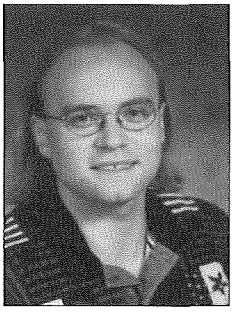
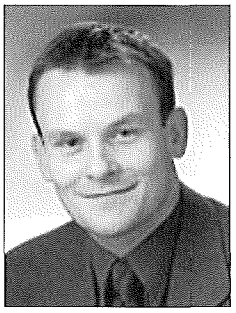
IV. The design of logistics systems by logistics practitioners – Optimal results by the use of the conjoint-analysis?

Herbert Kotzab
izredni profesor
Oddelek za menedžment
Copenhagen Business School
Danska



Thomas Reutterer
izredni profesor
Oddelek za trgovino
in marketing
Wirtschaftsuniversität
na Dunaju
Avstrija



Izvleček

Oblikovanje logističnih sistemov v logistični praksi – Optimalni rezultati z uporabo conjoint analize

Študija s pomočjo referenčnih sodb 39 logistični menedžerjev proučuje način, po katerem naj bi logistični menedžerji oblikovali idealno nabavno verigo. Literatura, ki pokriva SCM (Supply Chain Management) oz. upravljanje nabavnih verig (in še posebej ECR – Efficient Consumer Response), priporoča oblikovanje nabavnih verig bolj ali manj neodvisno od položaja posameznih členov verige, iz rezultatov naše »conjoint« analize pa izhajajo štirje idealni tipi za postavitev nabavnih verig.

Abstract

Using preference statements of 39 logistics managers, our study investigates the way, how logistics managers would design an 'ideal-type' supply chain. Although SCM-related (and especially ECR-related) literature suggests to design supply chains more or less independently from the position of respective supply chain members, we have derived four 'ideal-type' setups for supply chains based on the results of a conjoint analysis.

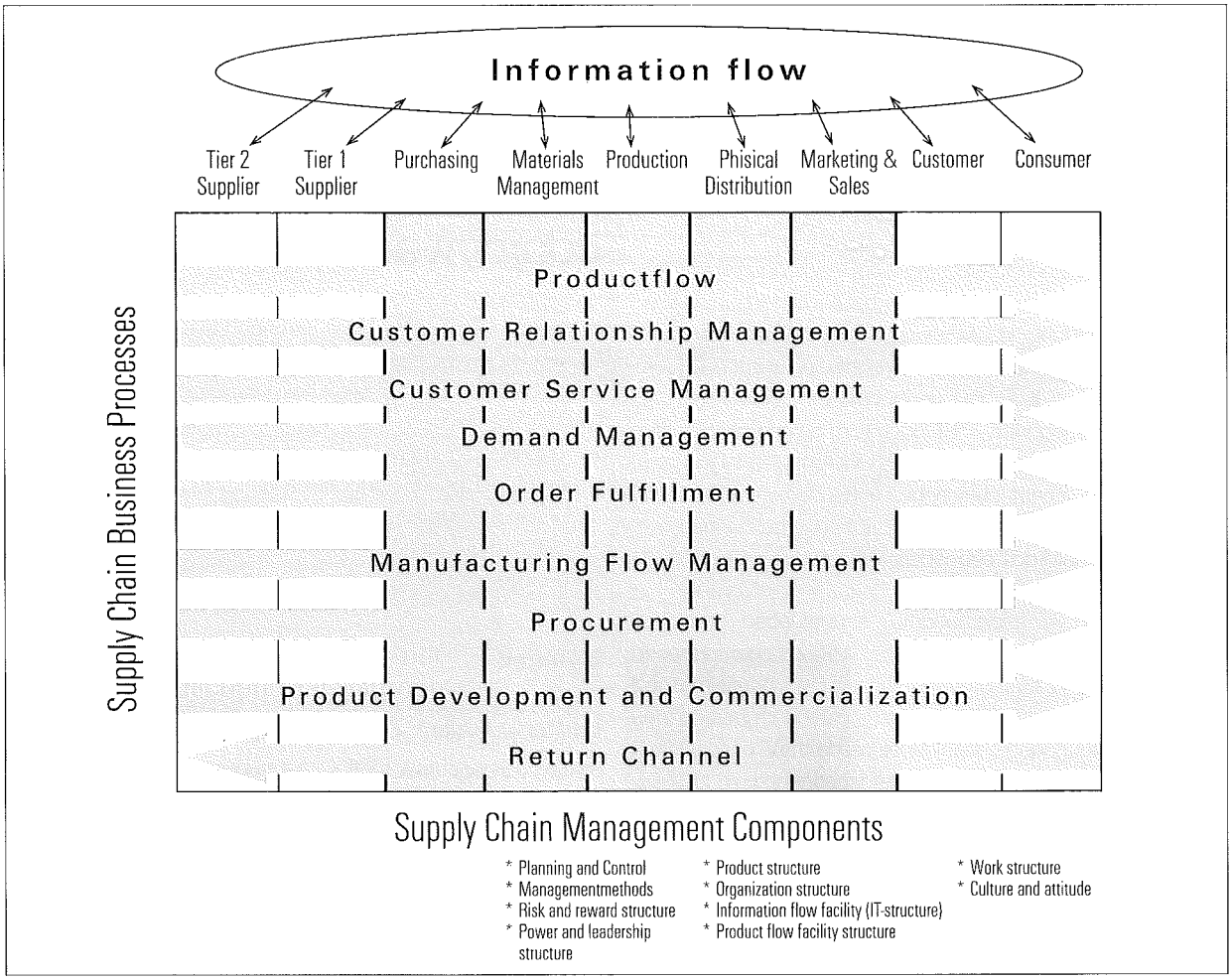
1. INTRODUCTION

Since the introduction of Efficient Consumer Response (ECR) in Europe in 1994, general thoughts on (re)designing a supply chain become more and more 'popular' amongst logisticians. Thereby, a number of different ECR-proposals assume a similar understanding of the different members of the supply chain on the way their supply chain is working[1]. In our study we investigated the validity of this assumption.

Based on an experimental design, we asked logistics managers of manufacturing, retailing/wholesaling companies and managers of third-party-providers to rate various versions of supply chain setups with respect to the question "How would you design a logistics system?" based on four

[1] Efficient Consumer Response Europe, "CEO Overview — Efficient Consumer Response", 1997.

Figure 1: The general Supply Chain Management Model as suggested by Cooper, Lambert and Pagh[8]



predetermined parameters. This approach promised to determine so-called 'ideal-type' logistics systems established on the impressions of the interviewed managers.

Our study shows that there are significant differences in the way a supply chain would be redesigned. The differences identified are not due to the position within the supply chain, but more to the size of the supply chain member (measured in sales and number of employees).

