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# Can Target Costing Be Applied in Green Logistics? - Evidence from a Conjoint Analysis

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# CAN TARGET COSTING BE APPLIED IN GREEN LOGISTICS? − EVIDENCE FROM A CONJOINT ANALYSIS

*Complete Research*

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## Abstract

*The purpose of this paper is to provide a method to identify customer (sustainability) demands, map these via price equivalents and use the equivalents for green logistics target costing. We use the methodology of Expert Survey and Choice Based Conjoint Analysis to study purchase decisions and determine customers' price readiness for sustainable logistics services. The results are inter alia that the three dimensions of the triple bottom line are already seen as essential decision criteria for the selection of logistics services. By means of Target Costing, supported by a Choice Based Conjoint Analysis, companies are in a position to calculate the financial framework available for investments in more sustainable products. This is illustrated by the use of a fictitious example. The main limitation of our research is that the survey was executed with German participants only. Our paper is the first to equally cover the three sustainability dimensions (economical, ecological and social) for target costing in the area of logistics, especially in the field of freight transport. In addition, it is the first paper to use a conjoint analysis for the determination of the price readiness for sustainable logistics services of costumers and to apply this information to target costing.*

*Keywords: Green Logistics, Target Costing, Sustainability, Choice Based Conjoint Analysis.*

## 1 Introduction and Motivation

Nowadays, the topic of sustainability is discussed in different areas. This also includes the logistics area where the transport sector is accountable for 35% of the total energy consumption in the European Union (European Environment Agency, 2013). Public Reputation and environmental legislation (e.g., (ISO, 2012; Kyoto Protocol, 2012)) are just two reasons why sustainability is a major topic in science, practice and society. Driven by mass media, consumers demand more and more (environmental, ethical) transparency and the general sense of responsibility for the environment increases (Dangelico and Pujari, 2010; White et al., 2012). Green Logistics (GL) and Green Supply Chain Management (GSCM) are seen as important global challenges (Rao and Holt, 2005; Vachon and Klassen, 2006). There are many underlying reasons for "greening" logistics organizations, for instance, legal compliance, societal expectations, controlling of environmental-related costs, competitive pressure to name but a few (Murphy et al., 1995). Also GSCM leads to an improved environmental performance, which in turn entails cost savings and competitive advantages (Rao and Holt, 2005). Studies have shown that sustainability management, for example, organizational adoption of sustainable business practices, equally has an influence on the financial performance of companies and therefore contributes to the economic performance and leads to higher profit margins and enterprise value (Alvarez et al., 2001; Rao and Holt, 2005; Schaltegger and Synnestvedt, 2002).

Companies should be aware that sustainability has already been identified as relevant for logistics. In this paper, we intend to provide a method to identify the customers' (sustainability) demands, map these via price equivalents and use the equivalents for green logistics target costing. Therefore, we

have chosen the methodology of Choice Based Conjoint (CBC) Analysis (Green and Srinivasan, 1978) to study purchase decisions and determine the price readiness of customers for a sustainable logistics service. The research question we want to answer in our work is:

*Can the conjoint analysis be used as a decision support tool for Green Logistics target costing?*

Our paper is structured as follows: Section 2 gives an overview about related work. In section 3 the research methodology (expert survey and CBC analysis as well as data collection and analysis) is explained in detail. After that, the analysis of the results takes place. Section 5 provides the conclusion and implications, followed by section 6 where we focus on limitations of our study and possibilities for future research.

## 2 Related Work

To identify related work, we performed a literature search by the use of the databases EBSCO and Science Direct. Furthermore, we directly searched on the homepages of controlling and logistics journals ranked B or higher in the VHB jourqual ranking[1]. The search was conducted by using the keyword "target costing" in combination with "green or sustain*" and "logistic*" as well as the corresponding German translations. We concentrated on relevant literature published as of 2000.

