8. Expert-Based Scenarios for the Logistics Service Industry 2025

The previous chapter 7 represented the first research part of this thesis. It captured the current state of scenario planning practices in the logistics service industry from an internal and an external perspective. It revealed, in line with the literature review, a backward picture of such planning practices compared to industry sector standard and overall. The need for an exemplary industry focused scenario study in the logistics environment was particularly worked out in the chapters 5.3 (literature review) and 7.3 (conclusion of triangulation research). This chapter 8 presents the research results of research phase II and therefore addresses the identified research gap.

8.1. Response Analysis of Delphi Survey

The core of the scenario development was a two-round Delphi study among 30 experts. The research concentrated on the top 50 logistics service providers by turnover in Germany 2005. For synergy purposes in sampling the same contact database was used for the scenario check and the Delphi survey. However, the internal rank order for target persons slightly differed. Whereas the scenario check concentrated on strategy and corporate development, the Delphi survey focused on members of the management board (see chapters 6.3.1 and 6.4.5.2 for further details). The two-step sampling approach allowed for easier access to the targeted experts for the Delphi research and had therefore a positive impact on its participation rate. There were 7 experts that participated in both the scenario check and the Delphi study. Moreover, 20 logistics service providers were represented in both research initiatives.

In the scope of the first Delphi round 72 potential experts of the top 50 logistics service providers were contacted either directly via telephone or indirectly via the secretaries and assistants. They were informed of the research initiative and asked for general interest. Solely 1 of the 72 potential experts directly indicated no participation so that the questionnaire and accompanying documents were sent to 71 managers. In total 30 experts (41.7%) agreed to participate (see Figure 29 on page 186). The maximum target sample was thus achieved. An analysis of nonresponses revealed that 26 experts (36.1%) refused due to shortage of resources. Interestingly, only 5 of the 42 nonrespondents (11.9%) argued that they are not interested in such research at all. Both the high participation rate and the patterns of nonrespondents’ reasoning underline the high attention getting value of the research topic. It was further strengthened during the telephone conversations with the target persons, since most of them reacted very positively to the study content.
In total 11 of the 30 participants (36.7%) were members of the management board of one of the top 50 logistics service providers, whereas 12 of the experts (40.0%) were associated to strategy or corporate development departments (see Figure 30 on page 187). Nine of the latter 12 experts are actually head of the respective department. The remaining 7 participants (23.3%), summarised under “other management function”, came from different backgrounds. As with the response pattern of the scenario check (see chapter 7.1.1), the initial target person delegated the questionnaire to other persons within the organisation who were felt to be similarly or even more suitable for the purpose. The “new” experts predominantly came from marketing and innovation, thus departments that are also dealing with strategic futures questions. The full list of Delphi panel members and their respective companies is included in Appendix 5. A comparison of the respondents of the scenario check and the Delphi study reflects the different preferences in target persons. The representation of members of the management board is significantly higher in the Delphi research than in the scenario check, whereas the share of strategy and corporate development shows an inverse pattern. The questionnaire has, in fact, less been delegated to other persons in the course of the Delphi research. This may be attributed to the fact that the Delphi research asked for a higher competence profile than the scenario check as well as to its higher local value and scope.
The first round questionnaire additionally asked for the experts’ experience in the logistics industry in years. The underlying rationale was to cross-validate the expertise a posteriori as well as to obtain another variable for secondary analyses. Figure 31 illustrates the distribution of the respondents’ experience. All respondents fulfilled a minimum 5-year industry experience, often used as expertise measure in Delphi studies (see e.g. V. W. Mitchell, 1991, p. 340). In total 8 of the 30 experts (26.7%) have worked for more than 20 years in the logistics field. The majority of 17 experts (56.7%) have between 5 and 15 years experience in the logistics environment. The maximum duration among the participants was 40 years, whereas the average work experience amounted to 17.5 years. The high work experience can be taken as an additional quality criterion for expert selection and strengthens the validity of the data collected.

A secondary goal in expert selection had been defined as to reach a high representation of the top 50 companies in the sample. The 30 participants represent 24 of the top logistics service
providers (48.0%). Thus, the market of the “global players” is largely covered. Figure 32 illustrates the distribution of turnover of the respondents as well as of the top 50. It becomes apparent that the 24 participating companies evenly represent the overall sample of the top 50 logistics service providers. The class of beyond 1,000 million turnover is slightly overrepresented. Of the 10 companies belonging to this category, 6 participated in the Delphi study. The majority of the participating companies yielded a turnover between 251 and 500 million Euros in 2005. In total, 9 of them fall into this category. Since all of the top 50 logistics service providers achieved a turnover above 200 million Euros in 2005, it is not conspicuous that the class of below 250 million Euros counts the fewest companies. Overall, the participants represent approximately 70.7% of the cumulative turnover of the top 50.

![Figure 32 Sample Representativeness by Turnover in Delphi survey](image)

Most of the respondents preferred to fill in the questionnaire electronically. In the first survey round, solely 5 experts filled in the questionnaire by hand and returned it via fax. The average processing time in the first round amounted to 19.6 days. Figure 33 on the next page illustrates the return patterns of the first round per day and cumulative. The last questionnaire was received on day 50 after the first contact had been established. It is clearly recognisable that the two major peaks occurred near the deadlines. In total 26 of the 30 questionnaires were received within 30 days, whereas 4 laggards followed in the coming 20 days.
Figure 33 Daily and Total Number of Questionnaires Returned in Survey Round 1

All 30 first round participants could also be motivated to take part in the second round. This is an exceptional result, since Delphi studies usually yield average response rates of 30% in the first and 70 to 75% in the second round (see chapter 3.5.7 on dropout rates). Thus the first round response can already be considered an above average result. A response rate of 100% for the second round can, however, be regarded as high quality criterion for the study design, its organisation and the attention getting value of the content. As in the previous round, most experts preferred to fill in the second round questionnaire electronically. This time solely 3 questionnaires were returned via fax. As expected, the average processing time of the second round was shorter. The participants returned their questionnaires after 16.7 days on average. Figure 34 on page 190 shows the return patterns of the second Delphi round. The last questionnaire was received after 38 days. As in most other surveys, the majority of questionnaires were returned near elapsing deadlines.
Further interesting results can be obtained from an item analysis. In total, the two questionnaires comprised 146 items, i.e. single evaluations on the three scales expectational probability, desirability, and impact. In the final analysis, solely 41 of 4,380 items (30 experts times 146 items) were missing, equalling a missing values rate of 0.9%. This has to be considered a very low rate and accordingly the completeness of the data material is high. Moreover, solely 13 missing values (31.7%) concerned the primary variable “expectational probability”. The majority of 28 missing values (68.3%) were associated with two remaining secondary variables. Thus, the data quality concerning the primary variable was even higher.

8.2. **Expert Estimations of the Probable Future**

This chapter will concentrate on the final analyses of the Delphi data and the development of an expert-based scenario for the probable future. The analyses will include an overall graphical illustration of the projections’ expectational probability, a data analysis of the arguments given by the experts, as well as common statistical Delphi analyses. In addition, strategic cluster of projections will be discussed. The chapter will conclude with a scenario of the highly probable future.

8.2.1. **Comparative Illustration of Totality of Future Projections**

Figure 35 on page 191 illustrates the evaluation of all projections in form of a scatterplot. The final number of projections amounts to 41, since 1 of the initial 38 projections had been split up during the interim analysis and 2 projections had additionally been proposed by experts. The abscissa represents the mean expectational probability in percent, whereas the ordinate
refers to the mean impact of the respective projection on the logistics service industry, if occurred. It has been measured on a 5-point Likert scale. The numbers represent the projections that have been positioned in the scatterplot according to their overall means. Table 19 on the next page shows the final list of the 41 projections and their respective numbers. Each projection is either marked as a diamond or point. The former indicates that there was consensus among the experts concerning the projection’s expectational probability, thus its interquartile range was 2 or below. The point projections, in turn, show that there was no consensus among the expert panel, since the final interquartile range exceeded 2. These cases, thus, concerned rather controversially discussed topics. However, dissent does not mean that the evaluations of these projections have no value for the research. In particular such controversial issues can make important contributions to futures management, e.g. in the scope of the discontinuity analysis and surprising futures.

![Figure 35 Overall Evaluation of Projections by Expectational Probability and Impact](image-url)
| No | Projection |
|----|------------|
| 1  | The problem of energy supply (e.g. scarcity of fossil energies, nuclear power) remains unsolved globally. |
| 2  | The almost entire recycling of products and scrap within the value chain (“reverse logistics”) has become a legal regulation. |
| 3  | Source-based allocation of costs emerging from usage of natural resources (pollution, exhaustion of natural resources, etc.) has to a large extent been accomplished. |
| 4  | International barriers of trade are significantly lower than compared to the year 2007. |
| 5  | Intensified climate protection regulations have increased the attractiveness of rail and sea transports. |
| 6  | The absolute national investments in traffic infrastructure have significantly decreased in real terms. |
| 7  | Increasing international harmonisation has led to global alignments of political and legal conditions. |
| 8  | Global sourcing, production and distribution are common practice in almost all markets and value chains worldwide. |
| 9  | The quality of a company’s global networks and relationships has become the key determinant of competitiveness. |
| 10 | A multitude of developing and emerging countries has narrowed the gap to the industrial nations by economically catching up in the tertiary and quaternary industry sector. |
| 11 | The demand for local goods and services has significantly increased primarily due to resource scarcity, environmental pollution, and the assimilation of living standards between developing/emerging countries and the industrial nations. |
| 12 | Global standards and norms are established that assure the cost optimised planning, control and execution of international transports and their respective information flows. |
| 13 | The cost factor “labour” has been displaced by the factor “access to resources” leading to relocations of production to resource sites. |
| 14 | The customer demands regarding convenience, simplicity, promptness, and flexibility have turned logistics into a decisive success factor for customer retention. |
| 15 | The supply and disposal among densely populated areas on the one hand and depopulated, rural regions on the other hand have led to location dependent price structures for logistical services. |
| 16 | Security costs and costs for protection against industrial espionage, crime, and terrorism have disproportionately increased in the logistics industry. |
| 17 | The social responsibility has lost its national basis. Logistics service providers increasingly make location and personnel decisions upon global ethical standards and independently from national, cultural, and ethical interests. |
| 18 | Labour shortage concerning young, highly-qualified, mobile personnel has led to restraints in company growth. |
| 19 | The increasing knowledge expansion and the focus on knowledge generation, processing, and dissemination have led to substantial structural changes in the logistics industry. |
| 20 | Paperless transport has become common practice in national and international transport business. |
| 21 | Due to the integration of physical and electronic document flows almost all documents reach their receiver the same day. |
| 22 | Innovations in transport logistics (e.g. new types of vehicles, alternative propulsion, innovative materials) have substantially contributed to the reduction of resource consumption. |
| 23 | New technologies in logistics obtain faster acceptance as compared to 2007. |
| 24 | Required information and communication technology demands large capital investments, which can hardly be raised by small and medium-sized logistics service providers alone. |
| 25 | Biometric identification has become standard identification technology in logistics and enables fast and secure access controls. |
| 26 | Intelligent, automated planning and control systems (agent systems, autonomous cooperation) are widely used in logistics. |
| 27 | Innovations in transport logistics (e.g. new types of vehicles, alternative propulsion, innovative materials) have substantially contributed to a recovery of the current traffic infrastructure. |
| 28 | The area-wide utilisation of e-business has led to direct sales contacts between end customers and producers, which resulted in displacement of wholesale and retail. |
| 29 | The decentralised production of many goods on-site in small-scale factories (fabbing, 3D printer, digitised products) has led to substantial structural changes in the logistics industry. |
| 30 | The demand for high-value, customised logistics services has increased disproportionately. |
| 31 | Small and medium-sized specialised logistics service providers have merged into global networks in order to stay competitive. |
| 32 | Customers increasingly demand for consultancy services from logistics service providers in order to cope with the increasing complexity and dynamism in their markets. |
| 33 | The market for digitised document logistics has largely displaced the market for physical document logistics. |
| 34 | Alternative distribution networks have been established in the CEP-market (courier, express, parcel). Petrol stations, kiosks, and local public transport are increasingly used for pickup and delivery of parcels. |
| 35 | The consolidation phase among large logistics service providers has reached saturation so that the global mass market is divided between five to nine providers. |
| 36 | The volumes of classical logistics services (transport, handling, storage) have significantly increased. |
| 37 | Large logistics service providers (more than 250 employees, more than 50 million Euros turnover) take longer planning horizons for their vision and strategy development into consideration and are therefore increasingly using corresponding futures methodologies (e.g. scenario technique, early warning systems). |
| 38 | Customers increasingly take ecological aspects into consideration for their establishment of international logistics networks and the selection of logistics service providers. |
| 39 | The logistics industry is considerably stronger affected by large-scale outsourcing deals than 2007. |
| 40 | Customers expect document logistics to be an integral element of the service portfolio of a logistics service provider. |
| 41 | Service providers from adjacent industries (e.g. facility management, FF-services, security services) increasingly enter the market for logistics services so that the classical borders between industry, retail and wholesale, and logistics services are blurred. |

Table 19 Final List of Projections in Scenario Study
An analysis of the expectational probabilities revealed a decrease in the standard deviations (SD) of all projections that had been evaluated in both rounds (see Table 20 on page 194). In line with the fundamental rational of the Delphi technique, the feedback of the statistical group response and the experts’ comments therefore led to a convergence among the expert panel, meaning that the participants more strongly agreed in their estimations. The strongest convergence was measured for projection 20 (Paperless transport). Its standard deviation decreased by 27.9%. The projection 26 (Agent systems), in turn, recorded the weakest change by 4.5%. Consensus, i.e. an interquartile range (IQR) of below 2, was measured after two Delphi rounds for 25 of the 41 projections, equalling 61.0%. In total 9 of the 25 projections (36.0%) achieved consensus in the first round and were therefore, except projection 37 (Futures orientation), excluded from round 2. During the interim analysis expert comments indicated that despite an interquartile range (IQR) of 2, the projection 37 (Futures orientation) might better be reformulated. It was therefore also included in round 2. In some cases in Table 20, the differences between values were marginal. The author then decided to show two decimals in order to make them visible.
|                           | Round 1 (N = 30) | Round 2 (N = 30) |   |   |
|---------------------------|------------------|------------------|---|---|
|                           | IQR   | Mean  | SD  | IQR   | Mean  | SD  | Mean change | SD change |
| **Political-legal**       |       |       |     |       |       |     |             |           |
| 1 Energy supply           | 2     | 6.9   | 1.7 | 2     | 6.6   | 1.9 | 3.7          | -12.2     |
| 2 Reverse logistics       | 3     | 6.3   | 2.2 | 2     | 6.6   | 1.9 | 0.6          | -12.4     |
| 3 Source-based allocation | 4     | 5.3   | 2.4 | 3     | 5.6   | 2.0 | 5.7          | -17.2     |
| 4 Barriers of trade       | 3     | 5.5   | 2.1 | 2     | 5.6   | 1.9 | 1.6          | -16.4     |
| 5 Attractiveness of rail and sea | 3    | 5.4   | 2.0 | 3     | 5.6   | 1.9 | 3.1          | -6.1      |
| 6 Traffic infrastructure | 4     | 5.0   | 2.1 | 4     | 5.0   | 1.9 | 0.0          | -8.3      |
| 7 International harmonisation | 5    | 4.1   | 2.4 | 3     | 3.9   | 2.0 | -4.1         | -13.5     |
| **Economical**            |       |       |     |       |       |     |             |           |
| 8 Global sourcing         | 2     | 7.7   | 1.2 | 1     | 7.0   | 1.4 | 4.9          | -23.7     |
| 9 Global networks         | 3     | 6.8   | 1.9 | 1     | 7.0   | 1.4 | 0.9          | -11.4     |
| 10 Developing countries   | 2     | 6.7   | 1.6 | 2     | 6.5   | 1.5 | -0.6         | -16.4     |
| 11 Local goods            | 3     | 4.9   | 2.0 | 2     | 5.0   | 1.5 | 1.0          | -14.6     |
| 12 Standards              | 4     | 5.0   | 2.5 | 3     | 4.6   | 2.0 | -3.9         | -22.8     |
| 13 Labour vs. resources*  |       |       |     |       |       |     |             |           |
| **Socio-cultural**        |       |       |     |       |       |     |             |           |
| 14 Customer demands       | 2     | 7.8   | 1.4 | 1     | 7.0   | 1.4 | 0.9          | -11.5     |
| 15 Location dependent prices | 4    | 6.2   | 2.4 | 2     | 6.5   | 1.9 | 0.9          | -11.5     |
| 16 Security costs         | 3     | 6.2   | 1.9 | 3     | 6.5   | 1.5 | 0.9          | -11.5     |
| 17 Social responsibility  | 4     | 6.1   | 2.2 | 3     | 6.2   | 2.1 | 0.9          | -11.5     |
| 18 Skills shortage        | 5     | 5.7   | 2.4 | 3     | 6.1   | 2.0 | 0.9          | -11.5     |
| 19 Production relocation  | 4     | 5.0   | 2.1 | 3     | 5.4   | 1.8 | 0.9          | -11.5     |
| **Technological**         |       |       |     |       |       |     |             |           |
| 20 Paperless transport    | 3     | 7.1   | 2.1 | 2     | 7.5   | 1.5 | 4.5          | -14.9     |
| 21 Document flows         | 3     | 7.1   | 2.1 | 2     | 7.3   | 1.7 | 4.9          | -14.9     |
| 22 Transport innovation - resources | 5 | 5.7  | 2.3 | 3 | 6.4  | 1.8 | 0.9          | -11.5     |
| 23 Technology acceptance | 3     | 5.5   | 2.0 | 2     | 5.9   | 1.6 | 0.9          | -11.5     |
| 24 ITC investments        | 5     | 5.8   | 2.3 | 3     | 5.7   | 2.0 | -0.6         | -9.9      |
| 25 Biometric identification | 3    | 5.4   | 1.8 | 2     | 5.6   | 1.7 | -0.9         | -9.9      |
| 26 Agent systems          | 3     | 5.4   | 1.7 | 2     | 5.5   | 1.7 | -0.9         | -9.9      |
| 27 Transport innovation - traffic infrastructure | 5 | 5.7  | 2.3 | 3 | 5.5  | 2.1 | -0.9         | -9.9      |
| 28 E-Business             | 3     | 4.9   | 2.0 | 3     | 4.87  | 1.8 | -0.7         | -7.0      |
| 29 Fabbing                | 2     | 4.2   | 1.8 | 2     | 4.2   | 1.8 | 0.0          | -7.0      |
| **Industrial environment**|       |       |     |       |       |     |             |           |
| 30 Customised logistics   | 1     | 7.2   | 1.7 | 1     | 7.2   | 1.4 | 0.0          | -7.0      |
| 31 SME mergers            | 2     | 7.2   | 1.4 | 2     | 7.3   | 1.7 | 0.9          | -11.5     |
| 32 Consultancy            | 1     | 6.9   | 2.2 | 1     | 6.9   | 2.2 | 0.0          | -7.0      |
| 33 Digitised document logistics | 3 | 6.5  | 2.1 | 2 | 6.8  | 1.6 | 0.9          | -11.5     |
| 34 CEP-market             | 3     | 6.6   | 1.9 | 2     | 6.7   | 1.7 | 0.9          | -11.5     |
| 35 Consolidation          | 2     | 6.6   | 2.0 | 2     | 6.7   | 2.0 | 0.9          | -11.5     |
| 36 Classical logistics services** | 3 | 6.4  | 2.1 | 2 | 6.6  | 1.9 | 0.9          | -11.5     |
| 37 Futures orientation    | 2     | 6.4   | 1.8 | 2     | 6.5   | 1.5 | 0.9          | -11.5     |
| 38 Ecological aspects     | 3     | 6.1   | 2.0 | 2     | 6.2   | 1.7 | 0.9          | -11.5     |
| 39 Outsourcing*           | 2     | 6.6   | 2.0 | 4     | 5.9   | 2.1 | 0.9          | -11.5     |
| 40 Document logistics as integral element | 4 | 5.5  | 2.1 | 2 | 5.8  | 1.8 | 0.9          | -11.5     |
| 41 Adjacent industries    | 5     | 5.6   | 2.2 | 4     | 5.57  | 2.1 | 0.9          | -11.5     |

*Table 20 Convergence of Group Opinion Over Delphi Rounds

*N = 24; **N = 29
In total 239 times, experts revised their first round answer, of which 84 times (35.1%) estimations were adjusted downwards and 155 times (64.9%) upwards. This means that each of the 30 experts changed his first round answers approximately eight times on average. Moreover, in the scope of 30 projections evaluated in both rounds, 8 experts (26.7%) on average changed their estimation per projection.