2. CONCEPTUAL CONTEXT

Supply Chain and Logistics system

Handfield and Nichols define a supply chain as "all activities associated with the flow and transformation of goods from the raw material stage (extraction), through to the end user, as well as the associated information flows[2]". This definition seems to be very closed connected with the -within the German literature - widely used term of a logistics system[3].

The difference between a logistics system and a supply chain is according to Bowersox and Closs twofold[4]:

a) a supply chain is an extended logistics system, whereby the extension refers to the inter-organizational integration
b) the trigger of a supply chain is the end user (pull instead of push orientation).

Managing the Supply Chain/Logistics System

The art of managing a supply chain (= Supply Chain Management or SCM see e.g. Houlihan[5]) is seen as the key area in increasing the overall performance of the business. Within the literature, one can find several attempts of defining the phenomena SCM. The definitions reach from »the integration of business processes from end-user through original suppliers that provides products, services, and

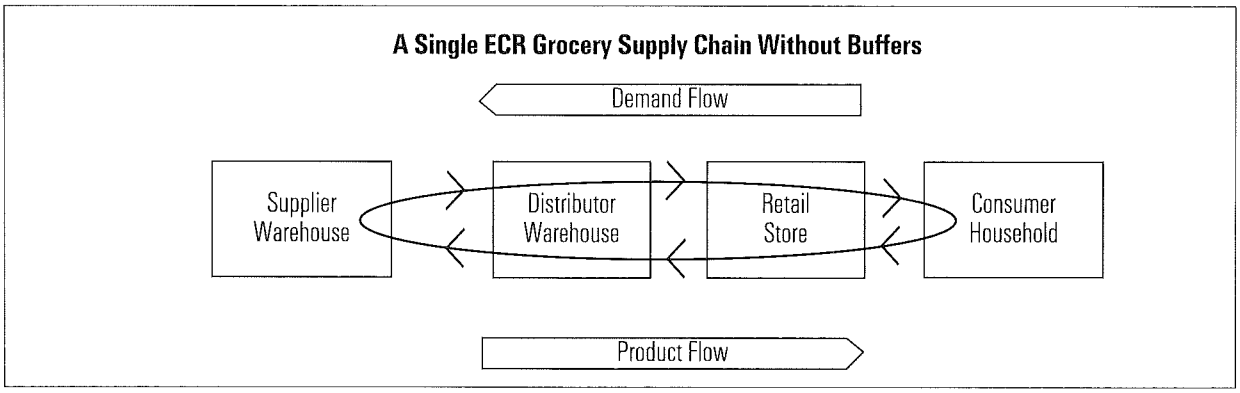
[2] Handfield, R. B., E. L. Nichols, *Introduction to Supply Chain Management*, Upper Saddle River, NJ, Prentice Hall, 1999, p. 2

[3] e.g. Pfohl, H. C., *Logistiksysteme*, Berlin, Heidelberg et al., Springer, 1995.

[4] Bowersox, H. J., D. J. Closs (1996), *Logistical Management: The Integrated Supply Chain*, New York, McGraw–Hill, p. 101.

[5] Houlihan, John, "International Supply Chain Management", *International Journal of Physcial Distribution and Logistics Management*, 1987, 51–66.

Figure 2: US ECR Model[13]



information that add value for customers[6]« by The Global Supply Chain Forum to "interfirm linkages designed to attain joint cost savings, product enhancements, and competitive services" by Cavinato[7].

In our paper, we follow the definition of Cavinato and understand SCM as a special form of strategic partnership between members of a supply chain with positive effects on the overall performance of the logistics system. Regarding to the various processes to be used for SCM we follow the SCM-model of Cooper, Lambert and Pagh, who have presented a very broad SCM-model (presented in Figure 1).

SCM aims to reduce the cycle time in the channel, to reduce total channel inventory, to avoid the duplication of costs and to increase the overall customer service[9]. This goal can be achieved by integrating and coordinating different flows of merchandise and related information, which consist between all members in a supply chain (starting with tier suppliers and ending with the final customer). Thus, SCM is replacing the 'old' logistical paradigm, where advancements in logistics service are accompanied by increased costs. The reason for turning the traditional principal upside down lies in the use of modern information technology by realizing SCM and thus realizing a just-in-time orientation within the supply chain[10]. The presented empirical SCM-examples up to now, seem to be very promising for logisticians to redesign their traditional logistics system. Within the grocery business the concept of SCM has been (partially) realized by using the concept of Efficient Consumer Response (ECR)[11].

ECR – definition, model and goal

ECR is defined as a logistical partnership between retailers and manufacturers in the grocery business with the goal to increase the performance in this business[12]. Comparing the very first ECR-model introduced by the FMI and developed by Kurt Salmon Associates (Figure 2) with the presented SCM-model (Figure 1) we can discover some similarities.

ECR also tries to integrate different members of a channel, from the vendor to the final customer. The goal of ECR is to minimize costs and increase value for the final customer[14]. Starting with the introduction of an ECR-model for the US-American grocery industry[15], the ECR-idea has been presented for different European markets, e.g. in Austria. The ECR-ideas and realizations are carried out by nationally organized ECR-movements, consisting of companies representing all member of the supply chain (in Austria: manufacturers, retailers/wholesalers and third-party-providers[16].

Problem definition – The design of a supply chain

SCM and ECR are discussing and questioning the way distribution channels are yet organized and propose the way the various supply chains should be organized in the future[17].

[6] The Global Supply Chain Forum, quoted by D. M. Lambert, J. R. Stock, and L. M. Ellram, *Fundamentals of Logistics Management*, Boston et al., Irwin, 1998, p. 504.

[7] Cavinato, J. L., "Identifying interfirm total cost advantages for supply chain competitiveness", *International Journal of Purchasing and Materials Management*, 1991,10—15.

[8] Cooper, M., D. Lambert, J. Pagh, "Supply Chain Management: More than a new name for logistics", *International Journal of Logistics management*, 1997, pp. 1—14.

[9] Lalonde, B. J., "Distributing inventory. More speed, less cost", *Chain Store Age Executive*, 1994, 18 MH — 20 MH; K. O'Laughlin, W. Copacino, "Logistics Strategy"; J. Robeson, W. Copacino (ed.), *The Logistics Handbook*, Toronto et. al., The Free Press, 1994, 57—75.

[10] Zentes J., "Effizienzsteigerungspotentiale kooperativer Logistikketten in der Konsumgüterwirtschaft"; Isermann, Heinz (ed.), *Logistik. Beschaffung, Produktion, Distribution*, Moderne Industrie, Landsberg/Lech, 1994, p. 351.

[11] Von Tucher F., H. Wiezorek "Efficient Consumer Response"; Klaus, Peter, Krieger, Winfried (ed.), *Gabler Lexikon Logistik. Management logistischer Netzwerke*, Wiesbaden, Gabler, 1998, pp. 93—99.