The analysis reveals that none of the identified papers covers the three levels of sustainability (economic, environmental and social) in an equal way. The economic level is handled in every paper; the social and/or ecological levels, however, are often covered less extensively, or they are even neglected. Two thirds of the papers are of German origin. Table 1 presents the current scientific work on Green Target Costing, the method and focus of the respective paper, and it shows whether any ecological and social issues are handled.

| Paper | Method | Main Focus | Ecological | Social |
|---|---|---|---|---|
| Albrecht 2007 | Conceptional | Consideration of ecology-oriented customer requirements; Consideration of "ecology relevant product life cycle phases"; Internalization of external environmental costs. | Yes | No |
| Asen & Wiesehahn 2011 | Conceptional | Dynamic Carbon Accounting by combining Activity-Based Costing; Target Costing, Life Cycle Costing; Consideration of customer requirements; Publication of external costs, like emissions (NOx), non-methane, particles, noise and accidents. | Yes | Yes |
| Berlin 2012a | Case study | Green logistics services; Consideration of customer requirements; Determination of target costs and target emissions; Development of reduction recommendation; Continuous improvement via Kaizen Costing | Yes | Partially |
| Chen et al. 2008 | Case study | Determination of target costs by using ecology-related customer requirements and environmental costs; Consideration of transport costs; Concerns about odor, pathogens and environmental contaminants. | Yes | Partially |
| Goldbach 2003 | Case study | Prioritization of environmental targets and cost targets within a value chain. | Yes | No |

[1] http://vhbonline.org/service/jourqual/

| | | | | |
|---|---|---|---|---|
| Günther & Stechemesser 2011 | Conceptional | Target Costing and life-cycle-related Target Costing; Consideration of customer requirements and willingness to pay; Shifting the internalized external costs; Approach of conjoint management for the collection of economic costs. | Yes | Partially |
| Günther 2008 | Case study | Publication of internalized environmental costs; Internalization by prospective transition, profit waiver, reduction of allowable costs. | Yes | No |
| Herbst 2001 | Case study | Determination of customer requirements and willingness to pay; Determination of allowable costs and drill down the environmental costs on components. Development of an environmentally oriented cost management, considering ecological and economic aspects. | Yes | No |
| Kaneko et al. 2013 | Case study | Consideration of customer requirements in the area of Target Costing; Climate change and its impact on strategic target costing. | Yes | Yes |
| Pawellek et al. 2009 | Case study | Consideration of target costs and target emissions (CO2 emissions); Use of IT to determine the weighting of individual components of the logistics products. | Yes | No |
| Rünger et al. 2011 | Conceptional | IT system for the development of a virtual product with consideration of energy consumption and cost targets. | Yes | No |
| Theuvsen et al. 2005 | Case study | Determination of ecology-oriented customer requirements using conjoint analysis; Consideration of environmental costs. | Yes | No |

*Table 1. Related Work*

To the best of our knowledge, our paper stands out from these articles, as it is the first to equally cover the three sustainability dimensions (economical, ecological and social) for target costing in the area of logistics, especially in the field of freight transport. In addition, it is the first paper to use a conjoint analysis for the determination of the price readiness for sustainable logistics services of costumers and to apply this information to target costing.

# 3 Research Methodology

Conjoint measurement is a method to determine functional and structural properties of a product or service (Green and Srinivasan, 1978). In an effort to study purchase decisions and determine the price readiness of customers, we apply the Choice Based Conjoint (CBC) Analysis, as it reflects real buying decision processes (Cohen 1997, S. 16) by assuming utility-maximizing behaviour of respondents. In other words, customers will always select the product that grants them the highest utility value. Thus, the utility of the properties and their characteristics can be adequately elicited via CBC analysis, which then allows determining the preferences of customers (Green and Srinivasan, 1990). To gather a good model of the real world, different stimuli are created in the CBC analysis. A stimulus is described by several attributes and their values. Different choice sets with multiple stimuli are presented to the respondents, who are asked to evaluate these sets (e.g., choose one, prioritize them, etc.)

## 3.1 Pre-Study: Expert Survey

To identify relevant attributes and values for the CBC analysis, we invited experts from regionally, nationally and internationally operating logistics companies to participate in an expert survey (Myers, 2009; Recker, 2013). The survey consists of several questions that are divided into ten categories (General Requirements, Road transport, Shipping, Aviation, Transport Planning, Packaging, methods, standards and indicators for the assessment of external costs and demographic data about both the companies and the respondents). The survey was carried out in October and November 2013 and can be accessed via <link removed due to blind review>.

Over 200 German companies were invited to participate in the survey; 51 of which started the survey and 21 companies fully completed it. Around 29% of the companies that fully completed the survey employ less than 500 employees, 29% employ 500 to 5000 and another 29% more than 5000 employees; the remaining companies did not provide any details in this respect. The majority of the companies (72%) operate internationally (43% Europe-wide, 29% worldwide), around 14% act at national level, and the remaining companies did not provide details.

The results of the survey show that 81% of the companies are dealing with sustainability in the area of logistics. Of these, 5% state to be experts, 48% estimate their knowledge to be advanced, 10% are interested but only monitoring the developments, and the rest shows little or no interest in this theme (23%) or did not provide an answer (14%).