The distribution of projections in Figure 35 on page 191 reveals further interesting patterns. It can be observed that most of the projections have an average impact of 3 or higher as well as an average expectational probability of 50% or more. The result underlines at this point that the a priori formulation and selection of projections have accurately taken place. The scenario study solely included content that is considered relevant for the logistics service industry. Further interesting patterns can be observed concerning the consensus/dissent distribution. The different colours clearly show that dissent projections are mainly found in the area of 40 to 60% expectational probability, whereas consensus projections predominantly appear in the area of 60 to 80%. This is not a conspicuous result, but a common pattern in such Delphi evaluations (see e.g. Ogden et al., 2005, pp. 34-35). By its nature, dissent is more associated with eventualities, where the future development is still difficult to assess. In case of projections with higher expectational probabilities (above 60%), the experts feel more firm in their estimations.

8.2.2. Quantitative Content Analysis of Expert Reasoning

Chapter 6.4.5.5 dealt with the interim analysis of the Delphi research. It included results of a qualitative analysis of the comments given by the experts. A summarising content analysis was used to aggregate the data for qualitative feedback. This chapter will expand on the former interim results. It presents outcomes of a quantitative content analysis (see Krippendorff, 2004) of the final set of qualitative data. As expected, the large majority of comments were given in the first round. In total 1,039 arguments were received, whereas solely 49 comments were added in the second round. The low second round result is though not conspicuous, since the first round result was already exceptionally high and left not much room for new lines of argumentation. Overall, the experts gave 1,088 arguments to justify their estimations of the expectational probabilities. Table 21 on the next page presents the results of the quantitative content analysis. The reference number of projections for average calculations was 41.
| Characteristic                                                                 | Value |
|-------------------------------------------------------------------------------|-------|
| Total number of arguments                                                    | 1,088 |
| Arguments for political-legal projections                                    | 214   |
| Arguments for economic projections                                          | 162   |
| Arguments for socio-cultural projections                                     | 186   |
| Arguments for technological projections                                      | 242   |
| Arguments for projections of industrial structure                            | 284   |
| Average number of arguments per projection                                   | 26.5  |
| Average number of arguments per expert                                       | 36.3  |
| Average number of arguments per expert and projection                        | 0.9   |
| Total number of PRO-arguments (high expectational probabilities)              | 649   |
| Average number of PRO-arguments per projection                               | 15.8  |
| Average number of PRO-arguments per expert                                   | 21.6  |
| Average number of PRO-arguments per expert and projection                    | 0.5   |
| Total number of CONTRA-arguments (low expectational probabilities)           | 439   |
| Average number of CONTRA-arguments per projection                           | 10.7  |
| Average number of CONTRA-arguments per expert                               | 14.6  |
| Average number of CONTRA-arguments per expert and projection                | 0.4   |

Table 21 Quantitative Content Analysis of Experts’ Comments

It becomes apparent that overall each expert gave 0.9 arguments per projection on average. Moreover, 649 of the arguments (59.7%) were associated with high expectational probabilities, whereas 439 comments (40.3%) justified low probabilities. The analysis of comments per thematic group of projections revealed that most qualitative contributions were made to the industrial structure (26.1%), followed by the technological field (22.2%) and the political-legal field (19.7%). The fewest comments were given to projections of the economic field (14.9%). One could theorise at this point that the experts found it more difficult to justify their estimations on economic and socio-cultural projections. A possible conclusion would be that these estimations were given rather intuitively than rationally. However, this can not be proven here. The results further indicate that there seems to be no bias due to questionnaire length, since most qualitative contributions were made to the last two sections of the questionnaire.

8.2.3. In-Depth Analysis of the Future Industry Environment

This chapter discusses the results of an in-depth analysis of the five projection groups. Each group is graphically and numerically illustrated. The figures 36 to 40 compare the mean first round estimations with the final values along the two dimensions expectational probability and impact. The larger the difference, the greater the opinion change among the experts and the more convincing the feedback was. For easy understanding, the projections are labelled with key words. Each table after the figures summarises the respective research results numerically. They include the final expectational probabilities (EP), the degree of consensus
(C), the overall rank of the projection by its probabilities (R), its impact (I), and the percentage of experts finding the occurrence desirable (D). Moreover, the projections are group-internally ranked by their mean expectational probabilities. The in-depth analysis followed an 11-point analysis strategy. The following issues were examined per group and overall:

1. Projections with consensus/dissent
2. Projections with expectational probabilities higher than 70%
3. Projections with expectational probabilities lower than 50%
4. Explanations for the numerical results and discussion of their plausibility
5. Lines of argumentation for single projections
6. (In-)consistencies between projections
7. Round in which consensus was achieved
8. Number (percentage) of experts that have changed their opinion
9. Degree of opinion change from round 1 to round 2 (see also Table 20)
10. Projections for which the interquartile rate changed by more than 2 units (see also Table 20)
11. Projections that had an interquartile range of 5 (very strong dissent) (see also Table 20)

8.2.3.1. Cross-Group Comparison

The analysis has revealed that a large number of dissent projections particularly occurs in the political-legal and socio-cultural area. In both groups over half of the projections have not yielded consensus among the experts regarding the expectational probability. Since all projections have a strong reference to logistics, the dissent may not be caused by inexperience in the areas. Rather, social, cultural, and political-legal developments have shown to be more difficult to assess in general than e.g. technological aspects. The latter are often felt to be more concrete, whereas the former are more associated with “soft” issues. Therefore, political-legal and socio-cultural aspects are usually seen more controversially, which is also reflected within this study.

Economic and technological projections as well as projections of the industrial structure yielded larger numbers of consensus projections. Thus, the experts more strongly agreed in their estimations of the expectational probabilities. Furthermore, the economic and the industrial structure projections even include some for which a strong consensus (interquartile range of 1) has been achieved. The strong agreement on these three projections may be due to the fact that they concern developments that have already started today and are expected to further evolve over the next 20 years. They may be considered megatrends of logistics.

Projections with a strong dissent (interquartile range of 4) have been measured in the political-legal and the industrial structure field. One of these three projections has though been proposed by an expert in round 1 and was therefore solely once evaluated. Presumably, a
feedback and second evaluation would have resulted in less dissent among the experts. However, the remaining two projections have indeed been very controversially discussed over two Delphi rounds. They achieved averaged expectational probabilities of 50 and 56% and therefore fall into the category of eventualities.

8.2.3.2. Political-Legal Projections

The political-legal field comprises seven projections, of which three projections (42.9%) achieved consensus. Compared to other fields, this percentage is rather low. Among the four remaining projections, one actually reached strong dissent after two Delphi rounds. Most of the projections have been evaluated with medium expectational probability. Only the projection 1 (Energy supply) is ranked among the top 10. The projection 7 (International harmonisation) achieved the lowest mean expectational probability in the data set. The interim analysis of the experts’ comments revealed no significant ambiguities so that reformulations were not necessary.

Figure 36 Comparison of Political-Legal Projections
Table 22 Delphi Statistics of Political-Legal Projections

Of particular interest in the political-legal field are, at first, single values of the projection 1 (Energy supply). The projection yields a high expectational probability of 69%. Most experts thus believe that the problem of energy supply will not be solved on a global scale in 2025. Astonishingly, 6 of the 29 experts (20.7%) found that such a development is desirable. A more detailed analysis of their lines of argumentation though indicates that their answer was presumably caused by a mix-up of the context. The qualitative data of all 6 experts have a clear positive notion regarding environmental issues, e.g. they discuss technological progress in alternative propulsion. It may be possible that they related their positive evaluation of desirability on their qualitative arguments rather than on the negatively formulated projection. A comparison with similar environment-focused projections (2 Reverse logistics, 3 Source-based allocation, 22 Innovation - resources, 38 Ecological aspects) supports this assumption, since desirability has always been rated under ecology-minded aspects. The eco-friendly position of all experts is, in fact, a general phenomenon that could be unveiled in the Delphi study. Even in case that respective projections would have restrictive impacts on the own business, the large majority of experts considered such developments desirable. The result thus underlines the emerging ecological sense of responsibility within the industry that has often been content of current discussions. The energy pessimists argue that the energy supply problem will still be unsolved particularly due to the combination of progressing resource exhaustion and increasing energy demand from developing and emerging countries. The technological innovations until 2025 are not considered efficient enough to compensate the increase. Further counterarguments refer to conflicts of interest in international negotiations that are attributed to lobbying of the energy sector. The energy optimists, in turn, place a great deal of hope on alternative energy sources. They argue that such ways will be far more extensively used in 2025. Technological progress is assumed to raise energy efficiency
considerably and to allow for an easier and less costly exploration of unconventional resources.

The projection 2 (Reverse logistics) achieved consensus in the second Delphi round on a mean expectational probability of 66%. The change in the mean expectational probabilities and the standard deviation over the two rounds was, though, comparatively low. Interestingly, this environmental-friendly projection was found desirable by the large majority of the panel. In total 76.7% evaluated desirability in such a way. Thus, most experts expect and wish that the almost entire recycling of products and scrap within the value chain will have become a legal regulation until 2025. The increasing ecological awareness and resource scarcity are seen as the key drivers of this development. The latter is expected to turn the recovery of secondary resources even into a prosperous business area. Counterarguments of such future developments primarily concern the political enforceability and cost-benefit ratio in many fields.

The projection 3 (Source-based allocation) achieved a medium mean expectational probability of 56%, which marks this projection as eventuality. In addition, no consensus could be reached after two rounds. Although a reduction of the standard deviation by 17.2% took place, the estimations of the experts were still widely spread in the second round. Thus, it is controversially discussed whether source-based allocation of costs emerging from usage of natural resources will to a large extent be accomplished in 2025. Interestingly, the occurrence of the projection has, in line with other ecology-oriented projections, been found desirable by almost the entire panel. There are three key counterarguments of such a development. First, experts have argued that in many cases a source-based allocation of costs is simply not possible. Second, there may be a strong resistance of numerous lobbies. Third, such a large scale initiative is considered difficult to realise for a single nation. On an international scale, some experts argue, it would fail due to national differences. Supporters of this projection predominantly reason that the fundament for such a system has already been build and that corresponding technologies and procedures are likely to be further developed in the coming years. Current initiatives, such as emission trading and motorway toll, are already pointing to this direction. Finally, the main consumers are also the beneficiaries.

Regarding projection 4 (Barriers of trade), the expert panel reached consensus in the second Delphi round on a mean expectational probability of 56%. Like in the projection 3 (Source-based allocation), the development is thus rather uncertain and may be considered an eventuality. The changes in the mean expectational probability and standard deviation were only marginal. Eight out of 10 experts though wish that international barriers of trade would be significantly lower in 2025. Arguments for a further liberalisation include that the globalisation of the world economy is hardly irreversible. Globalisation deniers harm themselves, since they would become isolated. Moreover, further reductions of barriers of trade are currently negotiated. In contrast to that, some experts consider such developments
rather unlikely. They particularly refer to protectionism due to fear of the rise of emerging countries, such as China and India. They consider the emergence of international trading blocs and strong bilateralism more likely.

The projection 5 (Attractiveness of rail and sea) is controversially discussed. The experts achieve no consensus on whether intensified climate protection regulations will have noticeably increased the attractiveness of rail and sea transports until 2025. Like the two projections before, the mean expectational probability is 56%. The change in the standard deviation over the two Delphi rounds was only marginal, meaning that there was low convergence among the panel. Arguments for a high probability of occurrence include the increasing ecological awareness, current political initiatives towards a modal shift, and the capacity limit of road infrastructure. The arguments for a low probability of occurrence predominantly concern the lack of flexibility of rail and sea compared to road transport, deficiencies in respective infrastructure construction, and limitations in operating distance. In essence, the discussions indicated that an increase in attractiveness is likely, but due to the multitude of decision criteria a modal shift does not inevitably take place. Rather it is limited to long-distance transport, where sea and rail can utilise their benefits.

Conspicuous is the result of the projection 6 (Traffic infrastructure). It is characterised by a mean expectational probability of 50% and a strong dissent. Whether the national investments will have significantly decreased, is thus a highly controversial issue. Even after the feedback between the two survey rounds the reduction in the standard deviation and, consequently, the dissent were marginal. Solely 5 of the 30 experts (16.7%) changed their first round answer in the second Delphi round. In addition, the degree of change was low. The mean expectational probability even remained the same in the second round although these changes were made. Experts that question the occurrence of this projection predominantly argue that funds will be missing to hold up current national investments in traffic infrastructure, since other fields, such as the social framework, are considered more urgent. They are of the opinion that only private financing and usage-dependent refinancing will solve the dilemma. Key arguments for a low expectational probability, in turn, include the infrastructure’s growing importance as location factor, further increases in traffic volume, and the reluctance of private investors.

The projection 7 (International harmonisation) is of particular interest, since it received the lowest mean expectational probability of all 41 projections. It is also one of six projections where, due to the statistical feedback and comments, the mean expectational probability decreased in round 2 – from 41 onto 39%. Nevertheless, 8 out of 10 experts find the projection’s occurrence desirable. Although the projection did not yield consensus, the mean expectational probability does indicate that there may be no such global alignments of political and legal conditions in 2025. This may largely be attributed to remaining socio-economic differences between developing and emerging countries on the one hand and industrial nations on the other hand. Differences in exigencies and expectations due to cultural
issues play an additional role. Oftentimes, national political and legal frameworks are also seen as competitive location factor. In contrast, advocates of this projection refer to the necessity of international harmonisation in the scope of global competition and long-term adaptation of wealth and living standards.

8.2.3.3. Economic Projections

The economic field comprises a large proportion of consensus projections of 66.7%. Solely two of the six projections (12 Standards, 13 Labour vs. resources) achieved no consensus. Furthermore, the projections 8 (Global sourcing) and 9 (Global networks) reached a mean expectational probability of 70% or more, which overall only 7 of the 41 projections have achieved. Both projections are further characterised by a high impact on the industry as well as a high desirability percentage. Moreover, three of the six projections (50.0%) achieved a mean expectational probability of 50% or lower. This happened only in 7 cases of the 41 projections (17.1%). It has though to be noted that one of the latter three future theses, that is projection 13 (Labour vs. resources), was only evaluated in round 2.

![Figure 37 Comparison of Economic Projections](image-url)
No 2025: How will the economic conditions have changed for the German logistics service industry?  

| No | Economic Condition | EP | C | R | I | D |
|----|-------------------|----|----|----|---|---|
| 8  | Global sourcing, production, and distribution are common practice in almost all markets and value chains worldwide. | 77% | ✓ | 2 | 4.4 | 90.0 |
| 9  | The quality of a company’s global networks and relationships has become the key determinant of competitiveness. | 70% | ✓✓ | 7 | 3.8 | 72.4 |
| 10 | A multitude of developing and emerging countries has narrowed the gap to the industrial nations by economically catching up in the tertiary and quaternary industry sector. | 67% | ✓ | 12 | 3.3 | 80.0 |
| 11 | The demand for local goods and services has significantly increased primarily due to resource scarcity, environmental pollution, and the assimilation of living standards between developing/emerging countries and the industrial nations. | 50% | ✓ | 36 | 3.5 | 63.3 |
| 12 | Global standards and norms are established that assure the cost optimised planning, control, and execution of international transports and their respective information flows. | 46% | ✗ | 38 | 3.5 | 65.5 |
| 13 | The cost factor “labour” has been displaced by the factor “access to resources”, leading to relocations of production to resource sites. \(^{6}\) | 46% | ✗ | 39 (4.0) | (100.0) | |

**Caption:**
EP = expectational probability  
C = degree of consensus/dissent  
R = overall rank of the projection by probability  
I = impact on industry, if occurred  
D = percentage of experts finding the occurrence desirable

Strong consensus (interquartile range of 1)  
Consensus (interquartile range of 2)  
Dissent (interquartile range of 3)  
Strong dissent (interquartile range of 4)

**Table 23 Delphi Statistics of Economic Projections**

The mean impact of projection 8 (Global sourcing) is actually the highest value that has been measured within this study. Interestingly, the consensus among experts for projection 8 (Global sourcing) had already been achieved in Delphi round 1. It is seen very likely that global sourcing, production, and distribution will be common practice in almost all markets and value chains worldwide in 2025. Key arguments for the high expectational probability include that such practices are already prevalent in numerous markets today. It is further argued that global sourcing, production, and distribution provide benefits that companies can not omit in competition. This trend has already started and is considered irreversible. Interestingly, the result of projection 8 (Global sourcing) conflicts to some extent with the experts’ estimation of projection 1 (Energy supply). An unsolved or even worsened problem of energy supply is likely to restrain the globalisation process.