[12] Sherman R., "ECR Vision to Reality, Creating Innovative Strategies to Astonish Customers", Annual Conference Proceedings Council of Logistics Management, 1994

[13] Same reference as 12, p. 12.

[14] Kurt Salmon Associates, "Effici ent Consumer Response: Enhancing Consumer Value in the Grocery Industry", Washington 1993.

[15] Same reference as 1.

[16] Franzmair P. (1999), "Efficient Consumer Response", Presentation to students at the Fachhochschule üfr Marketing and Sales, February 26, 1999.

[17] Stern L., A. El-Ansary and A. T. Coughlan, *Marketing Channels, 5th Edition*, Upper Saddle River, NJ, Prentice Hall, 1996; M. Cooper, D. Lambert and J. Pagh, "Supply Chain Management: More than a new name for logistics", *International Journal of Logistics Management*, 1997, 1—14.

Especially in the ECR-related literature, the redesign-process is concentrating on four key questions (Table 1), proposing one 'perfect' supply chain, accepted by all members of this channel.

Table 1: Key questions for designing the 'ideal' ECR-supply chain

Key question	.... relates to....
(1) Who should be responsible for logistical activities?	... the problem area of make or buy of logistical activities and the concentration to the core businesses of the respective channel member.
(2) How should the concept of consolidation be implemented?	.... the problem area of centralization resp. decentralization of logistical activities and is closely related to the logistics organization of the respective channel member.
(3) How should be vertically integrated?	.... the problem area of consideration resp. non-consideration of the activities of all members within a channel in organizing the logistics activities of the respective channel member.
(4) How should the ECR-performance be measured?	... the problem area of defining the key numbers to measure the logistical performance, esp. how to evaluate the special input-output-relations within a channel.

Who should be responsible for logistical activities?

The focus of this key question is whether the individual supply chain member should make or buy supply chain activities within the supply chain. While the traditional logistics literature is concentrating this questions to the areas of inventory carrying and transportation[18], a number of authors are expanding this question to all activities[19].

A example for expanding the Make-or-buy-question to all supply chain activities is given by the Supply Chain Operations Reference Model (SCOR) of the Supply Chain Council[20]. Within this framework, SCOR examines if the activities performed in the chain should be made, delivered or sourced by the individual supply chain-member.

How should the concept of consolidation be implemented?

This strategic question aims on the way the supply chain activities are organized, especially if these activities should be consolidated (= centralized) at one point of the supply chain or broken up (= decentralized) between the members of the channel. There is some criticism in decentralizing supply chain activities. Bowersox and Closs are recognizing a causal relation between the degree of centralization and the companies profit[21]. But they suggest the concept of consolidation more for transportation capabilities within a supply chain. For Pfohl there is also a relationship between the size of the company and the centralization of supply chain activities[22]. But there is a lack on clear recommendations whether to centralize or to decentralize. It seems that the concept of centralization is very dependent on the individual situation of the supply chain member.

One example for consolidation (= centralization) as a successful SCM-strategy is given by the Consolidation Work Group of the ECR Best Practices Operating Committee. The committee admits that the realization of JIT-principles within the ECR-environment consequently leads to smaller order quantities attended by an increasing of the number of deliveries within the supply chain. The only way to solve this 'order puzzle' in an economic way for all parties participating is seen in the "opportunity for industry implementation of Consolidation"[23].

How should be vertically integrated?

This key area is focussing on the integration aspect of SCM and ECR. For Bowersox and Closs, the system integration is the key for reengineering a supply chain. Persson strengthens this suggestion by demanding both, internal and external integration as well. The power of coordination and integration is also recognized by Cooper and Ellram. The authors have thereby made a comparison between SCM and traditional logistics approaches. SCM is thereby emphasizing on a supply chain-wide integration of all activities of the supply chain members[24]. Morehouse and Bowersox call this strategy the breaking down of functional and enterprise silos towards a supply chain orientation[25]. According to Persson the success of SCM is dependent on the way integration is realized[26].

A promising example for the way integration could work can be seen in the many ECR-proposals by the various ECR-movements. The savings potentials within the different grocery industries (USA, Europe, Austria) lies between US-$ 100 million (in Austria) to US-$ 30 billion in the US. The key to achieve this potential lies in the industry-wide use of standards and processes to avoid duplication and triplication of workload[27].

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[18] e.g. Schulte C., *Logistik. Wege zur Optimierung des Material– und des Informationsflusses*, München, Vahlen, 1995; D. M. Lambert, J. R. Stock, *Strategic Logistics Management. 3rd edition*, Homewood, IL./Boston, MA, Irwin, 1993.

[19] Same references as 6.

[20] http://www.supply–chain.org/html/scor_overview.cfm, 1999–03–23, 01.13 p.m.

[21] Same reference as 3 and 16.

[22] Pfohl H.C., "Logistik als Überlebenshilfe in den achtziger Jahren", *Zeitschrift für Betriebswirtschaft*, 1983, 719–34.

[23] Consolidation Work Group ECR Best Practices Operating Committee and CSC Consulting, "Consolidation. Strategies to Maximize Efficiency and Minimize Costs", 1996, p. v.

[24] Cooper M.C., L. M. Ellram, "Characteristics of Supply Chain Management and the Implications for Purchasing and Logistics strategy", *International Journal of Logistics Management*, 1993, 13–24.

[25] Morehouse J. E., D. J. Bowersox, *Supply Chain Management. Logistics for the Future*, FMI, Washington, DC, 1995.

[26] Persson G., "Logistics Process Redesign: Some useful insights", *International Journal of Logistics Management*, 1995, 13–26.

[27] Same references as 1, 12 and 14.

How should the performance be measured?

This question is concentrating on the question how to evaluate the success of SCM or ECR. The way, how the supply chain performance is going to be measured is, according to Hewitt, a combination between efficiency and effectiveness evaluation[28]. Because of the special goal of SCM/ECR to increase service while decreasing costs, it seems that these two metrics are defined to be the cornerstones of the evaluation whether SCM fails or succeeds[29]. Handfield and Nichols also point out that the final outcome is of the greatest importance from the measurement perspective[30].

From the perspective of the analyzed literature, the SCM/ECR supply chain design problem can be reduced to the following (Table 2).

Table 2: Design components for designing a supply chain

Design component	Strategic
(1) Make or buy decision	Making or buying of supply chain activities
(2) Degree of Centralization	Centralizing or decentralizing supply chain activities
(3) Degree of vertical integration	Fully integrating or not integrating supply chain activities
(4) Performance measurement	Measuring of costs or services or both

Although the relevant literature seems to give logical answers to the design of a supply chain, we have not identified any empirical results referring to preferences and/or judgements of logisticians in deciding how to evaluate different alternatives of supply chain design.