57% of the participating companies practice combined transport and even 67% cooperate with other logistics providers to reduce empty trips. 81% of the respondents use time buffers to plan their transports. On average 65% of the road fleet consists of vehicles that fulfil the Euro 5 norm, 11% fulfil the Euro 6 norm, 15% fulfil Euro 4 norm. The remaining vehicles are below that or there is no information available. The most commonly used alternative fuel is biodiesel (on average 38% of the fleet), followed by natural gas (only 4.5%). Moreover, a large part of the companies implemented measures such as aerodynamic packages (73%), low rolling resistance tires (64%) and tire pressure monitoring systems (71%) to reduce emissions and noise. In general a reduction of tours is achieved by a long-time planning and reduction of empty trips (76%), as well as by the use of double deck trailers (28.5%). For the tour planning, 71.5% of the companies use IT systems. In order to achieve economic goals, many companies offer eco-trainings (76%) or incentives as a reward for ecological driving (47.5%). Furthermore, on average 59% of the packaging used is multi-way, 31% is disposable and only 10% is other packaging. The measurement of external costs is mostly carried out via norm EN 16258 (43% of the companies), followed by the corporate carbon footprint (38%) and ISO 14064-1 (28.5%). 28.5% of the companies measure the air pollution, whereas infrastructure usage is only measured by 14.5% and traffic noise by still only 5%.

| **Attribute** | **Attribute Description** | **Attribute Values** |
|---|---|---|
| *Modal Split* | Represents the distribution of freight transport by various modes of transport (road, rail, air, water) (Gregori & Wimmer 2011, S. 113). | 1. Company-specific modal split<br>Intermodal transport: goods are transported in two or more modes of transport, but the charging unit is not changed.<br>2. Sustainable Modal Split<br>Intermodal transport where most of the tranportation is done by rail or shipping. Road transport is kept as short as possible. Air transport is excluded. The company cooperates with other logistics service providers to enable more sustainable transport solutions. |
| *Delivery Time* | The time between placing the order and availability of the goods by the customer (sum of | 1. Delivery on specific date<br>Deliver date is specified by day, month and year and possibly time. |

| | | |
|---|---|---|
| | time for order processing, picking, packing, loading and transport) (Koch 2012, S.16). | 2. Delivery in specific period<br>Delivery is specified by a timeframe (e.g., calendar week) and not a specific day (and time). |
| *Climate Protection* | The reduction of transport-related emissions of pollutants (Schmied & Knörr 2013, S. 7). | 1. Publication of greenhouse gas emissions<br>Energy consumption and greenhouse gas emissions of freight transportation is reported in accordance with DIN EN 16258.<br>2. No publication of greenhouse gas emissions<br>There is no information about any pollution available. |
| *Noise Pollution* | Traffic noise can cause mental and physical health impairments. The transport sector is the main polluter of noise disturbances. The number of people affected is at a high level (BMVBS 2010, S. 88 f.). | 1. Publication of noise pollution<br>Noise pollution is reported in dB (A) in accordance with directive 2002/49/EG of the European Parliament and of the Council of June 25th 2002 on the assessment and management of environmental noise.<br>2. No publication of noise pollution<br>There is no information about any noise pollution. |
| *Human Resource Management* | Successful human resource management is a key factor for efficient transport processes as well as for a high-quality and efficient transport system (Bundesamt für Güterverkehr 2012, S. 105 ff., S. 135 ff., S. 153 ff.). | 1. There is evidence for good working conditions<br>Working conditions: weekly working time less than 45 hours, working time compensation accounts support work-life balance, encounter traffic and fixed routes reduce home absence, financial support of sports programs and training for the prevention of health stressors<br>2. No information about working conditions |
| *Price* | The price for the proposed service (gross price without storage and handling charges). | 1. 2112 € [equ. 0.11 €/tkm]<br>2. 2304 € [equ. 0.12 €/tkm]<br>The price was determined from statistical data in tkm (Kille & Schwemmer 2013, p. 40; Hütter 2013, p. 12). |

*Table 2. CBC Analysis Attributes and Values*

Since most of the examined companies do not offer shipping, rail or aviation services, the results of these areas were not further considered. Following (Green and Srinivasan, 1990), the founders of conjoint analysis for market research, we created various attributes as well as attribute values for the CBC analysis. We used the data gathered from the expert survey and the related literature to build these settings. Therefore, we used values that are already implemented at some companies or that were considered relevant in the related literature. The items finally selected for the analysis are shown in table 2.