The projection 9 (Global networks) is one of the three projections for which a strong consensus, i.e. an interquartile range of 1, was measured. In addition, it recorded the second largest reduction of the standard deviation between the two rounds. In total 8 of the 30 experts (26.7%) revised their first round answer, some of them very considerably. As a consequence, the dissent of round 1 turned into a strong consensus in round 2. It is considered very likely that the quality of a company’s global networks and relationships will be the key determinant of competitiveness in 2025. This may largely be attributed to the high division of labour across industries and the efficient utilisation of network intelligence linked with production benefits. Counterarguments concern the dominance of regional networks and discontinuation of networks as differentiation factor due to being standard for every business in 2025. These arguments had, however, no strong negative influence on the experts’ estimations.

\(^{6}\) Projection proposed by an expert. It has therefore solely been evaluated once in round 2. The values of impact and desirability are therefore set in brackets.
projections 9 (Global networks) and 8 (Global sourcing) also influence each other. In the course of ongoing globalisation in all markets and value chains, the quality of global networks and relationships will inevitably be the key determinant of competitiveness.

The analysis of the economic field further revealed a high percentage of experts that find the occurrence of projection 10 (Developing countries) desirable. In total 80.0% of the participants desire that the gap between developing and emerging countries on the one hand and the industrial nations on the other hand should have narrowed. The result indicates that logistics managers have established a social responsibility, on which respective initiatives should follow in the future. Consensus on an expectational probability of 67% had already been reached in round 1. Arguments for a high probability of occurrence concern the strong economic growth in many of these countries as well as increases in the level of education and wage level. It was further remarked that the development is already in progress as current IT offshoring activities illustrate. Nevertheless, there have also been some counterarguments. Some considered the horizon of 20 years too short for the described development, particularly related to the African countries.

In case of projection 11 (Local goods) the experts agreed in that a significant increase in the demand for local goods is at least possible. The mean expectational probability is 50% and the projection therefore uncertain. Conspicuous is though the high reduction of the standard deviation between the rounds that can be considered the second largest in this study. In total 12 of the 30 experts (40.0%) changed their first round estimation based on the feedback. The projection thus reflects one of the highest degrees of convergence among the Delphi panel. Accompanied by a small increase in the mean expectational probability, the standard deviation was reduced by 24.7% in round 2. Increasing transport costs and rising wage levels in developing and emerging countries are seen as the major divers for a higher attractiveness of local goods. However, the supporters of low expectational probabilities predominantly argue that low cost countries of the second generation will have evolved until 2025 and that most production will always take place where the lowest cost level is found. Interestingly, an occurrence of projection 11 (Local goods), often referred to as “glocalisation”, would conflict with the projections 8 (Global sourcing) and 9 (Global networks). Similar effects and interrelationships had already been found earlier for projection 1 (Energy supply).

The projection 12 (Standards) concerned the establishment of global standards and norms in logistics. Although it did not yield consensus after two rounds, convergence among the panel was clearly recognisable. In total 10 of the 30 experts (33.3%) revised their first round answer, resulting in a reduction of the standard deviation by 20.4%. Interesting in this context is also that 8 of these 10 experts adjusted their estimations downwards. As a consequence, the projection 12 (Standards) recorded the largest reduction of the mean expectational probability within this study – from initial 50% onto 46% in round 2. Arguments for a high probability of occurrence include that in the course of the ongoing market consolidation some large logistics
service providers are likely to push certain standards in the future. This will allow for cost reduction as well as further professionalisation and industrialisation of the logistics service business. Experts arguing for a low probability of occurrence predominantly refer to the large diversity of the logistics business, political hurdles, and restraints in flexibility.

The projection 13 (Resources vs. labour) describes whether the cost factor “labour” will have been displaced by the factor “access to resources” in 2025. The projection was proposed by a panel member and was therefore only evaluated once. It achieved a mean expectational probability of 46% but no consensus on this value among the panel. Approximately 20% of the panel consider the development very likely for 2025, whereas 30% do not believe that it will happen. The remaining half of the panel evaluates the projection 13 (Resources vs. labour) with a medium expectational probability. Advocates of the projection’s occurrence predominantly refer to enormous increases in cost for resources as a consequence of resource scarcity. Arguments for a low probability of occurrence include reductions in resource intensity of products, the development of substitution materials, and the increasing importance of services.

8.2.3.4. Socio-Cultural Projections

Of the six projections of the socio-cultural field solely the projections 14 (Customer demands) and 15 (Location dependent prices) achieved consensus after two rounds. In the case of the remaining four projections (66.7%) no agreement among the expert panel could be measured. Nevertheless, three of the four dissent projections showed clear convergence patterns. The standard deviation of the projections 16 (Security costs), 18 (Labour shortage), and 19 (Production relocation) could significantly be reduced. The projection 17 (Social responsibility) showed only marginal changes concerning its mean expectational probability and standard deviation between the two Delphi rounds. Solely 4 of the 30 experts (13.3%) changed their first round estimation. In total five of the six projections (83.3%) of the socio-cultural field achieved a mean expectational probability of 60% or above and their occurrence is thus believed to be rather probable. In addition, the mean expectational probability for all socio-cultural projections, except projection 14 (Customer demands), increased from round 1 to round 2. The projection 14 (Customer demands) is excluded, since it already achieved consensus in round 1.
The projection 14 (Customer demands) concerns whether increasing customer demands will have turned logistics into a decisive success factor for customer retention. With 78% it represents the highest mean expectational probability in the data set. Its mean impact of 4.1 similarly belongs to the highest values among the 41 projections. The projection 14 (Customer demands) has, thus, to be considered a key variable of the future of the logistics service industry 2025. The majority of experts justifies a high expectational probability by pointing towards the fact that already today a respective trend towards more convenience, simplicity, promptness, and flexibility is recognisable. This equally applies to end customers...
and industrial customers. A driver of the development is the increasing direct contact between end customers and producers. As a consequence, end customers demands are more directly communicated to the logistics service provider. Since differences in prices and quality of many products diminish, logistics is seen likely to become the key differentiator for customer retention in 2025.

Interesting results have also been obtained for the projection 15 (Location dependent prices), for which strong dissent had been measured in the first Delphi round. The experts’ estimations changed significantly in the second round, resulting in consensus among the panel on a mean expectational probability of 65%. Such a development would mean that customers have to pay more for logistics services in depopulated, rural regions. If a similar development is also recognisable in other service fields, the current trend of urbanisation could be intensified. The opinions concerning the desirability of the projection were, however, strongly diverse. Approximately half of the panel (51.7%) finds an occurrence for 2025 desirable. Advocates of this projection argue that due to the de-monopolisation on the markets the stress of competition is intensifying. Inclusive prices are hardly sustainable, since they bear the risk of being too low to be competitive or too high meaning greater financial risks for providers. Respective tendencies towards location dependent price structures, according to some experts, are noticeable already today. Counterarguments for such a development primarily concern the difficulty of enforceability because customers might not be willing to accept such prices and the State has a duty to grant services of general interest.

The projection 16 (Security costs) describes the disproportional increase in security costs in logistics until 2025. It achieved a mean expectational probability of 65%, but no consensus among the panel. Nevertheless, the impact of the projection’s occurrence on the industry is considered relatively high. The majority of the panel (75.0%) finds such developments undesirable. There are, however, some experts (25.0%) that wish for an occurrence, since they equate higher security costs with lower risk levels in logistics networks. Arguments for a high probability of occurrence include the continuous increases in security costs over the last years without any signs for a trend reversal. Furthermore, the importance of logistics as lifelines of countries has been stressed, making logistics networks also a preferred target for terrorism. Thus, the risk potential is very high and demands for corresponding actions. Counterarguments for the projection 16 (Security costs) include expected lower prices for security technologies. Some experts also consider the security level already that high that no further disproportional increases are likely to take place.

The projection 17 (Social responsibility) refers to a loss of the national basis of the social responsibility for the benefit of global, ethical standards. The projection achieved a dissonant mean expectational probability of 62%. Interestingly, the question of desirability splits the panel into exactly two halves. Arguments for a high probability of occurrence include the increasing importance of global, ethical standards due to ongoing globalisation. Globally
acting companies have simply to comply with international standards. Experts arguing against such a development primarily refer to the public ownership of some large logistics service providers. Similarly, owner-operated companies usually feel more locally obliged.

The projection 18 (Labour shortage) concerns labour shortage concerning young, highly-qualified, mobile personnel in 2025. At first it achieved one of the highest standard deviations of this research with its value of 2.4. Accordingly, an interquartile range of 5 was measured, indicating a very high dissent among the experts. Due to the feedback, 11 participants though changed their estimation in round 2 so that the interquartile range could be reduced to 3 and the standard deviation to 2.0 respectively. Since 8 of the 11 experts changed their estimation by 2 units on the 9-point Likert scale on average, the mean expectational probability increased from 57% in round 1 to 61% in round 2. Advocates of the projection’s occurrence refer to the demographic change, the lack of political awareness for further education, the increasing manpower requirements, and the higher demands of occupational skills. Key counterarguments, in turn, include the possibility of global recruiting, the awareness for the problem and the current initiation of counteractive measures, and more flexible work forms due to information and communication technology.

The interim analysis of the projection 19 (Production relocation) revealed an ambiguity. In its original form, the projection had included that not only production but also logistics activities are relocated out of Germany. The experts’ comments indicated that the two issues have to be considered separately. The author felt that the production part would be of higher interest for the study and therefore eliminated the logistics phrase. However, the reformulation did not result in consensus in the second round, but a significant convergence was measurable. The mean expectational probability increased from 50 to 54% while the standard deviation decreased by 14.6 percent. In total 13 experts changed their first round answer due to the reformulation. Nine of the 13 experts (69.2%) adjusted their estimation by averaged 2 units on the 9-point Likert scale upwards. Consequently, the projection 19 (production relocation) received the highest degree of convergence in this study. Key arguments for a high expectational probability include that the cost of production will remain the dominant location factor in the future. Labour-intensive production will, therefore, still be strongly relocated in 2025. The increasing flexibility of production is considered a key driver of this development. In addition, know-how, product quality, efficiency, and dependability in many low cost countries are continuously increasing. Counterarguments for an occurrence of the projection include increasing wage levels in low cost countries as a consequence of the latter aspect, the increasing importance of proximity to selling markets, and increasing transport costs. Overall, most experts believe that the projection is solely valid for some industries in the future, not for the majority of industries.
8.2.3.5. Technological Projections

In the technological field, consensus was achieved for six of the 10 projections (60.0%). These six projections concerned high, medium, and low mean expectational probabilities. Two of the projections achieved high mean expectation probabilities above 70% and are ranked among the top 10. Another two projections, in turn, reached mean expectation probabilities below 50%. Thus, the technological field covers the whole range of probabilities and is very diverse. Due to the experts’ comments in round 1, two of the 10 projections were revised during the interim analysis.

Figure 39 Comparison of Technological Projections
No | 2025: How will the technological conditions have changed for the German logistics service industry? | EP | C | R | I | D
---|---|---|---|---|---|---
20 | Paperless transport has become common practice in national and international transport business. | 75% | ✓ | 3 | 3.5 | 86.7
21 | Due to the integration of physical and electronic document flows almost all documents reach their receiver the same day. | 73% | ✓ | 4 | 3.3 | 86.7
22 | Innovations in transport logistics (e.g. new types of vehicles, alternative propulsion, innovative materials) have substantially contributed to the reduction of resource consumption. | 64% | ✗ | 19 | 3.5 | 80.0
23 | New technologies in logistics obtain fast acceptance as compared to 2007. | 59% | ✓ | 23 | 3.4 | 89.7
24 | Required information and communication technology demands large capital investments, which can hardly be raised by small and medium-sized logistics service providers. | 57% | ✗ | 26 | 3.6 | 31.0
25 | Biometric identification has become standard identification technology in logistics and enables fast and secure access controls. | 56% | ✓ | 28 | 2.2 | 72.4
26 | Intelligent, automated planning and control systems (agent systems, autonomous cooperation) are widely used in logistics. | 55% | ✓ | 32 | 3.4 | 75.0
27 | Innovations in transport logistics (e.g. new types of vehicles, alternative propulsion, innovative materials) have substantially contributed to a recovery of the current traffic infrastructure. | 55% | ✗ | 33 | 3.5 | 80.0
28 | The area-wide utilisation of e-business has led to direct sales contacts between end customers and producers, which resulted in displacement of wholesale and retail. | 49% | ✗ | 37 | 3.4 | 34.5
29 | The decentralised production of many goods on-site in small-scale factories (fabbing, 3D printer, digitised products) has led to substantial structural changes in the logistics industry. | 42% | ✓ | 40 | 3.0 | 50.0

Caption:
- EP = expectational probability
- C = degree of consensus/dissent
- R = overall rank of the projection by probability
- I = impact on industry, if occurred
- D = percentage of experts finding the occurrence desirable

Table 25 Delphi statistics of Technological Projections

The projection 20 (Paperless transport) pictures that in 2025 paperless transport will be common practice in national and international transport business. This is actually found highly probable by the experts. The panel achieved consensus on a mean expectational probability of 75%, which is the third highest result in this study. Moreover, the projection 20 (Paperless transport) is characterised by the largest reduction of the standard deviation from round 1 to round 2. In total 7 of the 30 participants (23.3%) have revised their answer in the second round, some of them rather considerably. As a consequence, the mean expectational probability increased from 71% to 75%, while the standard deviation decreased by 27.9%. One member of the panel even changed his estimation most possible from 10% in the first to 90% in the second round. An analysis of the expert’s comments in round 1 revealed that the fundamental opinion change is not caused by a misunderstanding, but is a result of the Delphi feedback. The key arguments for a high probability of occurrence include that paperless transport is already feasible today. In fact, “paperlessness” is, according to some experts, already widely realised for certain CEP-services. High cost pressure is considered a further key driver of the projection’s occurrence. Nevertheless, the heterogeneity of the transport sector, the multitude of interfaces, and legal or safety-related requirements can counteract this development.

The projection 21 (Document flows) describes that due to the integration of physical and electronic document flows almost all documents will reach their receiver the same day in the
future. As with the previous projection, the experts consider such a development very likely. The panel achieved consensus on a mean expectational probability of 73%, equalling a fourth rank in the overall ranking. While the changes in mean expectational probability were not very high between the two rounds, the decrease in the standard deviation was quite considerable. It decreased by 19.3%, indicating a strong convergence among the panel.

Advocates of the projection’s occurrence refer to the technical feasibility and ongoing standardisation in information and communication technology, whereas the arguments against an occurrence predominantly concern legal or safety-related requirements as well as emotional hurdles. Interestingly, the projections 20 (Paperless transport) and 21 (Document flows) point to the same direction. They represent consistent developments in the sense of an ongoing digitisation of the logistics business. In both cases, 86.7% of the experts find such a development desirable.

During the interim analysis comments of experts indicated that a projection on innovations in transport logistics had to be separated. It achieved a very high dissent, i.e. an interquartile range of 5, which could be attributed to ambiguity. The projection was spilt up into the two projections 22 (Innovation - resources) and 27 (Innovation - traffic infrastructure). The results of the second round reveal that this decision had been right. Both projections still reached no consensus, but the reduction of the standard deviations was considerable. The projection 22 (Innovation - resources) even recorded the largest change in the mean expectational probability, since it increased from 57 to 64%. This may be due to the fact, that all revisions concerned upwards adjustments. The projection 22 (Innovation - resources) states that innovations in transport logistics (e.g. new types of vehicles, alternative propulsion, innovative materials) will have substantially contributed to the reduction of resource consumption until 2025. Experts arguing for a high expectational probability refer to the resource scarcity and the resulting cost pressure, which in turn promotes respective innovation activities. A further driver is the growing ecological awareness in the society. Counterarguments include the high investment needs and the absence of revolutionary technologies. The projection 27 (Innovation - traffic infrastructure) additionally addresses substantial contributions of transport innovations to a recovery of the current traffic infrastructure. Contrary to the projection 22 (Innovation - resources), its mean expectational probability decreased from 57 to 55% between the rounds. Arguments for a high probability of occurrence include strong economic, social, and political pressure. Some experts, however, contrariwise reasoned that addition to capacity or recovery of traffic infrastructure will only induce new traffic. According to them, an absolute recovery is hardly conceivable.

Regarding projection 23 (Technology acceptance), the Delphi panel reached consensus in the second round for a mean expectational probability of 59%. Due to the feedback the initial mean expectational probability of 55% increased by 4 percentage points, while the standard deviation significantly decreased by 19.3%. Nine of 11 experts (81.8%) adjusted their initial answers upwards in the second round. Interestingly, the projection 23 (Technology
acceptance) gained the highest reception concerning desirability in the technological field. In total 89.7% of the panel thus found a faster acceptance of new technologies desirable. This may to a large extent be attributed to the fact that logistics is a strongly technology oriented business. Shorter technology life cycles, the costs sensitivity of the logistics service industry, and the increasing pressure from industry and retail are seen as key drivers for an occurrence of the projection. Counterarguments include that technology acceptance will be dependent on the same economic, legal, and social factors as today. Also, some experts argue that logistics is by its nature a reactive business rather than an active one and will therefore be more innovation-driven instead of innovation-shaping.