3. THE METHODOLOGICAL CONCEPT OF CONJOINT ANALYSIS APPLIED FOR PREFERENCE ANALYSIS OF SUPPLY CHAIN DESIGN COMPONENTS

In order to study managers' perceptions towards the relative importance devoted to the SCM/ECR components outlined in Table 2, we reference on a conjoint measurement framework. In the field of marketing research, conjoint analysis and related techniques of experimental choice analysis represent widely used methodologies for measuring and analyzing consumer preferences. Excellent reviews of the numerous technical improvements in this approach to preference measurement during the last three decades are provided by contributions of Green and Srinivasan or Carroll and Green[31]. In addition, a paper of Wittink and Cattin or more recently one of Wittink, Vriens, and Burenne document the widespread diffusion of conjoint analysis in marketing practice[32]. According to the authors more than 300 conjoint studies are conducted in the U.S. and Europe per annum. The majority of these studies focus on new product evaluation, competitive and/or product positioning analysis as well as market segmentation. However, applications to the business-to-business field (as intended here) are very rare.

In contrast to multi-attribute models frequently employed for measurement of product images, conjoint measurement represents a decompositional technique for deriving part worth estimates associated with selected aspects or attributes of a choice alternative on the basis of overall preference statements of respondents. Consequently, the task of conjoint analysis is to 'decompose' the holistic information about respondents' reactions (e.g., statements or choices) to a set of stimuli into the relative importance of each level of each factor (or attributes) according to a pre-specified utility model. For subsequent analysis these part worth estimates can serve as a basis for predicting the choice probabilities of various combinations of attribute levels.

Figure 3 provides a brief outline of the steps involved in a conjoint study. First, the analyst is required to specify a set of (salient) attributes of the stimuli under study as well as the number of specific level values for each of the attributes (step 1). A possible combination of such attribute levels is frequently referred to as a 'profile'[33]. Hence, according to the attribute-level-combinations depicted in the example of figure 1 a complete factorial design would comprise $3 \times 4 \times 2 \times 3 = 72$ different profiles. To obtain individual-level part worth estimates, respondents are required to evaluate these profiles. For this purpose conventional data gathering procedures utilize well-known techniques such as (metric) rating techniques, ordinal ranking of profiles, pair comparisons or choice of the most preferred profile ('choice-based' conjoint analysis) out of the corresponding set of stimulus profiles[34]. However, especially if there is a large number of attributes and levels, even for the most involved respondent the task is often characterized as excessively demanding, time consuming, boring, and frustrating[35].

Therefore, it is usually advisable to use some 'suitably' reduced sub-sample of the complete or full set of all possible profiles for the conjoint experiment. First of all, such a reduction of stimulus space can be simply achieved by a limitation of the number of attributes and/or levels. The reduction can be done by giving the primary focus on a few

[28] Hewitt F., "Supply Chain Redesign", *International Journal of Logistics Management*, 1994, 1–9; or C. Caplice and Y. Sheffi, "A Review and Evaluation of Logistics Metrics", *International Journal of Logistics Management*, 1994, 11–28.

[29] Same reference as 20.

[30] Same reference as 2.

[31] Green P. E., V. Srinivasan, "Conjoint Analysis in Consumer Research: Issues and Outlook", *Journal of Consumer Research*, 1978, 103–123; P. E. Green, V. Srinivasan, "Conjoint Analysis in Marketing: New Developments with Implications for Research and Practice", *Journal of Marketing*, 1990, 3–19; J. D. Carroll, P. E. Green, "Psychometric Methods in Marketing Research", *Journal of Marketing Research*, 1995, 385–391.

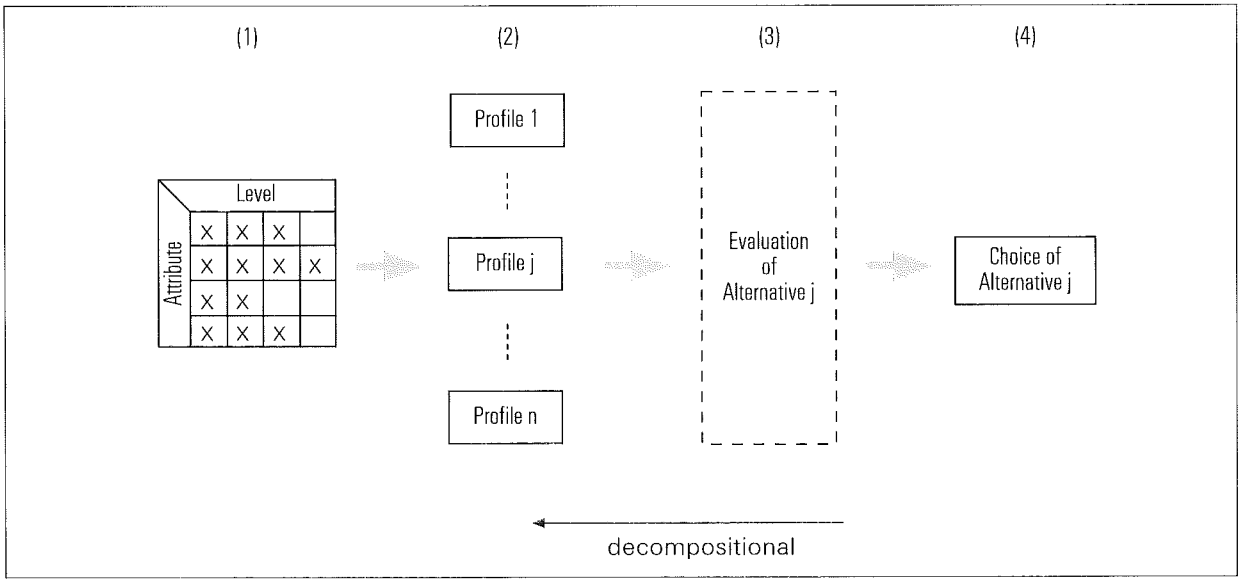
[32] Wittink D., P. Cattin, "Commercial Use of Conjoint Analysis: An Update", *Journal of Marketing*, 1989, 91–96; D. Wittink, M. Vriens, and W. Burhenne, "Commercial Use of Conjoint in Europe: Results and Critical Reflections", *International Journal of Research in Marketing*, 1994, 41–52.

[33] Green P. E., "On the design of choice experiments involving multifactor alternatives", *Journal of Consumer Research*, 1974, 61–68.

[34] Same reference as 29.

[35] Malhotra N. K., "An Approach to the Measurement of Consumer Preferences Using Limited Information", *Journal of Marketing Research*, 1986, 33–49.

Figure 3: The Conceptual Framework of Conjoint Analysis



dimensions that correspond with central aspects of how subjects perceive the stimuli type under investigation and/or managerial objectives of the respective study.