## 3.2 Study Design

The survey consists of the choice sets for CBC analysis, socio-demographic questions and additional questions for the segmentation and description of the participants. The survey was conducted online using CBC for SSI Web[2]. At first an introduction and an explanation of each attribute (cf. table 2) was presented to the participants. We introduced the following scenario to the participants: *You work in a company that plans to transport a product weighing 24 tons from Hamburg to Munich (about 800 km*

[2] http://www.sawtoothsoftware.com/index.php?option=com_content&view=article&&id=167

*total distance). The Company does not operate its own logistics department and therefore assigns a transport contract to a logistics service provider.* After the participants had read this introduction, we presented two transport alternatives from which the participants had to choose one. The alternatives differ as the attributes have different values. It is possible to fade in the initial explanation of each attribute for assistance. According to SSI Web, the optimal number of Choice Sets in this scenario is 18 randomized choice sets. Furthermore, for computer-based CBC-analyses it is recommended to use randomized choice sets; due to the non-correlation, a higher quality can be achieved.

With a larger number of choice sets, fatigue and boredom effects are to be expected, so that the participants may not make reliable decisions. To be able to detect and filter out such effects, we added two fixed choice sets to the 18 randomized sets (Johnson and Orme, 1996). To obtain an efficient survey design, 300 random combinations with a minimal interference were created. At the end of the survey, additional statements (measurement items) for detecting the environmental, social and economic attitude (construct) of the participants were added. Each construct was mapped to four items, which were rated on a 7-point Likert scale (from "Strongly Agree (1)" to "Strongly Disagree (7)").

Before starting the survey, we conducted a pre-test. Four scientists and three students participated in this test and made suggestions for improvement regarding formulations, content and understanding. We consolidated the proposals and included them into the survey before inviting the final participants. The survey was distributed among two groups. On the one hand we submitted the survey to employees in the transport industry, who execute cases such as the illustrated one in their everyday working routine. On the other hand we addressed students of economics, as we consider them to be the future decision makers. And since the students have already acquired knowledge in business economics and sustainability, we consider them to represent a good sample for our experiment. On those grounds, they can be viewed as relevant part of the target group (Compeau et al., 2012).

## 3.3 Data Collection

The invitation to the survey was sent via e-mail to more than 1,500 companies, 134 companies of which participated in the survey. After reviewing the submitted responses, we obtained 37 completed and usable participations. In addition, 307 students were invited to the survey. The participation rate among the students (260 fully completed questionnaires) was significantly higher. One reason is that we offered incentives for the participation in terms of bonus points for a course (Heerwegh, 2006). Although critically discussed (Gallagher et al., 2001), we believe the students to be a god sample for our experiment. Due to the experiences already gained during their studies in economics and courses on sustainability, the students represent a significant part of the target group (Compeau et al., 2012). The two surveys were conducted in the first quarter of 2014.

Overall 260 students and 37 corporate employees participated in the survey. The participants (of both groups) estimate their expertise in the area of sustainability as relatively high. For example, 24.5% of the employees state that they are interested in the topic of sustainability, 27% that they have an advanced knowledge and 2.5% that they have expert knowledge. Among the students, the values are at similar values. 41% indicated to be interested in the topic and 2% reported to be experts. More information about the participants in the study is shown in table 3 (clustered by Student Survey and Survey Company).

| **Age** | **18-24** | **25-34** | **35-44** | **45-54** | **55-65** |
|---|---|---|---|---|---|
| Company Survey | 1 (2.5%) | 22 (59.5%) | 7 (19%) | 6 (16.5%) | 1 (2.5%) |
| Student Survey | 249 (96%) | 11 (4%) | 0 (0%) | 0 (0%) | 0 (0%) |

| **Gender** | **Female** | **Male** |
|---|---|---|
| Company Survey | 6 (16%) | 31 (84%) |
| Student Survey | 82 (32%) | 178 (68%) |

| **Course** | **Economics (Bachelor)** | **Information Systems (Bachelor)** |
|---|---|---|
| Student Survey | 236 (91%) | 24 (9%) |

| **Sustainablity Knowledge (self-reported)** | **Expert** | **Advanced** | **Interested** | **Neutral** | **Low** | **Scarce** | **Unknown** |
|---|---|---|---|---|---|---|---|
| Company Survey | 1 (2.5%) | 10 (27%) | 9 (24.5%) | 9 (24.5%) | 4 (11%) | 2 (5,5%) | 2 (5,5%) |
| Student Survey | 0 (0%) | 5 (2%) | 107 (41%) | 96 (37%) | 29 (11%) | 23 (9%) | 0 (0%) |

| **Sustainability Importance for Company** | **Important** | **Rather Important** | **Indifferent** | **Rather unimportant** | **Unimportant** |
|---|---|---|---|---|---|
| Company Survey | 16 (43%) | 5 (13.5%) | 9 (24.5%) | 6 (16%) | 1 (2.5%) |