The projection 24 (ICT investments) describes that required information and communication technology (ICT) will demand large capital investments in the future, which can hardly be raised by small and medium-sized logistics service providers alone. It is one of five projections for which a strong dissent, i.e. an interquartile range of 5, was measured in round 1. On the 9-point Likert scale half of the estimations for this projection fell into the broad scale intercept between 30 and 80% mean expectational probability. The projection 24 (ICT investments) still reached no consensus in the second round, but the interquartile range could be decreased to 3 meaning that the dissent was significantly reduced. Arguments for a high probability of occurrence address the increasing complexity of systems, higher degrees of customisation, and the increasing impact of information and communication technology in a globalising world in general. Counterarguments, in turn, refer to more flexible possibilities and methods in software development, cost reduction by standardisation, and the further decline in prices for hardware.

Regarding projection 25 (Biometric identification), the Delphi panel reached consensus in the second round for a mean expectational probability of 56%. Both mean expectational probability and standard deviation changed only marginally over the two rounds. Interesting is though, that this projection achieved the lowest mean impact, that is 2.2, in this study. This may to a large extent be attributed to the fact that many experts consider biometric identification solely a niche solution for security areas. Advocates of the projection’s occurrence argue that technologies for biometric identification are continuously improved in the course of the fight against terrorism. It is therefore likely that the usage of such technologies will become standard in many industries in the future as well, when prices go down. Biometric identification is seen to have large potential for security improvement in logistics networks, particularly, if linked with other technologies such as Radio Frequency Identification (RFID).

The projection 26 (Agent systems) was reformulated during the interim analysis due to the experts’ comments. It had become apparent that the initial phrase “are area-wide used” was felt to be too absolute and broad. It was therefore replaced. The final projection depicts that intelligent, automated planning and control systems (agent systems, autonomous cooperation)
will be widely used in logistics in 2025. The reformulation and the feedback resulted in consensus among the panel on 55% mean expectational probability. In total, 12 of the 30 experts (40.0%) changed their first round answer. High expectational probabilities were predominantly justified by the increasing complexity of logistical systems that call for such planning and control mechanisms. It is speculated that the investment costs for such technologies are likely to decrease in the future. At the same time, the operability is expected to improve. In contrast to this, some experts question the decreases in investment costs and the effectiveness of such systems. They consider such technologies rather a flexibility constraint due to rigid automation.

The projection 28 (E-business) pictures that the area-wide utilisation of e-business will have led to the displacement of wholesale and retail until 2025. It achieved a mean expectational probability of 49% and is therefore one of seven projections in the study for which a value of below 50% was measured. In addition, no consensus among the panel was reached. Its mean expectational probability remained almost the same over the two rounds and the reduction of the standard deviation is marginal. This is due to the fact that only 4 of the 30 experts (13.3%) revised their first round estimation. Most of the experts stuck to their initial answer although the qualitative data on this projection were rather diverse. Advocates of a high probability of occurrence refer to current displacement tendencies. Leading internet dealers increasingly gain market shares. In addition, some producers are taking over storage and service functions of retail and wholesale or let them be organised by logistics service providers. In contrast, other experts argue that the core competences of retail and wholesale cannot be provided by producers.

The projection 29 (Fabbing) describes a future in which decentralised production of many goods on-site in small-scale factories has led to substantial structural changes in the logistics industry. It achieved consensus in round 1 and represents with 42% the second lowest mean expectational probability in this study. The idea of fabbing seems to be rather a dream of the future for the Delphi panel. An analysis of the arguments reveals that most experts expect such developments to happen much later in the future, if at all. A horizon of 20 years is considered too short. A further counterargument refers to scale effects that are still found to be the dominant driver of centralised production in 2025. Interestingly, half of the panel finds the occurrence of projection 29 (Fabbing) desirable.

8.2.3.6. Projections of the Industrial Structure

The industrial structure group comprised a high proportion of consensus projections. In total 10 of the 12 projections (83.3%) achieved consensus. In case of the projections 30 (Customised logistics) and 32 (Consultancy), the strong agreement among the panel was even reached in round 1. Similarly, the projections 31 (SME mergers) and 35 (Consolidation) yielded consensus in the first round. The projections 39 (Outsourcing) and 41 (Adjacent industries), in turn, were controversially discussed. Their final result was a strong dissent
among the panel. It has though to be noted at this point that the projection 39 (Outsourcing) had been proposed by a panel member and was therefore solely evaluated once. Compared to the other four groups, the industrial structure group includes the highest density of projections with high mean expectational probability. Four of its projections are ranked among the top 10. It is also interesting that these four future developments are all considered desirable by the majority of the Delphi panel. In addition, there is no projection that achieved a mean expectational probability below 50%.

Figure 40 Comparison of Projections of the Industrial Structure
No  | 2025: How will the industrial structure have changed for the German logistics service industry? | EP | C | R | I | D  
---|---|---|---|---|---|---
30  | The demand for high-value, customised logistics services has increased disproportionately. | 72% | ✔✔ | 5 | 4.3 | 82.8 |
31  | Small and medium-sized specialised logistics service providers have merged into global networks in order to stay competitive. | 72% | ✔ | 6 | 3.7 | 90.0 |
32  | Customers increasingly demand for consultancy services from logistics service providers in order to cope with the increasing complexity and dynamism in their markets. | 69% | ✔✔ | 8 | 3.8 | 93.3 |
33  | The market for digitised document logistics has largely displaced the market for physical document logistics. | 68% | ✔ | 10 | 3.0 | 80.0 |
34  | Alternative distribution networks have been established in the CEP-market (courier, express, parcel). Petrol stations, kiosks, and local public transport are increasingly used for pickup and delivery of parcels. | 67% | ✔ | 11 | 3.2 | 83.3 |
35  | The consolidation phase among large logistics service providers has reached saturation so that the global mass market is divided between five to nine providers. | 66% | ✔ | 13 | 3.9 | 37.9 |
36  | The volumes of classical logistics services (transport, handling, storage) have significantly increased. | 66% | ✔ | 15 | 3.9 | 71.4 |
37  | Large logistics service providers (more than 250 employees, more than 50 million Euros turnover) take longer planning horizons for their vision and strategy development into consideration and are therefore increasingly using corresponding futures methodologies (e.g. scenario technique, early warning systems). | 65% | ✔ | 18 | 3.6 | 79.3 |
38  | Customers increasingly take ecological aspects into consideration for their establishment of international logistics networks and the selection of logistics service providers. | 62% | ✔ | 21 | 3.4 | 100.0 |
39  | The logistics industry is considerably stronger affected by large-scale outsourcing deals than 2007. | 59% | ✫✫ | 24 | (4.0) | (100.0) |
40  | Customers expect document logistics to be an integral element of the service portfolio of a logistics service provider. | 58% | ✔ | 25 | 3.1 | 55.2 |
41  | Service providers from adjacent industries (e.g. facility management, IT-services, security services) increasingly enter the market for logistics services so that the classical borders between industry, retail and wholesale, and logistics services are blurred. | 56% | ✫✫ | 31 | 3.0 | 43.3 |

Caption:

EP = expectational probability  
C = degree of consensus/dissent  
R = overall rank of the projection by probability  
I = impact on industry, if occurred  
D = percentage of experts finding the occurrence desirable

Strong consensus (interquartile range of 1)  
Consensus (interquartile range of 2)  
Dissent (interquartile range of 3)  
Strong dissent (interquartile range of 4)

Table 26 Delphi Statistics of Projections of the Industrial Structure

The projection 30 (Customised logistics) achieved a mean expectational probability of 72% and is therefore seen likely to happen for 2025. Its mean impact of 4.3 is the second largest within this study. Furthermore, a large majority of 82.8% of the panel finds an occurrence desirable. Thus, the projection 30 (Customised logistics) is, according to the experts, a key element of the probable future of the logistics service industry. It depicts that the demand for high-value, customised logistics services will have increased disproportionately. The high probability of occurrence is primarily attributed to the increasing complexity and diversity of networked business processes. The relocation of production and outsourcing initiatives are considered the key drivers of the development. In particular reductions of the real net output ratio increase the demands for effective and efficient logistics networks. In this context, logistics performance is increasingly seen as competitive factor.
Regarding projection 31 (SME mergers), the Delphi panel reached consensus on a mean expectational probability of 72%. Thus, it is seen very likely that small and medium-sized specialised logistics service providers will have merged into global networks in 2025. Since 90.0% of the panel wish for this situation to occur, it is also a highly desirable future. Advocates of the projection’s occurrence argue that such a development is inescapable for small and medium-sized companies in order to stay competitive. It allows them to offer services beyond their regional niche portfolios and provides them with financial power. In addition, customers will increasingly ask for global presence and network capabilities. Cost optimisation is seen as an additional driver of the projection’s occurrence. Interestingly, numerous experts find that the development is likely to reach its peak already before 2025. However, particular interests of single providers and integration problems are considered the key restraints of this development. There is actually observable a congruence in the estimations of the similarly oriented projections 31 (SME mergers), 8 (Global sourcing), and 9 (Global networks). All three projections point at a likely and consistent development towards a more networked logistics environment in the future.

The projection 32 (Consultancy) describes that in 2025 customers will increasingly demand for consultancy services from logistics service providers in order to cope with the increasing complexity and dynamism in their markets. According to the Delphi panel, such a situation is rather likely to occur. The experts reached a strong consensus on a mean expectational probability of 69%. In addition, 93.3% of the panel find its occurrence desirable. Most experts argue that due to the global cross-industry work, logistics service providers built up a comprehensive knowledge base that they can use for consultancy services. First tendencies towards such a future are already recognisable concerning legal and customs concerns. In addition, the logistics business itself is getting more complex and therefore increasingly asks for specialists’ knowledge. Interestingly, the projections 32 (Consultancy), 30 (Customised logistics), and 14 (Customer demands) point towards a strong individualisation of logistics services in the future as a consequence of higher customer demands as well as increasing complexity and dynamism of the markets. The mean values of the expectational probability and impact of the three projections belong to the highest within this study.

The projection 33 (Digitised document logistics) concerns whether the market for physical document logistics will have been largely displaced by digitised document logistics in 2025. It is characterised by a very high reduction of its standard deviation. In total 8 of the 30 experts (26.7%) revised their first round answer resulting in a decrease of the standard deviation by 23.1 percent while the mean expectational probability increased from 65 to 68%. Thus, according to the Delphi panel it is rather likely that document logistics will to a large extent be digitised in 2025. The key arguments for the projection’s occurrence include the huge cost saving potentials and process-related optimisations. In the field of archival storage, such trends are already observable. It is expected that increasing internet security and higher data transmission capacities as well as deregulation of legal requirements will further drive the
substitution. Nevertheless, there will remain business segments, such as direct marketing and private communication, where physical document logistics has still many advantages over digitised procedures. Interestingly, the expected development would also be consistent with the expectations for the projections 20 (Paperless transport) and 21 (Document flows) that similarly point at an ongoing digitisation of the business.

Regarding projection 34 (CEP-market), the panel achieved consensus on a mean expectational probability of 67% in round 2. It was sufficient that only 4 participants revised their first round answer. The mean expectational probability marginally increased in the second round, while the standard deviation decreased by 11.2%. It is thus seen rather likely that alternative distribution networks will have been established in the CEP-market in 2025. Key arguments for a high probability of occurrence concern pressure to optimise logistics networks and to increase service quality for competitive reasons. Due to the higher mobility of customers, new, time-independent pickup and delivery concepts will be called for in the future. Experts arguing against this projection predominantly refer to the unassured promptness, reliability, and dependability of such alternative distribution networks. In addition, they stress the strong position of established networks. Interesting is the projection’s interrelationship with the projection 15 (Location dependent prices). Both future theses yield similar evaluations and depict related content. They describe ongoing changes in distribution patterns that are expected to result in alternative distribution networks and price structures.

The projection 35 (Consolidation) discusses whether the consolidation phase among large logistics service providers will have led to a division of the global mass market between five to nine providers in 2025. The distinct limitation in the number of providers has been intentionally made. It is a plausible situation for this development stage of the market cycle if one follows the concept of s-curves (see e.g. Deans, Kroeger, & Zeisel, 2003). The panel already achieved consensus in the first round on a mean expectational probability of 66%. It further reached a high mean impact value of 3.9. Advocates of the projection’s occurrence refer to the proceeding consolidation process and the scale economies of large logistics service providers in the global mass market. Counterarguments include the high fragmentation and diversity of the logistics market, possible quality and service problems of large providers, and the strong industry growth, that still provides sufficient possibilities for smaller companies. Interestingly, there were some comments made that rather fewer, e.g. three, or more, e.g. 20 to 30, logistics service providers will dominate the global mass market in 2025. As expected, predominantly logistics service providers of the top 10 list by turnover consider this development desirable.

The projection 36 (Classical logistics services) pictures a future in which the volumes of classical logistics services (transport, handling, storage) have significantly increased. The expert panel reached consensus on a mean expectational probability of 66%. Furthermore, the mean impact of the projection, if occurred, is found to be high. The arguments for a high
The probability of occurrence are numerous and include the increasing international division of labour, global sourcing, outsourcing, e-commerce, economic growth, higher living standards. Some experts remarked that in industrialised countries, such as Germany, the demographic change may counteract the development.

Further interesting results can be obtained from analysing the projection 37 (Futures orientation). It already achieved consensus in the first Delphi round. In its initial version, the projection considered whether logistics service providers in general will take longer planning horizons into consideration, increasingly using corresponding futures methodologies, such as scenario planning. However, some experts remarked that there may be differences concerning the futures orientation depending on company size. Thus, the projection was reformulated and included again in order to see how results will change if one exclusively focuses on large companies. In line with the European Commission’s (2003) SME definition, large companies were characterised as having more than 250 employees and yielding a turnover of more than 50 million Euros. In the course of the second round, the consensus became stronger among the panel, i.e. the standard deviation decreased by 17.8%. In essence, the data indicate that logistics service providers, particularly the large ones, are likely to be more futures oriented in 2025 and to increasingly use corresponding futures methodologies, such as the scenario technique. This is largely attributed to the unutilised potentials and the large competitive value of such orientation changes. In total, 79.3% of the panel find this development desirable.

The projection 38 (Ecological aspects) concerns a future in which customers increasingly take ecological aspects into consideration for their establishment of international logistics networks and for the selection of logistics service providers. The panel reached consensus on a mean expectational probability of 62% after two rounds. Experts arguing for high expectational probabilities primarily refer to the increasing ecological awareness and monetary consequences due to expected legal regulations in the future. Counterarguments include the intransparency for the customer and a dominant role of flexibility and time in the future. However, of particular interest is that all experts find the projection’s occurrence for 2025 desirable. The consentaneous result is actually unique within this study. The general ecology-minded notion could already be unveiled in the scope of other environment-focused projections, such as 1 (Energy supply), 2 (Reverse logistics), or 3 (Source-based allocation). It may be speculated that the expectational probability of 62% is going to increase in the next years, since in the light of the high desirability logistics service providers themselves may be a strong driver of the development.

The projection 39 (Outsourcing) was proposed by an expert in the first Delphi round. It concerns whether the logistics industry will be considerably stronger affected by large-scale outsourcing deals in 2025. The projection achieved a mean expectational probability of 59%, but strong dissent among the panel. Experts arguing for a high expectational probability refer
to the ongoing concentration of customers on core competences. In contrast, some panel members reason that logistics is already outsourced to a large extent. They consider it more likely that the industry will be rather affected by re-tenders of contracts than new large-scale outsourcing deals. In addition, it is remarked that customers are rather expected to reduce dependencies of single providers in the future and, therefore, will be outsourcing smaller volumes.

The projection 40 (Document logistics as integral element) pictures a future in which customers expect document logistics to be an integral element of the service portfolio of a logistics service provider. It was initially characterised by a strong dissent among the experts. Due to the feedback, 9 of the 30 experts (30.0%) revised their first round estimate resulting in consensus on a mean expectational probability of 58% in the second round. One of the participants even adjusted his estimate upwards from 30 to 80%. The mean expectational probability of this projection shows that the experts consider the development possible, but not probable for 2025. In addition, the opinions on the projection’s desirability are rather diverse. Advocates of a high expectational probability argue that there is a decreasing separation of material and information flows that inevitably leads to integrated service solutions. The increasing body of information is further militating for a high expectational probability. In contrast, arguments for a low probability of occurrence include the emergence of specialised document logistics providers and the reluctance of many companies to outsource document flows due to sensitivity of data. In the light of the high expectational probabilities of the related projections 20 (Paperless transport), 21 (Document flows), and 33 (Digitised document logistics), document logistics is though expected to be a key element of the logistics future. This would, in turn, mean that the projection 40 (Document logistics as integral element) is more likely to occur than its detached evaluation implies.

The projection 41 (Adjacent industries) concerns whether service providers from adjacent industries will have increasingly entered the market for logistics services so that the classical borders between industry, retail and wholesale, and logistics services will have been blurred. The projection achieved a mean expectational probability is 56%, but the opinions on this development are still very diverse after two rounds of evaluation. Its interquartile range could only marginally be reduced from 5 to 4, thus the dissent among the panel is still strong. Experts arguing for a high expectational probability refer to the attractiveness for adjacent industries to enter new markets. They may be able to realise synergy effects and develop into full service providers. Oftentimes, the customers for these services are the same. Some experts remarked that such a trend is already observable, e.g. hospital logistics by facility managers or transport services by security firms. However, the expansion processes are not unidirectional since logistics service providers are continuously developing value added services for differentiation purposes. It is seen likely that co-operations between adjacent industries will drive the blurring of classical borders in the future. On the contrary, some experts argue against the projection’s occurrence and refer to the lack of specialised logistics
know-how of new market entrants and the further increasing skill levels in the logistics business in the future.

