while the authors, similar to the Next-Net approach, used a quantitative approach combined with an expert judgement [23]. As Figure 8-3 shows, the assessment of the scenarios resulted in six scenarios that have a strong to medium potential pressure on the supply chain and a rather high probability. Those six scenarios, namely ‘aSPIRANT’, ‘PrOCEEDING’, ‘oFFsET’, ‘DiThER’, ‘UNEasE’ and ‘ENDANGEr’ are further used in following tasks of the work package.
9 Conclusion and summary

This report has presented future macro-scenarios based on projections of megatrends and trends resulting from the deliverable D2.1. The deliverable D2.2 provides an insight on the different available scenario techniques and shows the approach taken in Next-Net.

The different steps taken during the months of January to May in 2018 are reflected on and it is described how, based on the megatrends and trends, the future projections are developed for each PESTLE dimension. In addition, very significant and important insight have been gained with a survey. The survey provided excellent perceptions regarding the effect a projection might have on supply chains and expressed the impact factor of each projection on the supply chain. A quantitative approach with a cross-impact balance analysis has further supported the generation of future macro scenarios. Twelve scenarios have been selected via a consistency analysis.

A workshop, held at the Fraunhofer IML in Dortmund, provided further validation of the plausibility and probability of the scenarios. The participants of the workshop consisted of a round of experts based on C-level and senior management to discuss, refine, and extend the findings and insights gained from the creation of macro-scenarios. In addition, the experts assessed the overall potential pressure of a scenario on the supply chain.

On this basis, six scenarios have been selected out of the set of twelve that are probable and have a high potential pressure of change on the supply chain. Each scenario represents a different combination of the six PESTLE dimensions based on the development paths where some represent a positive, some a negative and other a mixed perception of the future. Those six scenarios will be used as an input in the following tasks of the work package to evaluate the specific impact on the supply chain and provide types of supply chains that fit best with a scenario while examining the possible effects it has on the structure, processes and resources of a supply chain.
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Annex A: List of Acronyms

AI  Artificial Intelligence
aSPIRANT  Strong Partnership enables homogeneous Frameworks allowing a sustainable And Technological development
Almost BLACK  Barriers, Lack of investments, Average economic growth and Collapse of Alliances in Europe
B2B  Business-to-business
B2C  Business-to-consumer
BRICS  Brazil, Russia, India, China and South Africa
CIB  Cross-Impact Balance Analysis
CIRCuiT  New business Concepts support Climate Protection while slow legislation Restrict Technological developments
DiThE  There is Digital and Technological development but not Enough to Compete globally.
DIY  Do it Yourself
E7  China, India, Brazil, Russia, Indonesia, Mexico and Turkey
EC  European Commission
E-Mobility  Electrical mobility
ENDANGEr  EuropeAN Disintegration emergiNG Economies
EPOCHAL Brink  Economic and Political Changes Lag and the Planet goes on the Brink
EScAPiSm  European diSintegration Producer Society
EU  European Union
FinTech  Financial technology
G7  US, Japan, Italy, UK, France, Canada and Germany
GAFAM  Google, Apple, Facebook, Amazon, Microsoft
GDP  Gross Domestic Product
IoT  Internet of Things
IP  Intellectual property
IT  Information technology
ICT  Information and Communications Technology
MINT  Mexico, Indonesia, Nigeria and Turkey
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>oFFsET</td>
<td>Free trade enables political and social development whereas fragmentation hinders technological and environmental change</td>
</tr>
<tr>
<td>OUTsET</td>
<td>Fragmentation ObstrUcts the global Economic and Technological development</td>
</tr>
<tr>
<td>PB</td>
<td>Projection bundles</td>
</tr>
<tr>
<td>PESTLE</td>
<td>Political, economic, social, technological, legal and environmental</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>REEs</td>
<td>Rare earth elements</td>
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<tr>
<td>SC</td>
<td>Supply Chain</td>
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<tr>
<td>SMEs</td>
<td>Small and medium-sized enterprises</td>
</tr>
<tr>
<td>SPIN DOWN</td>
<td>Strong partnership enables homogeneous frameworks allowing a sustainable and technological development</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>UNEasE</td>
<td>UNstable political sEtting and power shifting hinder the technological and Environmental development</td>
</tr>
<tr>
<td>US</td>
<td>United States of America</td>
</tr>
<tr>
<td>ZIRUS</td>
<td>Stuttgart Research Center for Interdisciplinary Risk and Innovation Studies</td>
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