*Table 3. CBC Analysis Participants*

### 3.4 Data Analysis

For the evaluation of the CBC survey, the SSI Web methods "Estimate CBC Utilities Hierarchical Bayes" (CBC-HB) and "Calculate CBC Counts" were used. Under the application of a hierarchical Bayesian approach, the CBC analysis provides a higher goodness of fit, which, by comparison with other methods, is due to its better responsiveness to the individual part-worth utilities (Rossi and Allenby, 2014). Moreover, it allows for the determination of part-worth utilities for each individual subject. We determined the results of the analysis for both, the individual participants as well as aggregated for all participants. The means and standard deviations are reported for each attribute. The larger the standard deviation, the more do the individual preferences differ for the considered expression. Considering the mean values and their standard deviations, the relative importance of individual characteristics is determined. The method Calculate CBC Counts enables the determination of the relative importance of the attributes and their values on the purchase decision, the customer utility. To verify this influence, chi-square tests of independence are performed. By detecting the degrees of freedom (df) and the significance level, it can be identified whether or not there is an independence.

## 4 Analysis of the Results

The analysis of the survey data was carried out in 2 steps. Firstly, we determined the attitudes towards the environmental, social and financial aspects within the two groups (companies and students). For this purpose, the participants had to rate a number of statements (see table 4) by means of a 7-point Likert scale (from "Strongly Agree (1)" to "Strongly Disagree (7)"). The results show that in both groups a pronounced ecological attitude prevails, which is even stronger in the company group. Although rated slightly below in both groups, also the social setting is of very high importance. The financial aspects, however, are not of high relevance in both groups, but a tendency to the careful use of money is recognizable.

| # | Statement | Companies | | Students | |
|---|---|---|---|---|---|
| | | $\bar{x}$ | $\sigma$ | $\bar{x}$ | $\sigma$ |
| | ***E**cological Attitude* | | | | |
| E1 | I am concerned about the increasing pollution of the environment | 2.1 | 1.4 | 2.6 | 1.2 |
| E2 | Environmental protection is very important for me | 2.1 | 1.2 | 2.6 | 1.2 |
| E3 | I actively support the environment by proper waste separation | 2.1 | 1.1 | 2.5 | 1.3 |
| E4 | I think that more needs to be done to protect the environment | 1.9 | 1.1 | 2.2 | 1.1 |
| | ***S**ocial Attitude* | | | | |
| S1 | I support minimum wages to ensure all people have a dignified life | 2.4 | 1.4 | 2.5 | 1.4 |
| S2 | I think that respect for workers' rights is a minimum requirement for companies | 1.8 | 0.9 | 1.9 | 1.0 |
| S3 | I think that measures for occupational safety are a minimum requirement for companies | 2.0 | 1.2 | 2.0 | 0.9 |
| S4 | I would like to have family friendly working models in my company | 2.1 | 1.1 | 2.3 | 1.1 |
| | ***F**inancial Attitude* | | | | |
| F1 | It was never a goal in my life to have a lot of money | 4.1 | 1.4 | 4.8 | 1.4 |
| F2 | Money is to be spent, not to be saved | 3.5 | 1.3 | 4.0 | 1.3 |
| F3 | I go shopping with a shopping list | 3.2 | 1.6 | 3.4 | 1.8 |
| F4 | I save money regularly | 2.5 | 1.1 | 2.9 | 1.3 |

*Table 4. Attitude of Participants*

These results show that there is already a high appreciation of the 3 levels of the Triple Bottom Line within the companies. Also the future decision makers (in form of students of economics) see environmental and social issues as important points, although their ratings are persistently slightly below those of the corporate staff. Thus, the demand and perception of non-monetary issues is already a high-topic in the society and should therefore be adequately addressed by companies. These circumstances will be further analysed by the CBC analysis. The goal is to assess the utilities of the individual characteristics of a logistics service and also to be able to convert it into a target cost function.