8.2.4. Identification and Evaluation of Strategic Clusters

The previous chapters have discussed single projections and their interrelationships. This chapter will concentrate on groups of projections that share certain characteristics for which different strategies or actions may be derived. The two dimensions expectational probability and impact are best suited for such an analysis. Numerous authors have stressed the value of clustering projections in scatterplots along these two dimensions (see e.g. Akkermans et al., 2003, pp. 291, 293; Alexander Fink & Siebe, 2006, pp. 133-134; Häder, 2002, pp. 187-189; Ogden et al., 2005, p. 34; Rikkonen, Aakkula, & Kaivo-Oja, 2006, p. 156). It allows for more specific and in-depth analyses and forms a fundament for preparing actions. Such an approach also helps to easily identify and select groups of projections for specific purposes, such as discontinuity analyses or the development of key and eventual strategies. Rikkonen et al. (2006, p. 156) refer to this type of scatterplots as “empirical strategic importance maps” that give a sense of what kind of challenges are to be dealt with. The clustering of projections into groups may, dependent on their distribution, be done either by a heuristic or a statistical approach. Schoemaker and Mavaddat (2002, p. 216) remark that the latter is appropriate if the projections are too close to each other so that no natural patterns are recognisable. Most researchers, however, follow the less structured and more intuitive approach. It was also felt to be sufficient for the Delphi data within this thesis. The Figure 41 on the next page illustrates the interpretive clustering of projections into four groups “potential surprises”, “high-impact eventualities”, “low-impact eventualities”, and “high-impact expectations”.
The first cluster, potential surprises, concerns projections that are of low expectational probability. They are often also referred to as non-expectations. It would be surprising if these projections came true. This is also the reason why such events and developments are often neglected in planning practice. There is, however, still a possibility that such projections may occur. This could be particularly dramatic in case of medium- or high-impact projections, usually termed wildcards. They have the power to change business radically and may have significant positive or negative effects for an industry or single company. Therefore, planners should also discuss at least some of these wildcards in strategy development. They form the basis for eventual strategies (Mićić, 2007b, p. 224). In the scope of this research, the projections 7 (International harmonisation) and 29 (Fabbing) could be identified as potential surprises. Since both are characterised by a medium impact, they may also be referred to as wildcards. A formulation of projection 29 already indicated its fundamental impact, if occurred. Fabbing, i.e. decentralised production on-site in small-scale factories, would lead to substantial structural changes in the logistics industry. It has been outlined in the methodology chapter 6.4.3 that this scenario study will also include a discontinuity analysis in form of extreme scenarios and wildcards. Chapter 8.3 will deal with this content. The two projections 7 (International harmonisation) and 29 (Fabbing) will then be picked up again.

The second cluster, high-impact eventualities, refers to projections that are characterised by a medium expectational probability and a high impact. In contrast to potential surprises, these projections are considered possible, but not rather likely. Eventualities are usually controversially discussed, oftentimes leading to dissent among experts. Such projections...
represent the highest degree of uncertainty and are neither believed to be probable nor very improbable (Mićić, 2007b, pp. 224-225). Therefore, planners should pay particular attention to the high-impact eventualities in strategic planning. Since they may influence the business radically, such projections should be monitored continuously. The primary fundament for strategy development will still be expected projections. Nevertheless, eventualities, in particular the high-impact ones, may form a secondary fundament and can be taken into account for the elaboration of a strategy (Mićić, 2007b, pp. 224-225). In the scope of this research, 10 projections were classified as high-impact eventualities. As expected, the majority of these 10 projections (80.0%) still noted dissent after two Delphi rounds. Interestingly, there is a dominance of political-legal and economic projections among the high-impact eventualities. Both fields are represented by three projections. Of the socio-cultural as well as the industrial structure field, in turn, solely one projection is classified as such. It has been noted earlier that the projections 13 (Labour vs. resources) and 39 (Outsourcing) had been proposed by the panel and were therefore only evaluated once. Since both lie at the border of the cluster, a second evaluation might have excluded them from the high-impact eventualities. In particular, a decrease in the mean expectational probability of the projections 13 (Labour vs. resources) would have been interesting, since the projection would turn into a significant wildcard. Due to this circumstance the projection 13 (Labour vs. resources) is also included in the discontinuity analysis in chapter 8.3.

The third cluster comprises projections that are of medium expectational probability and of low impact on the industry, if occurred. They are therefore termed low-impact eventualities. The characteristics of eventualities have been discussed in the scope of the second cluster before. The third cluster projections differentiate from them solely in the impact rating. Low-impact eventualities are considered possible, but not rather likely, and their occurrence would not greatly influence the business. Thus, in strategic planning they play a secondary role. Nevertheless, such events and developments have to be monitored, since they can turn into a potential surprise or high-impact eventuality. In the scope of this research solely the projections 25 (Biometric identification) was classified as low-impact eventuality. Its differentiation from other projections was, however, very significant. The expert panel is of the belief that biometric identification is just a niche solution for security areas. It is therefore not expected to have high impact on the logistics service industry in general. Nevertheless, external factors could influence its impact rating. Political and legal regulations or insurance issues could, for example, drive this projection towards the cluster of high-impact eventualities.

The fourth cluster refers to high-impact expectations. Projections that fall into this category are characterised by a high expectational probability and a high impact. They are therefore of great strategic relevance for a company, and strategic planning should concentrate on them. Such projections form the primary fundament for the development of goals and strategies, since they are believed to become real at a certain time in the future (Mićić, 2007b, pp. 224-
Nevertheless, planners should keep in mind that expectations turn into potential surprises, if they do not occur. Thus, their non-occurrence should also be considered in discontinuity analyses. In the scope of this study, the three projections 8 (Global sourcing), 14 (Customer demands), and 30 (Customised logistics) are classified as high-impact expectations, that additionally achieved consensus on their estimate. It would have been possible to extend the cluster and include further projections, such as 1 (Energy supply), 9 (Global networks), and 32 (Consultancy). The narrow clustering in this research was, however, chosen, since the three earlier projections clearly distance themselves from the other ones. The identified high-impact expectations comprise developments that have actually already started and which are expected to further evolve in the next 20 years. They concern changing customer patterns as well as globalisation consequences. One may refer to them as megatrends of logistics.

8.2.5. Scenario of a Probable Future

Besides the identification of the four strategic clusters in the previous chapter, an examination of probable projections irrespective of their impact can make a valuable contribution to the research. In this manner, attributes of a probable future of the logistics service industry can be determined. Figure 42 on page 224 illustrates the interpretive clustering result. In total, 12 projections can be grouped that are characterised by a high mean expectational probability and consensus among the expert panel. In three cases, the consensus was even strong. The projections 10 (Developing countries) and 34 (CEP-market) have, with 67%, the lowest mean expectational probability of the 12 projections and therefore represent the left border of the cluster. Interestingly, the group includes minimum one projection of each of the five thematic fields, resulting in a diverse mix of scenario elements. Most of the projections are associated with the industrial structure. In total, five future theses of this field are included in the cluster. Conspicuous is that, except projection 1 (Energy supply), all projections were found desirable by the large majority of experts. In 10 cases, 80% or more of the panel assessed an occurrence as desirable. The projection 9 (Global networks) achieved a desirability of 72.4%, which is still very high. The projection 1 (Energy supply), however, is found desirable by solely 20.7% of the panel. If one takes into account that the projection has been inversely or negatively formulated, it may though not be considered a “true” outlier. Thus, the picture of the probable future is, to a large extent, also a picture of a desirable future.
A further inspection of the 12 projections revealed eight key attributes of a probable future that are marked in bold in the succeeding text. Two of the included projections have been discussed in the light of contrarieness before. It has been remarked that an occurrence of the projection 1 (Energy supply) is likely to restrain the occurrence of projection 8 (Global supply). Nevertheless, this does not mean that their consideration in one scenario is implausible or inconsistent, since the projections can take place in different degrees of intensity. Thus, overall, the 12 projections allow picturing a consistent and plausible scenario of the probable future that shall be presented in the following.

In the year 2025, the problem of energy supply will still remain unsolved (Projection 1). Increasing costs for fuel will have given rise to high transport costs, provided that the development of resource-saving propulsions will not have been finished yet. Due to the increasing energy costs operating expenses of logistics property, such as warehouses, will also rise. This will in particular be noticeable in the field of temperature-controlled logistics due to the higher energy consumption. An emerging solution might be the installation of solar cells on the roofs of warehouses and distribution centres. Nevertheless, the experts’ estimations of the energy problem indicate that logistics services are likely to be more cost intensive in 2025.

Already today, many industries are characterised by high complexity and dynamism. The perceived uncertainty has increased and managers notice that they face more severe risks than before. In 2025, it is likely that many of the customers of logistics service providers will demand not only for classical logistics services but also for consultancy services, in order to
cope with the increasing complexity and dynamism in their markets (Projections 32). This situation may primarily be attributed to three developments. First, the globalisation and the international division of labour will have reached new, higher levels. Second, the „care factor“ will be more distinctive as a consequence of the extensive outsourcing initiatives. Third, the likely occurrence of projections 32 (Consultancy) is seen as a concomitant of the increasing information overload. Thus, logistics service providers are expected to act in more complex and more dynamic environments.

The ongoing globalisation will undoubtedly produce winners and losers in the coming 20 years. It is considered likely that many of the winners will also come from the group of developing and emerging countries. A multitude of these countries is expected to narrow the gap to the industrial nations by economically catching up in the tertiary and quaternary industry sector (Projection 10). This development conversely means that the environment of global acting logistics service providers is getting more competitive.

In 2025, customers will be expected to be even more sophisticated, segmented, and demanding in terms of convenience, simplicity, promptness, and flexibility. Logistics will therefore be even more a decisive success factor for customer retention (Projection 14). Moreover, it is expected that through efficient document logistics solutions a seamless integration of physical and electronic document flows will have become standard. Against this background, it is likely that almost all documents will reach the receiver the same day (Projection 21). Thus, logistics services will be provided faster in 2025.

Also, the logistics business will be more digitised in the future. Document logistics will play an even greater role in 2025 than today. Presumably, the market for digitised services will have displaced the market for physical document logistics to a large extent (Projection 33). The common online delivery of physical mail has already been noted before (Projection 21). Similarly, paperless transport will have become standard in national and international transport business (Projection 20).

For 2025, it is further considered highly probable that global sourcing, production, and distribution will have become common practice in almost all markets and value chains worldwide (Projection 8). The unsolved problem of energy supply is not expected to stop the globalisation movement. The world will further grow together. In such an environment, the quality of a company’s global networks and relationships is likely to be the key determinant of competitiveness (Projection 9). For this reason, small and medium-sized specialised logistics service providers will have merged into global networks (Projection 31). Thus, the logistics service world will be more global and more networked in 2025.

Finally, logistics services are also likely to be more customised in 2025. Expected changes in customer demands towards more convenience, simplicity, promptness, and flexibility have already been noted before (Projection 14). In line with these changes, the demand for high-value, customised logistics services is considered to increase disproportionately in the future.
Alternative distribution concepts for the last mile will additionally create more convenience for the customer in pickup and delivery processes (Projection 34).

8.3. Discontinuities and the Surprising Future

Chapter 4.2 concerned terminological basics of scenario planning. Among others, wildcards have been introduced as developments or events with a high impact, but a low probability of occurrence. Later, in chapter 6.4.3, the issue has been considered again in the scope of the futures methodology applied. It has been revealed that many scenario studies neglect discontinuities although they might be of fundamental impact for the industry or company. The author therefore decided to conduct a discontinuity analysis in the scope of his study. The Delphi data formed its overall fundament, of which the general framework was developed.

8.3.1. Eight Extreme Scenarios for the Logistics Service Industry

Eight extreme scenarios have been pictured, following the scenario cube logic, a relative of the well-known scenario axes (see chapter 6.4.3). A three-dimensional scenario space has been constructed in which various potential developments of the industrial environment are presented. The following subchapters present the scenario cube and the eight extreme scenarios.

8.3.1.1. Construction of Scenario Cube

Figure 43 on page 227 illustrates the structure of the scenario cube. Each of the three dimensions has been derived from the results of the Delphi survey. The projection 1 (Energy supply) represents the abscissa. It has been selected due its topicality, momentousness, and high impact rating. In addition, it is characterised by a high mean expectational probability, meaning that its non-occurrence may be treated as a wildcard. The ordinate is based on the projection 13 (Labour vs. resources). It has been chosen because of its characteristic as high-impact eventuality at the border to a potential surprise. The Z-axis, in turn, is represented by the projection 10 (Developing countries). Similar to projection 1 (Energy supply), its momentousness and high expectational probability have been key selection criteria. Its high complementarity to the other two issues has been a third selection criterion. Thus, the scenario cube has been constructed based on a political-legal and two economic projections. Its tenor is therefore rather global.
Based on the selected projections, the following three scenario questions have been formulated that form the edges of the scenario cube:

- Access to resources vs. labour: Will the access to resources or human capital be the cost and location factor number one in the year 2025?
- Problem of energy supply: Will the problem of energy supply be solved or unsolved in the year 2025?
- Global competition: Will the developing and emerging countries have narrowed the gap to industrial nations or will it even have expanded?

The eight corners represent the extreme scenarios consisting of the respective characteristics of the scenario questions. For each extreme scenario, a story has been built along the three dimensions as well as for its impact on the logistics service industry. Thus, each of the eight scenarios includes four scenario parts, of which the last is a transfer to the logistics context. The stories are written from an observer perspective looking back from the year 2025.

8.3.1.2. Extreme Scenario 1 – Human Location Factor

Problem of energy supply: The energy supply problem has not been resolved globally. The dependency on oil is no longer as drastic as it was 20 years ago, but 80% of the means of transportation are still powered by oil and 90% of goods are still produced using oil. With the increase in world population to 8 billion people, and the BRIC countries and other booming regions (such as Africa) approaching the state of industrial countries, global energy consumption has nearly doubled in the last 20 years. In the course of rapid industrialisation in China and India, peak oil was achieved in 2015. However, the exploration of unconventional oil sources, such as polar oil, deep-sea oil, oil shale, oil sand, etc. has become economical due to the high costs for fossil fuels. Many countries have been able to increase the portion of
renewable energy in their overall energy mix. Yet, this only slightly reduced the dependency on oil because the overall energy demand significantly increased.

Access to resources versus labour: Despite intensified energy problems, the access to resources has become considerably less relevant in comparison to labour. Human capital is a scarce resource in today’s knowledge society. The access to qualified personnel is the only sustainable competitive advantage in an increasingly mobile world. The share of manpower and the functions requiring highly-skilled workers (i.e. executive functions, organisation, management, R&D, consulting) has increased in Germany in the last 20 years from 40% to 55%. The availability of manpower has notably decreased due to demographic developments in Germany. Declining birth rates and the retirement of the “baby-boomer” generation have lead to a large domestic skills shortage. Since 2005, 20 million working people in the European Union have disappeared from the labour market. As a result, two employed persons must pay for one non-employed person today. Moreover, government officials in Germany have had to shift more and more money into the social system, causing the educational system to suffer. The shortage of young, highly qualified, mobile staff is thereby even graver.

Global competition: Contrary to the industrial countries, the qualified labour market in former developing and emerging countries has grown enormously. In the course of globalisation, over 1 billion people in the BRIC countries have overcome the threshold to consume in the past 20 years and have an annual income of US$ 3,000 at their disposal today. Many of the former developing countries (i.e. emerging African economies) have been able to catch up to the rest even in times of the increasing resource scarcity due to their abundance of natural resources and have correspondingly contended their way to a global negotiation power. Impressive investments in information and communication technology such as E-business were made and thereby the development of these countries was advanced. They have developed into attractive investment locations, not only because of their extended workbench, but also for their knowledge-intensive industries. In addition to the booming Asian countries, the ambitious “African lions” in Africa, such as Botswana, Ghana, and the Ivory Coast, are catching up internationally. The per capita income in many of these countries has risen significantly but still remains four times less than in industrial countries.

Impacts for the logistics service providers: The heightened energy shortage has attributed to de-globalisation trends in less knowledge-intensive industries (e.g. mass production, food). Production takes place locally in order to save transportation costs. Many mid-sized producers profit from these developments. The higher energy prices have caused waterway and railway transportation to become more attractive and have lead to alternative transportation strategies for many commodities or goods. Small and mid-sized roadway transporters, in turn, have suffered because of this development. In knowledge-intensive industries, there is a lack of qualified personnel in many domestic markets. In times of advanced global recruiting, young, highly-qualified, and mobile candidates have been concertedly recruited. The general trend over the past few years, however, is the orientation towards production networks of available
human capital. The production of complex and expensive products takes place where companies can rely on qualified employees. Such attractive locations can be found in the former developing and emerging countries where large knowledge centres have been established with lower income levels in international comparison and, at the same time, attractive sales markets. The availability of well-educated people has become the major location factor in which many regions of the world compete. “Soft” factors such as environmental quality and quality of life play a decisive role.

8.3.1.3. Extreme Scenario 2 – Factory Cities and Fusion Reactors

Problem of energy supply: The energy problem is considered to be solved worldwide. The ITER experiment (International Thermonuclear Experimental Reactor) in Cadarache in Southern France, which included members of the European Union, America, Russia, China, South Korea, and Japan, is considered a milestone in energy research. The tests with the reactor have demonstrated that generating energy via nuclear fusion is technically possible and can be economically worthwhile. In the coming 20 years, the initial problems should be under control. As of 2050, the first commercial fusion reactor should supply clean, safe, and almost unlimited energy. Then, two litres of water and half a pound stones as raw material will be sufficient to supply an entire family with electricity for one whole year. The portion of renewable energy of the overall energy mix has significantly increased over the past 20 years and attributes to approximately 35% worldwide. Germany has increased its portion of renewable energy to 45% due to the Reformed Renewable Energy Sources Act (ÜEEG), in particular in wind, water, solar, and geothermal energy. China, which has also oriented itself to the German legislation, generates approximately one-quarter of its demand for energy from renewable energy. It is foreseeable that the portion of these forms of energy will continue to expand in the future and fossil fuels will become less important.

Access to resources versus labour: Based on these developments, it has become apparent that the coming years will be determined by the fight over human capital rather than the access to resources. However, many precious metals and industry metals remain scarce and expensive in the course of the advancing industrialisation of China and India, but the success of innovations in synthetic manufacturing of substitute materials promises an easing of this situation. The campaign for skilled workers, in turn, has gone on for years, in particular in Europe. Contrary to the U.S. population, which has expanded by more than one-quarter in the past 20 years, Europe’s birthrate has declined. The number of people over 65 years of age has increased to 40 million since 2005, whereby the age group of 15 to 64-year-olds has shrunk by 20.8 million people. Furthermore, in the course of tertiarisation and quaternarisation in many political economies of the industrial nations, the contribution of human capital to profit has risen considerably. The demand for young, highly-qualified, mobile personnel is much greater than the supply in domestic markets.