Based on the conceptual considerations outlined in section 2 of this paper, we have defined four fundamental ECR-supply-chain design-attributes with such attribute levels as listed in Table 3. Following the heuristic to use a similar number of attributes and attribute-levels as frequently recommended in the relevant literature[36], we have chosen two levels for each attribute with the exception of the three-level attribute referred to as "performance measuring" (see also section 2).

Table 3: Attributes and Attribute-levels for the conjoint-analytical research design

ECR-Supply-Chain-component (attribute):	attribute-level in the research design: $\chi_1, \ldots, \chi_4$
(1) Make-or-buy	• »make« (1) • »buy« (2)
(2) Degree of Centralization	• »centralized« (1) • »decentralized« (2)
(3) Degree of vertical integration	• »fully integrated« (1) • »non-integrated« (2)
(4) Performance measuring	• »cost-oriented« (1) • »cost-and-service-oriented« (2) • »service-oriented« (3)

Given the attributes and levels as depicted in Table 3, a complete or 'full' factorial design would require the logisticians to discriminate between 24 different profiles. Of course, this represents a heavy burden on respondents' willingness and capability to join in the evaluation task. In order to discharge respondents with this respect, we further reduced the conjoint design via construction of an orthogonal main effects plan for the attribute-level combinations from Table 3 at the cost of neglecting interaction effects between attributes. However, this results in the 'fringe benefit' of a considerable reduction of the original full factorial design to a handsome set of stimuli profiles. Assuming further an additive-compensatory utility model without interactions between attributes[37], we arrive at the following basic utility function for profile evaluation:

$$y_j = \beta_0 + \beta_1\chi_{1,j} + \beta_2\chi_{2,j} + \beta_3\chi_{3,j} + \beta_4\chi_{4(1),j} + \beta_5\chi_{4(2),j}^{\,2} + \varepsilon_j, \quad (1)$$

where y_j represents the evaluation of profile $j = 1,K,m$ observed from a specific person $i = 1,K,n$, β_0 is a constant term and β_1,K,β_5 the model parameters indicating the effect of attribute level variation on the profile evaluation to be estimated; The indicator variables $\chi_{1,j},K,\chi_{4,j}$ represent a set of dummy variables reflecting the effect-coding for the attribute-level combination of profile j and finally ε_j is an exogenous stochastic nuisance term.

Notice, that the quadratic functional form for the attribute "performance measuring" (x_4) as chosen in (1) is indicative for a concave part worth function with peak part worth values for the level 'cost-and-service-orientation'. That is what we expect for this attribute, if we are willing to assume rational choice behavior of respondents[38] (remember furthermore that each categorical variable with k categories can be re-coded into a set of k-1 dummy variables; hence, the effect-coding x_4 of the "performance measuring" attribute requires two digits).

Since we observe m profile evaluations for each of the n respondents input data arrive in an elongated $m \times n$ two-way matrix or a so-called 'stacked data' format and the dummy-regression-type model formulation described by equation (1) can be more compactly rewritten as:

$$y = Xb + e, \quad (2)$$

[36] e.g Steenkamp J. B., D. R. Wittink, "The Metric Quality of Full–Profile Judgements and the Number of Attribute Levels Effect in Conjoint Analysis", *International Journal of Research in Marketing*, 1994, 275–86.

[37] cf. e.g. Shocker A. D., V. Srinivasan, "Multiattribute Approach for Product Concept Evaluation and Generation. A Critical Review", *Journal of Marketing Research*, 1979, 159–180; J. J. Louviere, "Conjoint Analysis", R. P. Bagozzi (ed.), *Advanced Methods of Marketing Research*, Cambridge 1994.

[38] Cf. same reference as 29.

where **y** is the column vector containing the profile evaluation values of respondents, the matrix **X** resembles the (binary) indicator variables as row vectors of the predictors and **b** the column vector of the parameters to be estimated; **e** again gathers the stochastic disturbances. The remaining task for the conjoint analyst is to fit equation (2) with the observed profile evaluations collected in the empirical study.

4. EMPIRICAL STUDY AND PARAMETER ESTIMATION

For our research we have developed a two-paged questionnaire consisting of eleven ECR-Supply-Chain-design related questions and nine questions to the person interviewed. The research was conducted during the 13th Annual Conference of the Austrian Council of Logistics Management. Table 4 gives an overview to the methodological design of the research.

Table 4: Methodology of the empirical research

Data collection and survey design	• personal interview with standardized questionnaire (closed and open questions)
Population	• attendees of the 13th Annual Meeting of the Austrian Council of Logistics Management (BVL Österreich) = 136 persons
duration of the data collection	• 13. And 14.6.1997
number of collected questionnaires	• 41
number of analyzed questionnaires	• 39

With this approach chosen, the study concentrated on the 'real' logistical decision maker. The total sample of 39 data sets represents manufacturers (8), retailer/wholesaler (12) as well as third-party-providers (19). Using this sample-mix, we have covered all possible members of a supply chain. Regarding to internal and external validity of the empirical results, the data show all of the bias of the Austrian-CLM-membership base. That is, the findings can be easily transferred to the members of the Austrian CLM. The businesses of the logistics managers interviewed represent a total sales volume of approx. 1.2 billion US-D and employ more than 80.000 people all over Austria. These companies can be regarded as leading companies within Austria's economy.

The eight profiles (i.e., different combinations of attribute levels) resulting from the main effects plan plus two additional 'holdout' profiles were presented to the logistics managers for evaluation. The interviewees were asked to rank them in order of preference for adoption with respect to their individual needs (1 = most preferred, and 10 = least preferred). Since the 'holdout' profiles serve for validation purposes they were excluded from the following parameter estimation. Thus, a remaining total of 39 x 8 = 312 profile rankings can be used for estimating the part worth values of the above utility model.

Although the metric assumptions, which are underlying standard OLS-estimation procedures are likely to be violated by the use of ordinal ranking data (which, of course, is also of concern for categorical or pseudo-metric rating data with response-style bias), the results of a comparative study by Jain, Malhotra and Mahajan[39] support evidence that OLS-estimates may provide remarkably robust part worth values with respect to their predictive power. Furthermore, the nearly perfect reproduction of the original rankings for the holdout profiles (as reported below in the tables of results) based on estimated part worth values justify the usage of OLS-fitting of the data in the present study.

5. RESULTS

In this section, we first present aggregate-level results of the conjoint analysis (derived via OLS-estimation of the model parameters) by using the total sample of respondents. Subsequently, in order to account for the heterogeneity of respondents, we present and discuss the estimates resulting from two different approaches of a 'pooled' or segment-specific analysis, which in the market segmentation literature are usually referred to as a-priori or a-posteriori segmentation schemes, respectively[40]. The first 'pooled' analysis arises from an a-priori grouping of respondents according to the respective position they occupy in the supply chain. Finally, we investigate the results derived from 'pooled' analyses based on an a-posteriori or cluster-based segmentation of the sample of logistics managers.