We used the Calculate CBC counts method from SSI Web to estimate the price readiness of the customers, cf. table 5. The service properties "Modal Split" and "noise pollution" are, according to the Att. $X^2$ values and the significance level of $p < 0.01$, not significant (in the area of companies) and thus have no influence on the selection decision of a transport service. In the student group, all attributes are seen as significant at a confidence level of 99%. This means, that all service properties have an influence on the selection decision of a transport service.

To evaluate the part-worth utility of the attributes and their values, we used the Estimate CBC Utilities-HB method. The results can be found in table 6. A high positive value of an expression indicates a high positive part-worth utility, whereas a negative value represents a negative part-worth utility. These outcomes confirm the results of the CBC counts Calculate method. Remarkable is the relatively high variance, especially in the area of the price at the companies. This heterogeneity was already noticeable in the determination of the financial attitudes of the employees. Here, the opinions deviate considerably from each other in this area. As all attributes of our CBC analysis had two values, every positive part-worth utility logically faces the corresponding negative value. The various attributes and values affect the selection decisions in favour of a specific transport service to different extents. The part-worth utilities of the individual items point to their relative importance (Moore, 2004). If a stimuli contain attributes with a value that represent a high part-worth utility, the total utility is affected correspondingly strong. On the contrary, attributes and values with a low part-worth utility do not have a great influence on the total utility. The relative importance (RI) of each attribute is also shown in table 6. The quality of the model is determined by SSI Web through the use of a likelihood test.

| **Attributes** | **Companies** | | | | **Students** | | | |
|---|---|---|---|---|---|---|---|---|
| | *Hits in %* | *Within Att. $X^2$* | *D.F.* | *Significance* | *Hits in %* | *Within Att. $X^2$* | *D.F.* | *Significance* |
| Company-specific Modal Split | 49.8 | 0.0 | 1 | Not sig. | 43.1 | 90.3 | 1 | p < 0.01 |
| Sustainable Modal Split | 50.2 | | | | 56.9 | | | |
| Delivery on specific date | 62.1 | 39 | 1 | p < 0.01 | 59.5 | 169.3 | 1 | p < 0.01 |
| Delivery in specific period | 37.9 | | | | 40.5 | | | |
| Publication of greenhouse gas emissions | 59.7 | 25 | 1 | p < 0.01 | 62.6 | 296.5 | 1 | p < 0.01 |
| No publication of greenhouse gas emissions | 40.3 | | | | 37.4 | | | |
| Publication of noise pollution | 50.8 | 0.2 | 1 | Not sig. | 58.7 | 140.9 | 1 | p < 0.01 |
| No publication of noise pollution | 49.2 | | | | 41.3 | | | |
| Evidence of good working conditions exist | 61.1 | 32.5 | 1 | p < 0.01 | 70.7 | 799.2 | 1 | p < 0.01 |
| No information about working conditions | 38.9 | | | | 29.3 | | | |
| 2112 € [equ. 0.11 €/tkm] | 68.3 | 88.8 | 1 | p < 0.01 | 58.7 | 142.3 | 1 | p < 0.01 |
| 2304 € [equ. 0.12 €/tkm] | 31.7 | | | | 41.3 | | | |

*Table 5. Price Readiness of Costumers*

The results show that at company-level, the price is the most important attribute, followed by the delivery time. However, the working conditions and the publication of greenhouse gas emissions achieve similarly high values as the delivery time. In the student group, the working conditions and the release of greenhouse gas emissions are the most important attributes, followed by the delivery time. The price only comes in fifth place entailing a relatively small influence.

| Attributes | Companies | | | Students | | |
|---|---|---|---|---|---|---|
| | $\bar{x}$ | $\sigma$ | RI | $\bar{x}$ | $\sigma$ | RI |
| Company-specific modal split | -2.9 | 31.0 | 6.3% | -30.1 | 28.4 | 11.5% |
| Sustainable Modal Split | 2.9 | 31.0 | | 30.1 | 28.4 | |
| Delivery on specific date | 57.7 | 64.7 | 21.0% | 38.8 | 45.6 | 15.0% |
| Delivery in specific period | -57.7 | 64.7 | | -38.8 | 45.6 | |
| Publication of greenhouse gas emissions | 51.6 | 38.2 | 17.2% | 52.5 | 34.7 | 18.9% |
| No publication of greenhouse gas emissions | -51.6 | 38.2 | | -52.5 | 34.7 | |
| Publication of noise pollution | -2.1 | 20.7 | 4.8% | 36.3 | 27.2 | 13.4% |
| No publication of noise pollution | 2.1 | 20.7 | | -36.3 | 27.2 | |
| Evidence of good working conditions exist | 54.0 | 64.1 | 19.7% | 80.2 | 33.0 | 26.8% |
| No information about working conditions | -54.0 | 64.1 | | -80.2 | 33.0 | |
| 2112 € [equ. 0.11 €/tkm] | 91.7 | 82.6 | 31.1% | 36.1 | 40.9 | 14.3% |
| 2304 € [equ. 0.12 €/tkm] | -91.7 | 82.6 | | -36.1 | 40.9 | |