Global competition: In contrast to the deficits in the labour markets of industrial nations, the developing and emerging countries register a massive offer of employees. The number of
people in the BRIC countries who earn an average salary according to local standards has increased over the past 20 years to over 1 billion. The standards of living in China and Mexico are often compared today with those in Spain 20 years ago. After years of being the workbench of the world, China has developed into one of the leading innovation spots in many high-tech industries. Multinational firms in the automobile, electronics, and telecommunication industries have exchanged their know-how in order to gain access to these markets for years. At the turn of the century, approximately 400 to 500 large companies of the world established R&D centres and collaborations with institutes and universities in China. Today, the country is a leader in biotechnology and gene technology, IT and aerospace engineering. In addition to the emerging countries, several developing countries have been able to achieve remarkable advances in the level of education through affirmative action in education and research, as well as access to the Internet. Two-thirds of all mega-cities (> 10 million residents) are located in developing countries. Many of these cities, for example Lagos, Delhi, Bombay or Mexico City, have grown to more than 20 million inhabitants. These concentrated centres of the world economy are gateways for people, goods, knowledge, and money and produce up to 50% of the gross domestic product of the individual country.

Impacts for the logistics service providers: Transportation costs play a rather minor role these days. The global inventory of vehicles has nearly doubled in the last 20 years. However, fuel consumption and carbon dioxide emissions have been significantly reduced. This can be attributed to the innovations in motor technologies and fuels. Regular and diesel vehicles still characterise the streetscape with a global market percentage of 90%. One-quarter of all newly sold automobiles are though equipped with a fuel-cell-powered electric motor. After initial market expansion in the U.S., Europe, and Japan, the demand is now also increasing in other markets.

Global procurement, production, and distribution are standard in almost all market and value-added networks today. Many of the developing nations are firmly integrated in global trade with their mega-cities. The deficit of skilled personnel in the “old” industrial nations makes them more attractive. Recently, numerous production plants have been transferred to these regions due to the high concentration of human capital and low wages. The availability of well-educated people has become the most important criterion in order to compete against many other regions of the world. In addition to the relocation of manufacturing facilities, diverse industries have built “factory cities” together. These planned cities offer an attractive atmosphere as well as excellent infrastructure and try to recruit qualified employees to settle in these factory cities.

One of the largest challenges in logistics after the year 2020 is mega-city logistics. In some of the largest metropolitan areas there live over 20 million people, which all have to be supplied. Since inner-city traffic often comes to a standstill, standard parcel and mail deliveries require a great deal of time. Those who need something delivered quickly resort to small special providers which offer exact time deliveries, for example per helicopter – naturally, at
corresponding prices. In most developing and emerging nations, monopoly service providers operate and provide logistics services for single districts and bundle the commodity flows to relieve at least some of the strain on the traffic situation. Several of the controlled grown mega-cities, at least in the industrial nations, meanwhile operate underground supply networks of which the operation, maintenance, and upgrading are shared by several logistics service providers.

8.3.1.4. **Extreme Scenario 3 – The Era of Energy Wars and “Urban Mining”**

**Problem of energy supply:** The energy problem has grown more acute. As a result of expanding population and energy-hungry developing and emerging countries, the global energy consumption has nearly doubled over the past 20 years. China consumes 15 million barrels of crude oil daily, of which 70% is imported. Japan, which is poor in natural resources, is 99% dependent on energy imports. The oil imports to the USA are 60% higher than 20 years ago and the EU-nations import approximately 70% more energy today. Crude oil is still the primary source of energy. However, peak oil, in other words “half-time” of the era of oil, was reached in 2012. Since then, prices for oil and gas have exploded. The global demand exceeds the supply capacity by far. For over 50 years, new abundant deposits have not been found. The extraction of “unconventional” deposits, such as oil shale, is highly advanced, however the extracted share measured against demand is marginal. Current research concentrates on the extraction of crude oil from oil or bituminous sands, but the energy input for extraction is still much too high. The modern industrial nations are on their way to an energy turnaround, but the goal is still far away due to modest energy efficiency of renewable energy, problems with storage, poor acceptance by the population, and insufficient supply networks.

**Access to resources versus labour:** Not only fossil fuels are scarce. Since developing and emerging countries have almost caught up, over 60% of the global population has a decisive stake in resource demand. The prices of many industry and precious metals have quadrupled in the past 10 to 15 years. Diverse raw material deposits have already run dry and can only be re-extracted as secondary resources. The most prominent example is indium, formerly used for flat screens and light-emitting diodes (LED). Its economically degradable reserves have been depleted for almost 10 years. The winner of these developments is the booming waste disposal industry. The value-added of the waste industry has continually grown in the past 20 years so that the cost gap between extraction costs for secondary resources and market prices for primary resources has closed. Many of the former waste management enterprises are now referred to as resource producers and “urban mining”, i.e. the extraction of resources from waste and scrap material has particularly gained importance for raw material and energy-intensive industries.

**Global competition:** In the course of global scarcity of all raw materials, many emerging countries (e.g. Russia) and developing countries have been able to catch up economically due to their richness in commodities. In particular, the Golf of Guinea has become one of the main
crude oil regions of the world. International crude oil companies from the U.S., Europe, and Asia have invested millions of dollars in the acquisition of licenses and advancements in the last 20 years, which could be used by the Sub-Saharan African countries for site development of their reserves and thereby own economic development. The revenues from the abundance of resources were used to pay off debt, fight poverty, and support other industries that allow for diminishing the dependency on raw material sales. Central Asia and Africa reap the benefits of stronger global-political negotiation power due to their natural resource deposits. In addition, the urbanisation in these regions is vastly advanced. Almost half of the population of Africa and Asia live in cities today. These people are firmly integrated in global trade via their mega-cities with more than 20 million inhabitants and profit considerably from globalisation.

**Impacts for the logistics service providers:** An end to the worldwide struggle for natural resources is not in sight. The large oil-consuming nations and regions: the USA, European Community, Japan, China, and India, compete for the dwindling fossil fuels. Political tension and social turbulence is the result in the extracting countries, in particular in Africa. Acts of sabotage and kidnappings are a part of everyday life and protection of the sources and transport routes is only possible via military force. The access to power and resources has become a decisive competitive factor. Western companies commit to alliances with the extracting countries in order to safeguard their resource interests. However, an important trend reversal has emerged: in-sourcing. Several concerns have increased their real net output ratio by acquiring shares in or taking over foreign extracting companies. Entire manufacturing sectors have been relocated to the consumption sites due to the energy difficulties.

Resource logistics has developed into a booming branch particularly in regions where resources are depleted or do not exist. Europe relies on waste and resource logistics in order to safeguard resource security and create independency. Germany has further strengthened their lead in this area and is considered technological leader. Municipal solid waste is recycled in Germany and utilised nearly 100% as a secondary resource. By the year 2030, most industrial waste will be entirely recycled environmentally-friendly in order to ensure the supply of basic raw material. This procedure is highly efficient, since many recycled products have a higher percentage of resources than in their natural state of extraction today.

### 8.3.1.5. Extreme Scenario 4 – Battle for Metals

**Problem of energy supply:** The path to a global energy turnaround is improving. The portion of renewable energy of the overall global energy consumption already accounts for 40%. Depending on the location requirements, countries use sunlight and solar thermal, wind, water, biomass, and geothermal as sources of energy. Iceland is a prime example, relying only on renewable energy. It hasn’t been dependent on crude oil for 2 years. In Africa, large solar power plants supply a major portion of the urban population with electricity. India meets 30% of their demand for energy via an energy mix of wind parks and hydropower stations as well as biogas plants and solar plants. In the interim, fossil fuels and atomic energy are still used –
however more efficiently and environmentally-friendly than before. Four years ago, for example, the first 1,000 megawatt coal-burning power plant with carbon dioxide capture and storage (CCS) was put into operation. The energy generation from nuclear fusion is also very promising. However, it will take some more years until this technology will be fully developed. Crude oil still covers a large portion of the global energy demand, but reserves in Africa and technological innovations for efficient extraction from unconventional deposits (polar oil and deep-sea oil) offer enough leeway.

Global competition: The global population amounts to 8.5 billion people, one-third live in cities. Thirty mega-cities exist with more than 10 million inhabitants. Most of these cities are located in developing and emerging nations. The urban population in Africa has doubled in the past 20 years. India will overtake China in the next 5 years in terms of being the most populated country. Most mega-cities have taken advantage of their opportunities and utilised the city development measures which they have been entitled to. Through investments in education, health facilities, and infrastructure, the standards of living and educational levels are higher than before. With the introduction of the 150 dollar laptop 15 years ago, an educational revolution occurred. Within the first 2 years, 100 million cheap notebooks were sold in developing and emerging countries, with which an “E-velopment” wave began. The access to information and communication technology is standard for people living today in Brazil, Uganda, or Egypt and they have taken their place in the global IT market. In the millennium of cities, mega-cities are the gateways to global economies and represent the most important financial, manufacturing, information, and sales markets. In developing and emerging nations, they generate up to 60% of the GDP.

Access to resources versus labour: The battle for energy resources has declined due to the energy turnaround. However, the fight for metal resources has taken on unimaginable dimensions over the past few years. The industrialisation and urbanisation of developing and emerging countries is one reason. China and India consumed approximately 60% of the globally-produced cement in 2024 as well as 50% of the global steel production. Brazil and Mexico are growing in double digits in heavy industries. The prices for precious metals (gold, silver, platinum) have increased over the past 5 years by 110%, industrial metals (aluminium, copper, nickel, zinc) by 180%. Experts predict that price increases can be expected in the future based on the current worldwide demand. The deposits of many exotic elements, for example indium and gallium, have already been depleted for a few years. If no other copper deposits are found, total depletion of inventories is expected in 10 years. Then the only possibility will be the recovery as secondary resources, as with exotic elements. In times of exploding metal prices, theft is unfortunately a very lucrative business. Organised crime bands demount and steal metals systematically. Recycling factories and scrap dealers have to have the highest safety precaution systems, since they have been the target of many armed robberies in the past.
Impacts for the logistics service providers: The access to metal resources has become the decisive competitive factor. Manufacturing companies operate according to the motto, “global sourcing and distribution, but resource-near production”. In the intense battle over metal resources, many firms relocate manufacturing to mining sites in order to guarantee resource safety. Numerous companies have increased their real net output ratio by partial or complete buy-outs of foreign mining companies. Companies increasingly utilise synthetic substation materials in production in order to reduce resource intensity (“de-materialisation”) – which is often a disadvantage for the consumer. Many consumers complain about the low quality and durability of products. In order to compensate for supply shortages, many companies in resource-intensive industries have high inventory levels and are therefore often the focus of organised resource crime. Throughout the world, organised metal theft has reached unimaginable dimensions. The logistics industry is particularly hard-hit by this development. Scrap metal and raw material have to be stored like luxury items and have the same safety standards as money transportation. Railway containers, tracks and overhead contact lines have been stolen time and again. After several railway accidents, tracks are protected by nightly patrols and satellite surveillance. As a consequence, there are enormous costs for the protection and security for scrap metal and raw material.

Energy logisticians today ensure the supply of the consumer with the required energy at the right time and to the right place. They are merchants and infrastructure providers in one. Their work includes the trade on electricity markets and on online energy markets, optimised cost management of the energy mix, as well as the establishment and maintenance of an energy structure. Due to today’s information and communication technology, it is possible to operate virtual power plants. They represent clusters of decentralised smaller power plants which are collectively run by a central control entity and therefore allow for delivering peak load electricity and balancing power. A world without global energy logistics is in times of the energy turnaround hardly imaginable anymore.

8.3.1.6. Extreme Scenario 5 – The World of 2 Classes

Problem of energy supply: The portion of renewable energy in the worldwide energy consumption could only be gradually extended over the past 20 years due to only moderate energy efficiency of renewable energy, problems with storage, poor acceptance by the population, and insufficient supply networks. Altogether 80% of the global energy demand is still covered by fossil fuels. The scopes of these fuels are constant despite the increasing energy consumption per person due to better extraction procedures and site development of new extractions. Over the next 8 years, the last ice in the Arctic Ocean, which accommodates one-quarter of the global energy reserves, will melt. According to current market prices, the Arctic energy reserves are valued at 2 billion U.S. dollars. The neighbouring countries (USA, Denmark, Norway, Canada, and Russia) share the mining of these natural resources.

Access to resources versus labour: The labour market situation in most industrial nations, in particular in Europe, has been further exacerbated. Progressing demographic change and
increasing demand for qualifications attribute to the acute lack of skilled personnel. In the past 20 years, the EU population has only grown slightly – above all due to immigration. Statistics illustrate that the number of people over 65 has risen by 52.3% (40 million) since 2005, while the age group 15 to 64 year-olds has declined by 6.8% (20.8 million). For the coming 20 years, regressing numbers are forecasted. Together with the demographic shift, knowledge intensification for production and service creation as well as the percentage of the digitally networked worker (“E-Work”) have further increased. Altogether, 70% of the value-added are attributed to knowledge and capital. This has further aggravated the shortage of young, highly qualified personnel.

Global competition: Urbanisation has, particularly in developing and emerging countries, advanced so that today two-thirds of the worlds’ population lives in cities. Approximately 100 metropolises with more than 5 million inhabitants exist worldwide. As many people live in Asian cities as in the entire world in 1953. Many of the mega-cities with over 10 million residents grew without control, industrialisation, or infrastructure. They have developed from “cities of the millennium” to cities of misery. Approximately 80% of the building fabric in the cities of developing countries were built informally. Two-thirds of the city inhabitants live in inhumane conditions in marginal neighbourhoods without even the most elementary basic infrastructure. Water and air pollution due to traffic, industrial plants, and lack of sanitary sewage disposal and waste disposal belong to everyday life as well as high crime rates and violence. A rich upper-class, consisting of 10% of the city population, is counteracted by a large under-class, consisting of 70%. Natural and environmental catastrophes, industrial accidents, and terrorist attacks have lead to many lost lives in these areas over the past few years. In addition to epidemics such as cholera and malaria and increasing HIV infections, other non-infectious diseases have dramatically spread. For example, the number of adult diabetics living in developing nations increased by 170% from 84 million to 228 million in the past 30 years. Unhealthy lifestyles, poor nutrition, and lack of exercise have attributed to this situation.

Impacts for the logistics service providers: Due to global warming, not only natural resources can be easily extracted in the Arctic. Maritime logistics also changed profoundly. For years, the Northern Sea Route and the Northwest Passage have been passable throughout the entire year. Hence, the distance between Asia and Europe for ships declined from 24,000 km to 14,800 km. Natural resources such as nickel, copper, gold, and diamonds are brought from Siberia via the Northern Sea Route to Europe and transported on to North America. Last year, the amount of goods transported via this route was approximately 50 million tons. However, the energy problem still has not been solved. The portion of renewable energy of the global energy demand has slowly increased, but the dependency on fossil fuels, especially in logistics, is still high. High transportation costs have led to manufacturing of goods at the place of consumption. In the developing and emerging countries, simple products are fabricated due to the low level of skilled workers. In the industrial nations, products are
produced which require knowledge, consultation, and service. Mankind is more strongly divided into a 2-class society than 20 years ago. The aging society related to tertiarisation or quaternarisation has inevitably led to a market for senior citizen services which is growing at a double-digit rate. Many logistics service providers realised the trend early on and have continuously expanded their senior citizen logistics. As best-generation logistics service providers, they organise every service for the older generation – from resident transport and moving services to mail, washing services, meals, and shopping services.

8.3.1.7. Extreme Scenario 6 – Energy Turnaround and Viruses

Problem of energy supply: The energy supply problem has been solved. Electricity is generated up to 80% from clean, renewable energy. Continual technological advances as well as discretion and acceptance of people led to an energy turnaround. Renewable energy can be used inexpensively and efficiently in mixes. Wind energy is the most important energy source in Europe and covers 54% of the annual electricity consumption in Germany. Large offshore wind parks were established along coastlines over the past 20 years. Even near Northern Africa large European wind parks were constructed. The trans-European high power network with a transmission capacity of 10 GW enables inner-European electricity flow and safeguards network stability through the connection to other networks, for example North Africa. Although previously one of the largest energy consumers in the world, Sweden has covered its entire energy demand via wood-burning power plants for many years. Iceland is also no longer dependent on crude oil energy thanks to its hydropower, geothermal power, and wind energy. The performance of solar tower power plants could be increased to 300 megawatts. These solar power stations, which were primarily built in Morocco, Algeria, and Egypt, are an important element in the global energy supply. The largest plants can be found in the Sahara, so that the neighbouring countries could finally make use of this infertile desert landscape.

Access to resources versus labour: In the course of the global energy turnaround, crude oil, natural gas, coal, and uranium are no longer important. Instead, human capital has become a scarce raw resource. The demographical turning point has lead to an acute lack of skilled professionals in Europe. The exacerbated demographical development has made employee selection a strategic survival topic for European companies. The age pyramids of many member nations look more and more like “trees”. The lack of qualified employees has been further aggravated by the lack of investment in education and training. Experts predict that the proportion of over 65-year-olds will increase to 30%, and the proportion of people over 80 will increase to 11% over the next 20 years in Europe. By the year 2050, the economies of many European countries could stagnate due to a lack of young manpower, and poverty among the elderly could reach unforeseen dimensions. Therefore, EU countries are focussing on a point system for the future in which particularly qualified immigrants may relocate without a confirmed employment position as long as they fulfil certain requirements. Points
are allocated according to age, academic and professional qualifications, as well as language skills. The point system replaces the EU work permit (which previously could be issued by member countries and was valid in the entire EU) for highly qualified, young employees and operates similar to the American Green Card system.

Global competition: Despite solving the global energy problem, the gap between industrial and developing or emerging nations is larger than ever. The HI virus has spread further. Large portions of the population in developing and emerging nations are infected. Since the first outbreak of the acquired immunity deficiency syndrome in the 1980s, approximately 83 million Africans have died from it. China estimates that 50 million are infected with the HIV virus and in India, the death toll is 31 million over the past 20 years. The consequences for the economic growth of these countries are immense, since HIV/AIDS often kills young and middle-aged adults. The population pyramid in many places looks like a sand glass. Many African and Asian countries have suffered from enormous losses in manpower and human capital. In South Africa, the HIV/AIDS rate of infestation in companies is up to 50%, resulting in high employee absence rates and employee turnover. India’s economic growth has decreased approximately 40% over the past 20 years as a result. Non-infectious diseases have also increased worldwide in the course of increased urbanisation and industrialisation. More than three-quarters of all diabetics worldwide live in less developed countries (LDC) and newly industrialising countries.