Aggregated results from the supply chain management decision-makers perspective

Using the total sample of respondents, aggregate part worth estimates and relative importance value results for the supply-chain design components under study are as given in Table 5.

Table 5: Relative importance of the examined supply chain design components

Supply Chain design parameters	part worth estimates (n=39)	Relative Importance (per cent)	Range	standard deviation
1. Make-or-buy-decision		29.93	0-67	.2122
a) make	-.3812			
b) buy	.3812			
2. Degree of Centralization		13.75	0-57	.1404
a) centralize	.2750			
b) decentralize	-.2750			
3. Degree of vertical integration		24.73	0-80	.2083
a) integrated	.8500			
b) not integrated	-.8500			
4. Performance measuring		31.59	0-91	.1956
a) cost orientation	4.0500			
b) cost and service	5.6625			
c) service orientation	4.8375			
5. Constant value	-.1500			
Kendall's t (Profile)	.982			
Kendall's t (Holdout)	1.000			

In contrast to the absolute value of the part worth u_a contribution associated with a certain attribute or supply-chain

[39] Jain A. K., N. K. Malhotra, V. Mahajan, "A Comparison of Internal Validity of Alternative Parameter Estimation Methods in Decompositional Multiattribute Preference Models", *Journal of Marketing Research*, 1979, 313–322.

[40] For an up–to–date literature review cf., e.g., T. Reutterer, "Competitive Market Structure and Segmentation Analysis with Self-Organizing Feature Maps", P. Andersson (ed.), *Proceedings of the 27th EMAC Conference, Track 5: Marketing Research*, Stockholm 1998.

design element denoted a, the corresponding relative importance w_a of the same attribute measures the impact of the feature on the total utility of a specific supply-chain setup in relative terms. Hence, the w_a values makes the relative impact or importance of the supply-chain design components comparable to each other. For each attribute considered in our study the associated importance value is computed as follows:

$$w_a = \frac{\max_{l_a}\{u_a\} - \min_{l_a}\{u_a\}}{\sum_{a} \max_{l_a}\{u_a\} - \min_{l_a}\{u_a\}} \qquad (3)$$

Notice, that with the only exception of attribute x_4 ("performance measuring") the part worth values u_a are equivalent to the β_a-coefficients for respective attribute levels l_a. Due to it's concave nature, the partial utility contribution of the "performance measuring" attribute is given as $u_4 = \beta_4 x_{4(1),j} + \beta_5 x_{4(2),j}^2$ (see previous section).

As a consequence, the relative importance values and favorite attribute level chosen with a positive sign suggest the following preference structure in supply chain designing at the aggregate level:

- The most preferred attribute is the factor 'performance measuring' with a relative importance of approx. 32 %. The second most preferred factor is 'The make or buy decision' with an importance of approx. 30 %. Close behind in the preference ranking is the attribute 'Degree of vertical integration' with an importance of approx. 25 %. The less preferred attribute is the 'Degree of Centralization' with an importance-value of approx. 14 %.
- Hence, the 'ideal' supply chain would show a channel, where
  - the logistical activities are outsourced (part-worth-estimate + .3812),
  - the logistical activities are performed centrally (part-worth-estimate + .2750)
  - the logistical activities are fully vertically integrated (part-worth-estimate + .8500)
  - the logistical performance is measured by looking at the relationship between costs and services (part-worth-estimate +5.6625).

From a perspective of general SCM and ECR know-how the chosen 'ideal' supply chain might not be surprising. The results support the assumption that the common SCM-ideas have been already transferred into logistics practice. But, there are some remarks due to the ranking, presented by the analysis of the data.

The factors 'Performance measuring' and 'Make or buy decision' are dominating the proposed model. We interpret this result as one consequence of using SCM as powerful tool for rationalizing and reengineering the total business. The factor 'Degree of Centralization' might not be of value for the logisticians. This result is interesting, because of the number of publications presenting the consolidation of SCM-activities within a supply chain as a key strategy to reduce costs and increase service[41].

As it is also depicted in Table 5, the value of the rank correlation coefficient (Kendall's τ) which evaluates as a 'goodness-of-fit' measure the agreement between observed and (according to the estimated parameters) predicted rankings for the stimuli profiles, suggests very satisfactory estimation results; the same applies for the holdout profiles.

On the other hand, inspection of the standard deviations for the presented results indicates that there is a considerable variation of individual rankings, which is vanished by data aggregation. In order to reduce variance and to uncover one possible source of preference heterogeneity, we have segmented the preference rankings on the basis of economic sector membership of the interviewed persons (manufacturing, retail/wholesaling, third-party-provider = a-priori-segmentation).

Results of the a-priori-segmentation by channel member

Based on the a-priori segments mentioned above, separate conjoint analyses have been performed for each sub-sample. Tables 6 and 7 represent the empirical results of these segment-specific conjoint-analyses.

In comparison with aggregated results some differences in the ranking and selecting of attribute levels become obvious. These differences could be interpreted behind the SCM-theory as follows:

- While retailers and manufacturers rank the 'Make-or-buy-decision' as most important attribute, third-party-providers value the attribute 'Performance measuring' as most important. The 'Degree of Centralization' is for all segments the lowest preferred attribute. The relatively high value of the 'Performance measuring' attribute might be due to the 'pressure to succeed' of logisticians within an organization. All logisticians, independent from the position within the supply chain would measure the performance as input-/output-related number.
- The assumption that a manufacturer represents the first step within a supply chain might explain the low ranking of the 'Degree of vertically integration' from the manufacturers. Because of the importance of the output of a manufacturing logistics system for the next echelons (retailer and/or third-party-provider) as the input for their relevant logistics system[42], the representatives of these echelons consequently have ranked this attribute higher.

[41] Kotzab H., "Improving Supply Chain Performance by Efficient Consumer Response? A critical comparison of existing ECR—approaches", L. Pelton, P. Schnedlitz (eds.), *Proceedings of the 1998 American Marketing Association Marketing Exchange Colloquium, Second Edition,* Chicago, IL., American Marketing Association, 1998.

[42] Toporowski W., *Logistik im Handel. Lagerstruktur und Bestellpolitik einer Filialunternehmung,* Heidelberg, Phyisca, 1996; or J. Gattorna, "Logistics for Retailers", Gattorna, John (ed.), *Insights in Strategic Retail Management,* West Yorkshire, MCB University Press, 1985, 150–63.