*Table 6. CBC Part-Worth Utilities*

Within the company group, there are some attributes that show large variances, especially the price attribute. For a more detailed investigation, we clustered those participants who rated each of the questions E1 to E4 with at least "Agree". The results of this analysis are shown in table 7.

| | **Companies** | | **RI** |
|---|---|---|---|
| **Attributes** | $\bar{x}$ | $\sigma$ | |
| Company-specific modal split | 0.0 | 18.6 | 3.7% |
| Sustainable Modal Split | -0.0 | 18.6 | |
| Delivery on specific date | 97.1 | 78.8 | 32.4% |
| Delivery in specific period | -97.1 | 78.8 | |
| Publication of greenhouse gas emissions | 64.0 | 54.2 | 21.3% |
| No publication of greenhouse gas emissions | -64.0 | 54.2 | |
| Publication of noise pollution | -10.3 | 10.8 | 3.9% |
| No publication of noise pollution | 10.3 | 10.8 | |
| Evidence of good working conditions exist | 99.6 | 65.8 | 33.2% |
| No information about working conditions | -99.6 | 65.8 | |
| 2112 € [equ. 0,11 €/tkm] | 16.5 | 9.6 | 5.5% |
| 2304 € [equ. 0.12 €/tkm] | -16.5 | 9.6 | |

*Table 7. CBC Part-Worth Utilities of a more Homogeneous Group of Employees*

As can be seen from table 7, the price plays only a minor role within this homogeneous group, whereas the working conditions and the publication of greenhouse gas emissions gain in relevance. Thus, these findings validate our approach to cluster participants into homogeneous groups in order to gain more consistent results.

With this knowledge, companies can prepare for more sustainable products and services, e.g., in the realm of logistics. This information cannot only be used to determine the customers' price readiness, it also facilitates target costing and thus the calculation of the available financial framework for investments in more sustainable products. In the following, we set an example. In order to have sufficient data for the analysis, we used the data collected from all companies (cf. table 5 and 6). The results (table 6) show that a price increase of 192 € is connected with a part-worth utility loss of 183.4 (range -91.7 to 91.7). A part-worth utility of 1.0 thus corresponds to a value of 1.05€, provided that a linear part-worth utility function can be assumed. With this knowledge it is possible to calculate the total utility of any product combination (stimuli) by summing up the part-worth utilities of each attribute/value pair. By using the part-worth utility function of the price, it is possible to determine how much more (or less) a costumer is willing to pay for any changes in conditions (change of values). The part-worth utility function (linear function calculated by the two given points (2,112 € = part-worth utility of 91.7 and 2,304 € = part-worth utility of -91.7 (cf. table 6))) is:

$$p(n) = 2208\text{-}1.047n \text{ (where n is the part-worth-utility)}$$

This information can be used for target costing. Through the use of the part-worth utility function, it is possible to calculate differences in prices for several product combinations, which should be illustrated in the following example. As can be seen in table 6, the price, the delivery time, the publication of greenhouse gas emissions as well as the evidence of good working conditions have a significant impact on the total utility of a transport service. Let us suppose, there is a logistics provider, who gives information about his good working conditions but does not publish any information about the corporate greenhouse gas emissions (case 1). Now, the provider wants to revise his product line and considers to measure the company's greenhouse gas emissions and to publish the measured values (case 2).