Impacts for the logistics service providers: By solving the energy problem, globalisation reached its peak. Work, capital, and resources are more mobile than before. But the lack of manpower in the industrial nations and the spread of diseases and pandemics in LDCs and newly industrialising countries substantially restrict global procurement, production, and distribution. Therefore, companies invest massively in workplace health promotion in order to prevent illnesses at the workplace, to strengthen sanitary capabilities, and to improve the well-being of the employees. The number of member companies of the Global Business Coalition (GBC) to fight HIV/AIDS, tuberculosis, and malaria increased from 200 in 2007 to 3,000 today. Following the example of former Daimler Chrysler around the turn of the century, these companies invest in regions of conflict in health education, prevention programmes, voluntary testing, provision of medicine and medical care for employees and their families. Since antiretroviral medications (ARVs) have become less expensive, many multinational companies are relocating their production and servicing sites to former low-cost countries once again after years of reservation. High-quality products are, however, still consumed and produced in industrial nations.

Logistics service providers are involved in international catastrophe management in times of increasing earthquakes, floods, starvation, and pandemics. They utilise their expertise and networks in humanitarian or catastrophe logistics in order to bring aids the necessary equipment and relief supplies as quickly as possible. As catastrophe managers, they
coordinate the efficient handling, storage, and loading of humanitarian aid at airports as well as their smooth further transportation.

8.3.1.8. Extreme Scenario 7 – Space Logistics

Problem of energy supply: The portion of renewable energy of the overall global energy consumption could only be increased marginally in the past 20 years. The use of this type of energy increased in absolute terms, at the same time the global energy demand nearly doubled in the course of industrialisation in China and India. The extraction volume and consumption of natural resources, in particular fossil fuels, are larger today but also more environmentally-friendly than ever before. For example, clean 1,000 megawatt brown coal power plants with carbon dioxide capture and storage (CCS) were ready for series production 5 years ago. Thanks to efficient automotive technology, vehicles waste one-quarter less fuel than 20 years ago. The leading economic nations of the world agree that a solution to the resource problem cannot be found on Mother Earth. In the year 2007, the second race to the moon began among the U.S., Russia, China, India, Japan, and Germany in order to claim lunar resources, especially Helium-3. The recent ITER experiment in Southern France demonstrated that energy generation via nuclear fusion is technically possible and can be cost-effective. Helium-3 would be particularly appropriate for nuclear fusion, since it is not radioactive and an adequate reactor does not require a massive casing. In contrast to the Earth, Helium-3, like many other resources, is abundant on the moon. After a successful one-week mission to the moon by a five-member team of U.S. astronauts 5 years ago, NASA plans to begin their “Vision for Space Exploration” in the coming months by establishing a permanent moon station. China and India are also planning similar ideas after their successful missions. In the next 10 years, lunar infrastructure and logistics will be expanded. Future missions will concentrate on the 2 kilometre large asteroid Amun which is near to the Earth and estimated to have over 20,000 billion dollars worth of resources.

Access to resources versus labour: The outlook for nearly unlimited access to resources over the next 10 years, particularly in the future extracting countries, has caused more imprudent handling of resources worldwide. Many industries are relying again on fossil fuels and resources in the medium term. Experts project a significant departure from the still relatively expensive renewable energy sources and synthetic alternative materials to a resource-intensive but environmental friendlier economy over the next years. After the failed energy turnaround, the access to resources is an instrument of power for companies and countries more than ever. The winners of this development are the already advantaged industrial nations, since they will initially have the exclusive privileges of lunar extraction.

Global Competition: Many LDCs and newly industrialising countries observe these developments with fright. The span between the industrial nations and the LDC and newly industrialising countries has become larger over the past few years because of corruption, money laundering, outbreaks of pandemic diseases, and environmental crises. The Sub-Sahara countries of Africa which are rich in crude oil have experienced the “resource curse” the most
over the last 20 years. Up to 30% of the annual crude oil revenues have disappeared in this region. Billions of “petro-dollars” from crude oil extraction have been transferred to the United States, Europe, and Asia. The “Dutch disease” has also exacerbated the situation – as in the Netherlands during the 1960s the resource industries expanded at the expense of other industries and withdrew qualified employees and capital. Moreover, high export fortunes revalued the currencies, causing the remaining export sectors in the global market to become less competitive. Exclusive lunar excavation could result in long-term complete dependency of these countries on the industrial nations.

Impacts for the logistics service providers: In the course of increasing demand for fossil fuels, the transportation costs increased dramatically in the past years. The outlook for a solution to the energy problem via extraterrestrial resource extraction led to an intensification of the situation. Even if transportation costs will become a negligible factor in the medium to long term, they now play a significant role. The transport of goods hasn’t been worthwhile for years so that there is a significant trend to regionalisation. In the course of “glocal” procurement, production, and distribution, many products, particularly food, are almost entirely procured locally once again.

In the race of leading nations to extract extraterrestrial resources, space logistics has become one of the most lucrative business areas of top logistics providers, but also logistics research institutes. The demand for consulting in the field of terrestrial and interplanetary supply chain management is high. For many years, nations have been fighting for qualified members. Expert knowledge from Germany, the logistics hub of Europe, is particularly sought after. Recently, some global logistics service providers have been planning not only to consult, but also to get involved themselves in the space business. Within the next few years, it is expected that logistics service providers will send geo-stationary satellites into space and take over supply management of space stations.

8.3.1.9. Extreme Scenario 8 – The Global Energy and Water Crisis

Problem of energy supply: The global energy demand has doubled over the last 20 years due to continuously increasing consume in the industrial nations as well as urbanisation and industrialisation of highly populated emerging countries, above all China and India. Peak oil was already reached in 2015 and the era of cheap crude oil therefore ended. Since then, a solution to the global energy problem has been desperately searched for – until now without success. The proportion of renewable energy of the overall global energy consumption could only be slightly increased over the past 20 years and the anticipated success of nuclear fusion has not been proven. Nevertheless, the goal of global energy turnaround will be pursued. Due to exploding oil prices, mineral extraction has concentrated on the fossil fuel “coal” for years, whose world energy reserves shall last for another 160 years. This resource is however also limited, but today’s coal-burning power plants operate with carbon dioxide capture and storage (CCS) and thereby do not release emissions into the atmosphere. Bio-energy made
from corn, sugar cane, or grain is also becoming more important with production and consumption increasing continuously for years worldwide.

Global competition: More threatening than the scarcity of fossil fuels is, however, the scarcity of water. Mankind is in a global water crisis, which is particularly detrimental for the emerging markets. Although water covers approximately two-thirds of the earth’s surface, only .01% is drinking water, which is also not contaminated or frozen in ice or snow. As a result of the strong growth of the world population, the global demand for water has increased nearly 45% over the past 20 years. Half of all countries in the world suffer from serious water shortages, in particular the Near East, Africa, India and China. Experts predict that the situation will get worse with further population growth. They project that by 2050 up to 60% of the world population will suffer from water shortages – if appropriate measures are not taken. Environmental pollution and climate changes are the causes of this development. One million tons of waste are disposed of in rivers and lakes daily. As a consequence, water contamination is one of the greatest causes of disease and death in the mega-cities of developing nations. Due to the global fresh water crisis, the number of environmental refugees has quadrupled in the past 20 years.

Access to resources versus labour: In times of energy and fresh water crises, resources have become the most important cost factor and have repressed the significance of labour cost. The demand for fossil fuels and agricultural raw materials is higher than ever. The global demand for grain has increased by 50% in the past 20 years, whereas the demand for milk and meat have even increased by 100%. Such skyrocketing demand for agricultural products is caused by the increase in the world population, the climate change, as well as emerging use of bio-energy. Overall, the agricultural demand of the emerging nations has quintupled. China currently imports approximately 20% of the global wheat production and imports 30 times more corn than 20 years ago. The consumption of agricultural goods is booming. With oil prices at 200 dollars per barrel, many countries are relying on biogenous fuels and bio-electricity from corn, sugar cane, or grain. In Germany, the portion of the entire fuel consumption is already 10%. The global ethanol production, made from corn and sugar cane, has quadrupled in the past 20 years. The winner of these developments is South America with its fertile soil and low population. Brazil is a pioneer in this field and covers approximately 20% of its own demand for fuel with bioethanol. Moreover, it exports two-thirds of the generated bio-fuel to the USA, whose ethanol production has increased sixfold over the past 20 years. Yet 90% of the world energy consumption is still covered by fossil fuels. Sixty percent of the global crude oil is extracted by members of OPEC. This high dependency has caused the battle for these raw materials, in particular oil, to escalate. In extraction regions of the LDCs and emerging nations, in particular Africa, social disturbances, acts of sabotage, and kidnapping of oil industry employees belong to everyday life. Pipelines are tapped into just as crude oil vessels are attacked and abducted by pirates. The waters around Somalia, Indonesia, Borneo, Saudi-Arabia, and Nigeria are the focus of such maritime attacks.
Impacts for the logistics service providers: The logistics service industry has been concerned with two things in the past few years: the skyrocketing fuel costs and the high degree of security required. Both factors are drivers of the strong regionalisation over the last 10 years. Procurement and production worldwide take place more often on a regional basis near the place of consumption. Global transportation is solely worthwhile for complex, high-priced products. The OPEC members and a few other developing and emerging countries rich in natural resources buy themselves access to valuable products via their resources. Countries without this negotiating power are left to take care of themselves. In order to safeguard the goods in transport, handling, and storage, companies are forced to follow strict security measures. Since more than 10% of the storage facilities in Germany were burglarised, the security branch has experienced a downright boom. Today, almost all commercial property is kept under surveillance by fully digital network cameras and biometrical admission controls. To monitor the transport, companies utilise standard radio frequency identification and real-time satellite tracing. Since 90% of all goods are still transported per ship, organised crime is the largest risk of maritime logistics. In order to protect themselves from modern pirates, many vessels are equipped with protective gear to protect them from being rammed by kamikaze boats, high-pressure water canons, as well as 9,000 volt high voltage fences. The investment in this armament causes considerable costs, which is reflected in the transportation costs. Logisticians have to make the decision: A higher price amounts to better security and lower insurance rates. A lower price increases the risk of being attacked but also the profit margin. With the global fresh water crisis, many logistics service providers have become involved in water logistics. A few have even specialised in this area. They support global water crisis management and continuously provide water extraction and purification, water transport and storage, as well as residual water supply. In numerous regions of crisis, these logistics service providers make their contribution in building up a reliable, hygienic water infrastructure.

8.3.2. Wildcard Analysis

The previous chapters pictured eight extreme scenarios along three dimensions following the scenario cube logic. The scenarios discussed within this chapter are characterised by a different notion. They describe single events or developments which may seem from today’s standpoint improbable but ultimately cannot be ruled out. It is not about the probability of such events, rather the potential impact which they or similar occurrences could have. These so-called wildcard incidents could be the result of technological breakthroughs, social tension, or political overthrows. Based on an analysis of the experts’ comments, three wildcards have been distilled for analysis in this thesis. They concern personal fabrication (fabbing), terrorist attacks, and consequences of a pandemic.
“Fabbing” describes the direct fabrication of objects from computer models. Since the 1980s, the opportunities available with this type of fabrication have been researched under the term “rapid prototyping”. Until now, applications were only possible in the industrial area. Additive-fabrication-technologies, such as 3D printing and laser sintering, have predominantly been used for rapid production of models. However, with technical advancement and decreasing equipment prices, these technologies could also be used for private use in 20 years.

A Personal Fabricator would be, similar to the personal computer, an affordable device for the production (fabrication) of goods in one’s own home. It would be comparable to the replicator from the science fiction series “Star Trek”, which created any arbitrary object by the push of a button.

United Parcel Service (UPS) demonstrated what the future could look like in a TV commercial in America in 1999. In the spot, a boy ordered a football via the Internet from his personal computer and after a short time, his printer (personal fabricator) “fabricates” a 3D print of the football. UPS couldn’t have imagined at the time that this scenario could possibly become true in the long-term future. Currently, Massachusetts Institute of Technology (MIT) and Fraunhofer-Allianz Rapid Prototyping are working intensely on this topic. Even visionary leader Bill Gates recommended reading the book “FAB: The Coming Revolution on Your Desktop? From Personal Computers to Personal Fabrication” written by MIT researcher Neil Gershenfeld (2005) at his annual CEO Summit some time ago.

Fabbing technology would cause a paradigm shift and decentralise production. In the “fabbing society”, private consumers could download a 3D model of a desired object from the Internet in order to produce it with their own Personal Fabricator. Only very large or complex objects would be centrally produced, above all large quantities of the necessary basic materials, i.e. the printer ink. The roles of developers, producers, retailers, and consumers would change and be completely new. The consumer would be “pro-sumer”, producer and consumer in one, and strongly integrated in the development and production process. As a result, manufacturers and retailers would become obsolete. The music industry is a prime example of how music retailers, which were once an attractive customer group for logistical service providers, disappeared within a few years because of online ordering. It is feasible that a similar dramatic development could occur in many other industries. Moreover, a shift in goods structures is also a possible consequence. Instead of ready-made products, primarily basic materials would be transported to central manufacturing stations and finely distributed because of the new de-central production methods.

Even if one assumes that additive production technologies will become more important, the scenario of a personal fabricator for everyone by 2025 is still improbable from today’s point of view. However, it cannot be ruled out – the advantages of PCs were similarly underestimated for a long time. Ken Olsen, founder of the Digital Equipment Corporation,
said in 1977 that there was no reason why someone would want to have a computer at home. As we know today, by the year 1998, 21 years later, the U.S. Census Bureau counted 42.1% of U.S. households with a computer and 26.2% with internet access.

8.3.2.2. **Terrorist Attacks on Logistics Network**

The disturbance of logistical networks could have detrimental effects on the economy of a country. Therefore, such networks are an attractive target for terrorists. Attacks on political, ideological, or religious targets are possible at different points. Important junctions, such as seaports and airports, could be knocked out by physical aggression. The same also applies to bridges or tunnels which overcome narrow passages between geographical boundaries. Attacks to these targets could bring traffic to a complete standstill or hinder transportation along the concerned route to a great extent.

Since 9/11, the fear of terrorist attacks on logistical networks has grown – particularly to the most important ship routes and seaports. The attack on the French tank “Limburg” along the coast of Yemen in October 2002 proved that these fears are realistic. A boat filled with explosives rammed a hole in the starboard of the ship and 90,000 of the 400,000 barrels of oil on board poured out into the sea.

Sea trade is concentrated on a few straits where attacks would have dramatic effects. The Strait of Hormuz, the Bab el-Mandab passage between the Gulf of Aden and the Red Sea, the Bosporus, the Suez Canal, the Panama Canal, and the Strait of Malakka are particularly endangered. This example demonstrates how strongly dependent countries are on maritime logistics infrastructure. One-third of global trade passes through the straits in Southeast Asia daily. Altogether 80% of the oil for Japan, South Korea, and China is transported through the Strait of Malakka. Terrorist attacks on oil tankers could lead to a complete block-off of the region and thereby stop trade flows. It is estimated that the closure of the Singapore harbour would cost approximately 200 billion dollars. The redirected sea route would take ships two days longer to reach their destination and cost 8 billion dollars per year.

A disruption of particular junctions in the logistical network because of a terrorist attack would have drastic impact on global trade. Global procurement, production, and distribution would concentrate on secure regions and avoid endangered locations and routes. The economic consequences for the excluded regions would be catastrophic. The security measures in each logistics area would be drastically exacerbated in the medium-term. Insurance premiums would increase enormously and damage trade as well. The shortfalls in supply could hinder the development of affected countries, for example Asia, and lead to political instability in the concerned regions.

Terrorists might also use logistical networks as gateway for their activities. It is feasible that they could ship weapons of mass destruction and ignite them in target harbours. If necessary, corresponding explosive devices could be loaded at sea. In addition to the catastrophic loss of life and infrastructure, the logistics industry would suffer long-term consequences. Not only the limitations caused by the high security measures would increase but also governmental
intervention in the global transport network would increase because of the fear of further attacks. Ultimately, the efforts to liberalise international trade which have gone on for years would be thwarted.

8.3.2.3. Spread of a Pandemic Through Logistics Networks

New pathogenic germs originate worldwide on a regular basis. The cause is primarily natural mutation. It has been observed that new agents are often more resistant to existing medical treatments. The effects of a pandemic can be appreciated by the example of the Spanish flu which killed up to 50 million people between 1918 and 1920 via an unusual virulent progeny of the influenza virus (subtype A/H1N1). Experts have been warning for years against the outbreak of a further pandemic. The World Health Organisation (WHO) estimates that in case of a spread of the avian influenza virus (type A/H5N1) 1.5 billion people would have to be treated and 40 million could die.

The economic consequences would be just as catastrophic. According to a current study, if a global epidemic occurred, 4.4 trillion dollars in losses could be expected. The potential for workplace absences due to illnesses is at a rate of at least 35%. The World Bank recently calculated that the mere occurrence of the bird flu in several East Asian countries, which did not claim many lives, caused costs between 0.1 to 0.2% of the GDP.

The impacts on logistics are obvious. International logistics networks are considered risks in this respect. Via the transport of people and animals that are carriers of contaminating agents a virus would spread quickly. Nation states and regional associations of states would seal themselves off from potential regions of danger. Global sourcing, production, and distribution would be paralysed by the employee absences. During the Spanish flu epidemic, up to 1,000 workers were absent at the Ford plants in Detroit. Moreover, comprehensive state control and quarantine provisions would become effective in order to avoid a worsening of the situation. Trade and tourism would be discontinued as with the outbreak of Severe Acute Respiratory Syndrome (SARS) in Asia in 2002/2003. The financial markets would be equally affected as the commodity markets. Production and supply chains would be interrupted. With just-in-time production, production would come to a standstill. It can be assumed that these developments would inevitably hit all industries.

Some companies have specialised in such scenarios and developed emergency plans in order to sustain operation to some extent. A few of the large financial service providers plan home office work on a large scale in case of emergency or rely on external providers. It is known that a few logistics service providers have worked out detailed emergency plans in agreement with health and regulatory agencies. Since SARS, several large industrial firms also have had crisis plans in order to avoid production stops. However, various studies prove that most companies are not prepared for pandemics and have not worked out corresponding emergency plans.
8.4. Critical Reflection on the Scenario Study

Chapter 8 represents research phase II of this thesis and explored the future of the logistics service industry in Germany 2025. The previous subchapters have pictured probable and surprising images of the future. The chapter 8.4 will concentrate on critical reflections on the scenario content and methodology.