Table 6: Aggregated empirical Conjoint-Results compared with the results of the analysis of the a-priori-segments

		A-Priori-Segment2		
	Total (n=39)	R/W (n_1=12)	TPP (n_2=19)	M (n_3=8)
Attribute		*part-worth-estimates*		
1. *Make-or-buy-decision*				
a) make	-.3812	.0208	-.6579	-.3750
b) buy	.3812	-.0208	.6579	.3750
2. *Degree of Centralization*				
a) centralize	.2750	.3333	.2105	.2813
b) decentralize	-.2750	-.3333	-.2105	-.2813
3. *Degree of vertically integration*				
a) fully integrated	.8500	.9167	1.0263	.2812
b) non-integrated	-.8500	-.9167	-1.0263	-.2812
4. *Performance measuring*				
a) cost-oriented	4.0500	3.1667	3.8947	4.7500
b) cost- and service-oriented.	5.6625	4.2917	5.5526	6.6875
c) service-oriented	4.8375	3.3750	4.9737	5.8125
5. *constant value*	-.1500	1.0000	-.0789	-1.0000
Kendall's τ (Profile)	.982	1.000	.982	.857
Kendall's τ (Holdout)	1.000	1.000	1.000	1.000
Attribute		*Relative importance of the attributes w_a (per cent)*		
1. *Make-or-buy-decision*	29.93	32.02	24.80	42.72
2. *Degree of Centralization*	13.75	17.55	11.82	12.00
3. *Degree of vertically integration*	24.73	25.50	29.66	11.03
4. *Performance measuring*	31.59	24.93	33.71	34.24
		Range		
1. *Make-or-buy-decision*	0-67	0-64	0-53	0-67
2. *Degree of Centralization*	0-57	0-53	0-57	0-28
3. *Degree of vertically integration*	0-80	0-62	0-80	6-21
4. *Performance measuring*	0-91	0-53	0-91	1-83
		Standard deviation		
1. *Make-or-buy-decision*	.2122	.2257	.1833	.2120
2. *Degree of Centralization*	.1404	.1745	.1378	.0946
3. *Degree of vertically integration*	.2083	.2039	.2377	.0483
4. *Performance measuring*	.1956	.1496	.1970	.2526

R/W = Retail/Wholesale; TPP = Third Party Provider; M = M

Table 7: 'Ideal' supply chain design preferences

		A-Priori-Segment		
	Total (n=39)	R/W (n_1=12)	TPP (n_2=19)	M (n_3=8)
Attribute		*'ideal' system result*		
1. *Make-or-buy-decision*				
a) make		Make		
b) buy	buy		buy	buy
2. *Degree of Centralization*				
a) centralize	centralize	centralize	centralize	centralize
b) decentralize				
3. *Degree of vertically integration*				
a) fully integrated	integrate	integrate	integrate	integrate
b) non-integrated				
4. *Performance measuring*				
a) cost-oriented				
b) cost- and service-oriented	c/s	c/s	c/s	c/s
c) service-oriented				
5. *constant*	-.1500	1.0000	-.0789	-1.0000

R/W = Retail/Wholesale; TPP = Third Party Provider; M = Manufacturer

- The tendency of permanent reengineering processes at the manufacturers level[43] could be one reason for the high ranking of the 'Make-or-buy decision' by manufacturers.
- The call for concentrating on core competencies consequently might explain the fact, that manufacturers have chosen the 'buy'-attribute level, while retailers have chosen the 'make'-attribute-level of this special attribute.

Although the results seem to be trustworthy, the results of conventional ANOVA-analyses clearly deny the differences to be taken as significant. Even if one wishes to account for the relatively small sample-sizes, the more robust Kruskal-Wallis test statistics (as an non-parametric equivalent of the ANOVA) confirms the non-significance of the differences. In addition, the various ranges and standard deviations show that also these segment-specific results possess high variations.

As a consequence, the assumption that the a-priori-classification scheme by channel-member-position would lead to a reduction of the variance cannot be supported. This criteria alone cannot explain the individual deviation in the ranking of the attribute and attribute-levels. It seems that the combination of other factors (such as company size, sales volume, product range, number of procurement and distribution relations, etc.) should be considered as further predictors for an adequate explanation of the differences in relative importance associated with the supply-chain features. Therefore, we applied an 'unsupervised' classification scheme for the respondents via employment of cluster analysis on the individual preference rankings.

Cluster-Solution

The evaluation of summed within-group variances (sum of squared errors) for various levels of hierarchical cluster analysis results suggested to focus our further analysis on a four-cluster solution. Table 8 presents the conjoint results derived separately for each of the a-posteriori formed segments or sub-samples:

[43] Hammer M., J. Champy, *Reengineering the coroporation: A manifesto for business revolution*, New York, NY, Harper Collins, 1994; Roos and others: J. Womack, D. Jones, D. Roos, *The machine that changed the world. The story of lean production*, New York, NY, Harper Collins, 1991.

Table 8: Relative importance of the examined Supply-Chain-design-components – a-posteriori-segmentation compared with the aggregated results

Attribute	*Total*	*Clusters* Cluster 1 (n = 11)	Cluster 2 (n = 13)	Cluster 3 (n = 6)	Cluster 4 (n = 10)
		part-worth-estimates			
1. Make-or-buy-decision					
a) make	-.3812	-.0227	-.5385	1.9583	-1.9750
b) buy	.3812	.0227	.5385	-1.9583	1.9750
2. Degree of centralization					
a) centralize	.2750	.7045	-.0962	.4167	.2000
b) decentralize	-.2750	-.7045	.0962	-.4167	-.2000
3. Degree of vertically integration					
a) fully integrated	.8500	.4091	1.8077	.2917	.4250
b) non-integrated	-.8500	-.4091	-1.8077	-.2917	-.4250
4. Performance measuring					
a) cost-oriented	4.0500	10.0000	1.3846	2.3333	2.0000
b) cost- and service-oriented.	5.6625	13.7500	2.0577	3.2917	2.8750
c) service-oriented	4.8375	11.2500	2.0192	2.8750	.26250
5. Konstant value	-.1500	-6.7500	2.7885	1.7917	2.1250
Kendall's τ (Profile)	.982	.857	.995	.992	.786
Kendall's τ (Holdout)	1.000	1.0000	1.0000	1.0000	1.000
Attribute		*relative importance of the attributes w_a (per cent)*			
1. Make-or-buy-decision	29.93	11.93	15.98	55.74	52.38
2. Degree of Centralization	13.75	18.64	12.50	13.60	10.09
3 Degree of vertically integration	24.73	13.71	50.28	10.01	12.45
4. Performance measuring	31.59	55.73	21.24	20.65	25.07
		A-Posteriori-Segments			
Range	*Total*	Cluster 1 (n = 11)	Cluster 2 (n = 13)	Cluster 3 (n = 6)	Cluster 4 (n = 10)
1. Make-or-buy-decision	0-67	0-38	0-29	50-64	40-67
2. Degree of Centralization	0-57	0-57	0-42	0-29	0-19
3. Degree of vertically integration	0-80	0-31	24-80	0-21	6-21
4. Performance measuring	0-91	21-91	0-35	10-36	14-21
Standard deviation	*Total*	Cluster 1 (n = 11)	Cluster 2 (n = 13)	Cluster 3 (n = 6)	Cluster 4 (n = 10)
1. Make-or-buy-decision	.2122	.1025	8.479E-02	4.554E-02	6.722E-02
2. Degree of Centralization	.1404	.1996	.1332	.1315	5.726E-02
3. Degree of vertically integration	.2083	.1129	.1383	9.275E-02	5.680E-02
4. Performance measuring	.1956	.1983	.1079	9.053E-02	5.214E-02