As the part-worth utility of the modal split is 0, it is not regarded anymore. The two cases are shown in table 8, as well as the corresponding part-worth utilities and the total utility.

| | **Case 1** | | **Case 2** | |
|---|---|---|---|---|
| **Attribute** | **Value** | **Part-Worth Utility** | **Value** | **Part-Worth Utility** |
| *GHG emissions* | Not published | -51.6 | Published | 51.6 |
| *Delivery …* | In period | -57.7 | In period | -57.7 |
| *working conditions* | Published | 54 | Published | 54 |
| **Total Utility** | **-55.3** | | **47.9** | |

*Table 8. Comparison of Total Utility of two Alternatives*[3]

According to the part-worth utility function of the price, case 1 has a total utility of -55.3, which has a price equivalent of € 2,265.90. Case 2 has a total utility of 47.9, which amounts to a price equivalent of € 2,157.85. Thus, case 2 is more attractive, as the price equivalent is lower. The difference of the two alternatives amounts to € 108.05. Due to the fact that case 2 represents the target status (publication of greenhouse gas emissions) at a lower price equivalent than in case 1, the difference can be used for target costing. If the (real) price of case 2 was € 108.05 higher than in case 1, the total utilities of both would be the same. Consequently, the amount of € 108.05 can be considered the target costs for investing in the publication of greenhouse gas emissions. To be more precise: insofar as the logistics provider succeeds in investing less than € 108.05 for the collection and publication of the GHG information, the investment would be advantageous and the provider would in turn earn more money than without publishing information on GHG emissions. Thus, the value € 108.05 can be used for (traditional) target costing methods.

# 5 Conclusion and Implications

This paper has shown that the three dimensions of the triple bottom line are already seen as essential decision criteria for the selection of a logistics service (cf. section 4). This was demonstrated by using two choice based conjoint analyses, one with 37 respondents from business employees and one with 260 student respondents. We discovered that in real business the price and the delivery time are the most important factors, followed by ecological issues (publication of greenhouse gas emissions) and social issues (good working conditions). These two factors are considered as similarly important as the delivery time. On the whole, though, the price is the predominant factor. But this picture may change with time, as the student analyses indicate. Within the student analyses, the social factor is the prevailing aspect, the ecological factor is in second place, and the price only plays a minor role. This could be explained by a lack of knowledge about business competition, but it could also indicate that the future decision makers and buyers adopt a more sustainable thinking.

We have also shown that there may be different groups of customers, which can be clustered and analysed separately. By means of this approach, companies are in a position to filter the requirements of different customer groups, which may be beneficial for the development of special products and, thus, may enhance customer satisfaction.

With this knowledge, companies can prepare for more sustainable products and services, e.g., in the realm of logistics. In section 4 we have furthermore shown how companies can gain knowledge about the preferences of their customers. This information cannot only be used to determine the customers' price readiness, it also facilitates target costing and thus the calculation of the available financial

[3] The part-worth utility is the utility of one attribute of a case and the total utility is the aggregated utility of all part-worth utilities of one case (e.g. in case 1: -51.6 + -57.7 + 54 = -55.3).

framework for investments in more sustainable products, which has been shown by the use of a fictitious example.

Though, our practical implications can be summed up as follows: There is already awareness for sustainable logistics services on the costumer level. Logistics provider should use methods like conjoint analysis to measure this awareness and provide adequate services or products. Furthermore they should get a better understanding of their costumers by clustering them in groups and provide individual services or products. This knowledge may lead to competitive advantages and can be used for target costing to provide the right product or service with the right price for the right group of costumers.

# 6 Limitations and Future Research

However, we are aware of the limitations of our study. First of all a limitation can be seen in the research method itself. There are studies indicating that the order of attributes and also the range of attribute values have an influence on the responses of the survey participants (Beattie and Baron, 1991; Melles, 2001). To reduce such effects, the random order of attributes is recommended (Chrzan, 1994). Due to the use of standard software we could not follow this recommendation. Furthermore the attributes in our analysis represent only a small number of the overall existing attributes to describe a logistics service. The selection was done by using the gathered knowledge from the expert survey. The restriction was necessary in order to avoid fatigue effects on the participants due to a large number of attributes (Green and Srinivasan, 1978).

Another limitation is that the survey was executed only with German participants. Furthermore we used a mixed group of companies (acting as costumer in our scenario). In practice the costumers are mostly more homogenous, though a clustering of the companies or the use of a more homogenous group may lead to other results. Though the use of students as sample is critically discussed (Gallagher et al., 2001), we outlined why they are a god sample for our experiment as they represent a significant part of the target group (Compeau et al., 2012).

Further research potential can be derived from these limitations. This study can be repeated with the use of random order of attributes to examine if there is an effect and if the results will differ from ours. Further on the study should be executed in different countries to gather information if there are different opinions regarding sustainability. In addition the study may be repeated with different company groups to gather specific insights into different branches. In order to evaluate the use of conjoint analysis for the generation of sustainable logistics services, field research and expert interviews should be conducted in companies which use these results in practice.

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