8.4.1. Discussions on Content

The results of the study imply that long-term analyses of the logistics environment are meaningful, since they help to orientate in complex and dynamic environments and therefore to reduce perceived uncertainty. They allow for a clearer picture of the future and to identify chances and threads. The scenario study has elaborated how experts of the leading global logistics service providers see the probable future of their industry and how some major discontinuities could look like. It is considered highly probable that the logistics service business will have become more cost intensive, more complex and dynamic, more competitive, faster, more digitised, more global and networked, and more customised by the year 2025. This conversely means that logistics service providers face great challenges but also many opportunities. Those who early set the course and invest in emerging fields may look more calmly into the future.

There are five dominant themes of the probable future that shall briefly be addressed here again in the scope of the reflections. First of all, there has been observable a general notion towards a strong social responsibility and ecological awareness in all five thematic fields. The desirability results showed strong favour for all such projections although their occurrence oftentimes might have restraining impacts on the providers’ business. Examples for the ecological awareness include legal regulations for reverse logistics, a stronger shift towards rail and sea transports, or source-based allocation of costs. The discussions in the scope of projections on developing and emerging countries were further evidence for the social responsibility among logistics service providers. They carry even more weight, if one takes into account all the activities of catastrophe and humanitarian logistics that have been initiated by some of the logistics service providers in the recent past. However, the study shows that it is likely that the energy supply problem and many of its consequences we face today remain unsolved in the year 2025. Nevertheless, the survey results also indicate that the patterns of thought and the people’s behaviour change towards a more sustainable attitude. Political and social pressure as well as technological innovations will have strong influence on the logistics business in the future. However, the survey results imply that in many cases the logistics service industry itself is likely to be a major driver of change.

A second issue that shall be addressed here concerns the globalisation movement. The projections dealing with globalisation issues were among the highest mean expectational probabilities. It was seen unlikely that there may be a reversal trend in the future. Rather, the expert panel was of the opinion that the pace will even intensify. Global networks and co-
operations are considered a prerequisite to stay competitive in the future – even for the small and medium-sized companies. This will mean that particularly in the case of the latter an even stronger global orientation will evolve in the future. Nevertheless, on the business level the world is growing strongly together, but on the political-legal scale some stumbling blocks appear. Protectionist behaviour, pessimist expectancies concerning international harmonisation, as well as global standards and norms are some of the issues discussed in the study. To cope with these hurdles will remain a challenge for logistics service providers in the future.

A third major concern that sticks out of the study refers to the shortage of qualified personnel in the future. Already today the logistics service industry faces demands that are not satisfied. Due to numerous reasons such as demographic change and retirement of the “baby-boomer” generation the situation is likely to worsen. The access to young, qualified, and mobile personnel is likely to evolve into a strong competitive factor in the future. It will be a key challenge for the logistics service industry to increase the attractiveness of the industry and to build up global recruitment structures. The continuous investment in further education of employees will be a central factor to attract potential employees, but also to retain the current ones.

A fourth central theme of the study refers to the expected changing customer demands. They have similarly been discussed in other studies. As with the globalisation, the respective projections are found among the highest mean expectational probabilities. Both globalisation and changing customer demands are interlinked and may be considered megatrends in logistics that have started in the past and evolve further over the next 20 to 30 years or even longer. Customers will be more sophisticated, segmented, and demanding, and will expect more in terms of customisation, novelty, quality, and price. In the future it will be even more imperative for logistics service providers to engage in new service developments in order to adapt to the changing customer needs and to differentiate in competition.

The expected strong digitisation in the future logistics business represents the fifth dominant issue that shall be reflected here again. Several projections have addressed substitution, digitisation, and document logistics. All of them point to the same direction. The impact of document logistics in general and digitised document logistics in particular is likely to increase significantly. The developments are expected to drive logistics to a faster, more flexible, more secure, and more transparent business. Although some of the experts question whether document logistics will become part of every provider’s service portfolio, the impact of these developments concerns the whole industry. The major challenge for logistics service providers will be to keep up with the newest technological standards in order to satisfy customer demands and to guarantee the trouble-free integration in global networks.

The five dominant themes concerned the experts’ perspective on the probable future. Similar care has been dedicated to the discontinuity analysis. The eight extreme scenarios were
pictured around three projections of the Delphi research. They described different futures in a slight exaggerative way so that they seem improbable, but not impossible. The range of topics was very diverse and included aspects such as the global energy consumption, energy turnaround, resource scarcity, nuclear fusion, labour shortage, emerging and developing countries, mega-cities, demographic change, terrorism, infectious and non-infectious diseases, global warming, space exploration, or the water crisis. They were intended to open the mind for very unlikely developments that though, if occurred, would have significant impact on the industry. In each scenario possible impacts for the logistics service industry were derived. As with the probable future before, several central themes could be distilled, of which some may evolve into significant business areas in the long-term future. They concerned mega-city logistics, resource logistics and urban mining, energy logistics, senior citizen logistics, catastrophe and humanitarian logistics, water logistics, space logistics, and space exploration logistics. The wildcard scenarios on fabbing, terrorism attacks, and pandemics complemented the discontinuity analysis and pictured possible situations in the future that logistics service providers might prepare contingency plans for. In essence, the discontinuity analysis contributed significantly to the scenario study. It came up with many new, inspiring, and surprising issues that are very valuable, particularly if related to the probable perspective of the future.

It has been noted earlier that there are several linkages between research phase I and research phase II. These concern the sampling database, the focus, and also the projection 37 (Futures orientation) (see chapter 7.3.2). The latter represents a direct linkage to the previous chapter on current scenario planning practices among logistics service providers. It addresses whether logistics service providers, in particular the large ones, will take longer planning horizons into consideration, increasingly using corresponding futures methodologies, such as scenario planning. According to the Delphi panel it is rather likely that there may be a stronger futures orientation of the industry in 2025. This result is consistent with the research outcome of the scenario expert interviews (see chapter 7.2.5). All 20 scenario experts believe that a futures orientation and the usage of respective practices, such as scenario planning, are of growing relevance for logistics service providers. Nearly half of the previously interviewed scenario experts even think that it may be more relevant for this particular industry than for others in the future. Interestingly, a comparison of the Delphi data with the scenario check results reveals some discrepancies. The scenario check showed a backward picture concerning scenario planning practices. In total 22 of 31 logistics service providers (71.0%) do not engage in such planning and the large majority of them (67.7%) solely considers medium-term horizons for strategic planning (see chapters 7.1.2 and 7.1.4). In addition, the openness of many nonusers concerning a stronger futures orientation is rather limited and rigid. A possible explanation for the discrepancies may be the differences in the sample. The percentage of members of the management board was significantly higher in the Delphi research. It may be possible that their perspective slightly deviates from the one of members
of strategy departments and corporate development, but this is rather speculative and unlikely. A second and more likely explanation could be that the strongest changes driving such a development are still to come in the next years. However, the emerging awareness among some of the large logistics service providers may be an indicator for a paradigm change towards a stronger and more long-term futures orientation.

8.4.2. Discussions on Methodology

The methodology within this thesis is quite comprehensive. It has therefore been even more imperative to document all steps clearly and to follow standardised, methodologically rigorous research procedures. Research phase II comprised the scenario study, that included both deductive and inductive elements. First, projections had been developed and subsequently evaluated in a structured Delphi process. Second, the Delphi data were used to identify patterns and, successively, to picture scenarios. As with any other sound research, it is important to evaluate the reliability and validity of the scenario study. The theoretical foundations of both issues have been thoroughly discussed in chapter 3.7. While reliability assesses whether the measures would yield the same results at different times, validity concerns whether the researcher is measuring what he thinks he measures.

It has been noted earlier that standardisation and pretesting can be considered the two most effective means for establishing reliability in research (see chapter 3.7.1). Particular attention was therefore paid to both issues in the scope of the scenario study. Standardisation was implemented at any of the Delphi and scenario specific elements. The Delphi process was based on the classical procedure of RAND Corporation, that represents the most approved and accepted variant of the Delphi approaches. Thus, the process included all four underlying key criteria (anonymity, iteration, controlled feedback, statistical group response) and therefore eliminated socio-psychological pressures that people face in conventional group communication. The major objective of this classical Delphi approach was to reach consensus on future developments among a homogeneous group of experts. In total 25 of the 41 projections (61.0%) achieved consensus. However, the typical Delphi effect of convergence among the expert panel could be confirmed for all examined projections. Of the remaining 16 dissent projections only 3 were still characterised by strong dissent. Since the Delphi research was limited to two rounds, the result is thus quite respectable. A further round might have yielded additional consensus among the panel, but may also have violated the validity of the data due to research fatigue and expert drop offs. Besides the general Delphi variant, further standardisation concerned the expert selection process and the development of projections. Both have to be considered the core of the Delphi process and the most essential elements for the scenario development in this thesis. The expert selection followed the three step procedure of Wechsler (1978, pp. 77-85). A recruitment strategy was further developed that included the compilation of a company internal expert ranking by numerous qualification criteria (see chapter 6.4.5.2). In addition, the target panel size was defined based on an extensive literature
review and in accordance with the recommendation of many authors. The scenario field was structured by the established PEST-analysis and Porter’s Five Forces. The formulation of projections paid attention to identified key criteria and a scientifically proven optimal number of words. The data input sources were very diverse and included internal and external expert workshops, a survey, expert interviews, extensive desk research, and the usage of a specific database (see chapter 6.4.5.3). To assure completeness of the content, experts could add projections at any time. This was done two times. It may be of interest at this point that three experts explicitly appreciated the high degree of comprehensibility by which the topic was captured. Solely two of the initial 38 projections had to be revised due to ambiguity, which underlines the high quality standard of the formulation process. The whole survey process was strongly standardised as well and followed established empirical research procedures. It was planned and executed in line with the Total Design Method by Dillman (1978) and its successor, the Taylored Design Method (see Dillman, 2006). The collection of the best practice research measures primarily concerned the web presence, the questionnaire design, the recruiting process, the usage of reminders, and the study concept in general. They have proven to contribute significantly to validity and reliability in research practice. The excellent response rates of the two Delphi rounds are a clear indication for its effectiveness. Similar methodological rigour has been applied to the interim analysis (see chapter 6.4.5.5). A three-step consensus measurement strategy was developed, that included qualitative and quantitative analyses. The literature review on consensus measurement revealed that the applied measures greatly vary and researchers make use of subjective criteria, descriptive statistics, or inferential statistics (see chapter 3.6). The author selected the interquartile range, mean, and standard deviation due to their effectiveness, simplicity, robustness, acceptance, and wide proliferation in Delphi research. The respective consensus criteria were also deducted from literature. Since the Delphi study was limited to two rounds, there was no need to use inferential statistics in order to determine when to stop the process.

So far, all described aspects concerned standardisation in the research process to assure a high reliability of the data. A large amount of time was also dedicated to the second mean, pretesting, for establishing reliability. Pretesting and succeeding revision took place at two situations in the Delphi process. First, after their initial formulation, the 38 projections were assessed by five experts that checked for completeness and plausibility of the content as well as methodological soundness (see chapter 6.4.5.3). Second, after completion of the questionnaire design, a pilot test was conducted among six experts from different backgrounds. Each expert was asked to fill in the questionnaire and to assess its layout and content. Their feedback and data were used to finalise the questionnaire (see chapter 6.4.5.4). However, similar strict rules were applied for the development of scenarios based upon the Delphi data in order to further assure high quality. The approach selected within this thesis was a combination of different, but standardised scenario planning elements. The value of expert-based scenarios has thoroughly been discussed in chapter 6.4.3. They ease the process
of scenario development, make the scenarios more profound, and conform to scientific standards. Particular attention was paid to plausibility and consistency, which represent the two key quality criteria of scenarios. Throughout the whole scenario writing process, intensive desk research as well as expert assessments assured their consideration. The discontinuity analysis itself may be considered a key quality criterion of this study, since it is often neglected.

Theoretical issues of validity in Delphi research have been addressed in chapter 3.7.2. It has become obvious that validity is much more difficult to assess than reliability in Delphi research. Some forms of validity, such as construct or predictive validity, are less appropriate for Delphi research. Nevertheless, there are other forms such as content validity and concurrent validity that represent more effective means for such research. They shall be discussed in the following. Many of the measures undertaken in this study to assure high reliability have actually also positively influenced the validity of the data. The two most critical validity threads in Delphi research are the selection of experts and the design of the questionnaire. The characteristics of both issues within this thesis have already been discussed in detail in the scope of reliability. Their structured, standardised procedures also guaranteed high validity of the data. In addition to the sophisticated expert selection process, expertise was confirmed a posteriori by including a question on work experience in the questionnaire. The exceptional low missing value rate of 0.9% may also be an indicator for the successful selection of experts, but primarily illustrates the completeness of the data material and therefore its high quality. Furthermore, the high response rate in the first round and the zero drop off rate in the second round can be considered significant arguments for a high validity of the data. Similarly sophisticated was the development of projections. The previously described pretests were used to establish content and face validity. The experts assessed the completeness of the questionnaire content, the balance of issues covered, the clarity of instructions, the layout of the questionnaire, and the claimed processing time. The great diversity of data sources for the development of the projections may also be seen as a promoter of content validity. In addition, each projection’s expectational probability had to be justified. This assured that no crude answers were given. The high amount of collected qualitative data, particularly to projections at the end of the questionnaire, indicates that there has not been bias due to fatigue.

Chapter 3.7.2 has also discussed the special role of criteria-related validity in Delphi research. Predictive and concurrent validity are its two subforms. The former examines the power or usefulness of the measures to make accurate predictions, whereas the latter compares the measurement device with a second assessment concurrently done. In particular predictive validity is difficult to assess in long-term forecasting and its measurement in Delphi research has been subject to much criticism. However, the second subform, concurrent validity, has found to be a more suitable measure in consensus judgements. Researchers may compare their results with other research-based evidence and congruence between findings may be an
indicator for concurrent validity. The author checked the results of the literature review in chapter 5.3 again in order to find a comparable study. Key matching criteria were a planning horizon near 2025, a German or European focus, and the examination of the probable future. Especially the latter caused problems, since many of the studies considered scenarios without any references to expectational probability. It became apparent that solely the research of Wagener & Herbst Management Consultants and Technische Universität Dresden (2002) shows sufficient similar characteristics in design and scope. Their study examined the future of the German transportation and logistics market in a European context until 2015. Interestingly, some strong congruencies could be identified that shall briefly be summarised here. In accordance with the author’s research, the study revealed:

- Capacity constraints in traffic infrastructure are likely to remain unsolved in the future. Private financing of infrastructure will take place in some areas, but not for the whole transport sector. Usage-dependent refinancing is considered the long-term solution for infrastructure investment.
- Innovations in transport logistics will particularly contribute to the environmental relief. The largest impact is attributed to alternative propulsion.
- The demands of end customers are expected to further increase concerning service quality, promptness, flexibility, and customisation. Time-definite delivery and online access will be dominant issues in the future. Direct contacts between end customers and logistics service providers are seen likely to increase due to e-business.
- The transport market will take oligopolistic forms.
- The potential for market entries into the transport sector by adjacent industries is considered low primarily due to the lack of specialised logistics know-how.
- The shortage of qualified personnel will become a serious problem in the future that is likely to restrain the industry’s growth.
- Global co-operations and networks will be a key success factor in the future. Many small and medium-sized companies will cooperate in order to realise economies of scale, to establish financial power, and to expand their service portfolio.

These seven points illustrate a high concurrent validity of the data. This is further supported by the fact that no significant conflicts in results could be revealed. However, this was just one case comparison and the conclusions are therefore limited. Nevertheless, they strengthen the overall picture of validity of the research. Interesting to add at this point is that the study of Wagener & Herbst Management Consultants and Technische Universität Dresden (2002) had a much broader sample and surveyed research institutes, politicians, authorities, associations, and companies.

The previous discussions concentrated on internal validity. External validity refers to the generalisability of the data. The issues discussed in the scope of concurrent validity at the same time also contribute to external validity, since they were based on a larger and more
diverse sample. Nevertheless, this may solely apply for the congruent aspects, but the scope of this study was even larger. As with the scenario check before, there are some limitations to external validity (see chapter 7.3.2). The research concentrated on the top 50 logistics service providers by turnover in Germany. This conversely means that the results may not be representative for small and medium-sized logistics service providers or for a comparable sample in other European countries. In addition, industry and retail may have a different perspective on the projections. Nevertheless, Figure 32 on page 188 (chapter 8.1) at least revealed a strong representation of the 24 participating companies for the top 50 in general.

It has been noticed in chapter 3.7.2 that besides the traditional forms of validity conclusion validity may also be assessed. Trochim (2006) refers to it as the degree to which the research conclusions about relationships are reasonable. The assessment of this type of validity within the scenario study is actually limited, since no large-scale empirical explanatory research has been conducted. However, one may consider the value of the scenario output in the light of conclusion validity. The scenarios actually consist of various interrelated influence factors. Their proper interplay in the storyline, i.e. the scenarios’ plausibility and consistency, may also be considered some sort of conclusion validity. The congruencies with other work as well as the scenarios’ expert assessments are under this circumstance also quality factors for conclusion validity of the data.

Finally, some additional limitations beyond reliability and validity considerations shall briefly be discussed here. The overall aim of research phase II was to develop probable and surprising scenarios of the logistics service industry 2025. The Delphi study represented a tool for the generation of profound input data for scenario development. It was though not the one and only contribution of the research phase. Thus, there could have been much more research into the collected Delphi data, which was, however, considered beyond the scope of this thesis. Other Delphi research, for example, concentrated on the comparison of subgroups (see e.g. Hakim & Weinblatt, 1993; Ludlow, 1975) or paid much attention to the examination of cross-impacts (see e.g. Enzer, 1981; Götze, 2006; Gray & Helmer, 1976; Scapolo & Miles, 2006). Such considerations have been excluded here for the reasons given. Another limitation concerns the general scenario process. The research was limited to the scenario development and therefore included no transfer of the outcome e.g. in form of strategy development. This is beyond the scope of this thesis and may be part of any company’s internal planning. Nevertheless, the chapter 9.3 will briefly address aspects of eventual usage possibilities of the study results for practice.