Compared with the overall results, we can identify the following segment-specific results:

- Cluster 1 represents a very performance-oriented supply chain where the 'Degree of Centralization' is also of high importance. The other two components do have low importance for this cluster.
- Cluster 2 can be interpreted as integration-oriented supply chain with a high attitude to 'Performance measuring'. Logisticians of this supply chain prefer the decentralization effects, while all the others prefer the centralization effects.
- The clusters 3 and 4 seem to be very similar. Both systems rank the dimension of 'Make-or-buy' and the 'Performance measuring' as very important for their supply chain. While the cluster 3-logisticians prefer the make-attribute-level, the cluster 4-logisticians prefer the "buy"-attribute level (as the other two clusters too).
- Due to the integration and performance measuring attribute levels we could not identify any differences between the clusters.

The inspection of the relative importance values in Table 8 clearly uncovers well separated groups of respondents with distinctive segment-specific preference patterns (ANOVA for the differences in relative attribute importance values provide significant results even at the level of $p < 0.005$). Table 9 shows the attempt of describing the identified clusters by selected variables with associated significance levels (sales, number of employees, channel member position, industry, logistics costs, existence of a logistics department, number of outlets, number of vendors).

Table 9: Description of the 'ideal' supply chains

Describing Varialbe	Total (n = 40)	A-Posteriori-Segments Efficient supply chain (n = 11)	Integrated supply chain (n = 13)	Make supply chain (n = 6)	Buy suply chain (n = 10)
Sales					
Average	709,40	358,11	573,13	2329,60	296,39
standard deviation	1369,76	512,26	1117,05	2722,44	297,79
Range	1-5600	8-1400	1-4000	170-5600	1,1-800
Number of employees					
Average	349	817	2044	7146	306
standard deviation	650	2010	5487	10751	453
Range	1-22000	4-6500	1-20000	70-22000	1-1500
Number of vendors/suppliers					
Average	571	349	145	2065	129
standard deviation	2159	650	199	4868	328
Range	1-12000	1-2000	10-500	6-12000	1-1000
Number of outlets					
Average	137	43	138	486	5
standard deviation	408	126	430	753	5
Range	0-1600	0-400	1-1500	1-1600	1-17
Logistics costs					
Average	21,18	25,84	23,56	9,28	23,00
standard deviation	20,36	14,90	10,72	10,23	35,38
Range	1-100	5-50	4,9-40	3-30	1-100
Logistics department					
Existing	47,5 %	72,7 %	38,5 %	50 %	30 %
not existing	52,5 %	27,3 %	61,5 %	50 %	70 %
Economic sector					
Retail	30,8 %	30 %	30,8 %	50 %	20 %
Manufacturing	20,5 %	20 %	0 %	33,3 %	40 %
Third-Party-Provider	48,7 %	50 %	69,2 %	16,7 %	40 %

ANOVA		Chi-Square	
Sign. of F - sales	**.029**	Pearson logistics department	.214
Sign. of F - number of employees	**.084**	Pearson economic sector	.194
Sign. of F - number of vendors/suppliers	.316		
Sign. of F - number of outlets	.114		
Sign. of F - logistics costs	.465		

Taking this additional descriptive information about group members into account, we can describe the identified divergent requirements on an 'ideal-type' supply chain as follows:

- **Efficient supply chain,** where the attribute of ‚Performance measuring' is the most important criteria for designing the supply chain. By considering the input-output-relations of a supply chain, logisticians of such a

supply chain concentrate on costs as well as services of the logistics performance. Due to the fact, that such logisticians rank the ‚Concept of Centralization' as second most important attribute, they should know about the economies of scale of intelligent logistics solutions and trust the effects of consolidation. This supply chain consists of small to medium sized enterprises of all economic sectors examined by our research. Compared to the total results, these companies do have lower average sales but more employees than the total sample. The number of logistical relations (= number of vendors and number of outlets) is also below the total average of the sample. Companies of this structure are more and more forced to look for efficiency in order to 'survive'.

- **Integrated supply chain,** where the vertical integration of all the activities performed by the different members of the supply chain is the most important attribute for the supply chain design. The companies within such a supply chain can be interpreted as medium sized retail businesses and/or third-party-providers. Their logistical performance is very dependent from the performance of their partners. Despite the fact of a small number of vendors and a moderate number of outlets, their logistics costs are above average of the total sample. This might lead to the assumption of some efficiencies in the system, which could be removed by integration.
- **Make supply chain** where SCM is seen as one core competence of the business. The typical enterprise of such a supply chain is a large retailing company, regarding to average sales and number of employees. Also the number of logistical relationships is higher compared to the average number of the total sample. However, the logistics costs are below average. It seems that make-logisticians are able to perform better than others.
- **Buy supply chain**, which is the opposite of the make-supply chain. The typical company in this channel is a small and medium sized manufacturer. The buying aspect might be due to the lack of an logistics department within the company. Consequently the make-logistician might be responsible for more business functions than logistics. The structure of these companies might not support economies of scale in performing logistics, therefore the buy-logistician outsources logistics.

6. CONCLUSION AND OUTLOOK

In our study, we have identified different expectations to 'ideal' supply chains by using a conjoint-analytical approach. Although the SCM-relevant literature implies one 'ideal' supply chain, we have identified at least another four ways in evaluating an 'ideal' supply chain. The presented information might be of value for the success of CM-partnerships between different members of a supply chain. Therefore, the different negotiators should first examine which type of supply chain is seen as 'ideal' by the counterpart.

Our results should be interpreted by the following restrictions:

- The 'ideal' system is based on a pre-selection, which we have executed by analyzing the literature.
- We did not examine if these parameters are the only parameters to be used for designing supply chain.
- We did not examine in which way the 'ideal' systems correspond with the real logistic system of the interviewed logistician
- Also, we concentrated on logisticians, while ECR is suggesting to extend the logistics perspective to managers of other business areas (e.g. marketing, IT, controlling, etc.).

These restrictions presented should be seen as future field of research in this area.