HORIZONTAL COOPERATIVE PURCHASING

Fredo Schotanus

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DISSERTATION

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by

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Chapter 1

Introduction

Purchasing functions of organizations involve a great deal of organizational costs due to the purchase of required products and services. In business organizations such as manufacturers, costs due to purchase prices account for 60% to 90% of the total turnover (Telgen and Boer, 1997). For service providers, this percentage is typically a hefty 35% (Degraeve and Roodhooft, 2001). In governmental organizations such as municipalities, the purchasing portion accounts on average almost 60% (Harink et al., 1999).

There are also quite some organizational costs involved with transactions associated with the purchase of required products and services. These transaction costs are more difficult to quantify than costs due to purchase prices. Nevertheless, as organizations make a lot of effort trying to reduce purchasing transaction costs by means of, among other things, e-procurement (Reunis et al., 2007) and supplier reduction (Cousins, 1999), it can be assumed that purchasing transaction costs are substantial as well.

As we discuss in the next section of this thesis, typical advantages of horizontal cooperative purchasing are, among other things, lower purchase prices of required products and services due to economies of scale and lower transaction costs due to reduced duplications of efforts and activities. Thus, at least in theory, horizontal cooperative purchasing can be quite a beneficial concept for business and governmental organizations. The remainder of this chapter further discusses this concept.

In the next section, we provide the background of the thesis. Next, we briefly discuss the relevant previous research. In Section 1.3, we develop the rationale for this thesis. Section 1.4 discusses the content of the thesis and the links between the chapters in some more detail. In the final section, we describe the line of research on which this thesis builds[1].

1.1. Research background

This section provides the background of the thesis. First, we define the concept of horizontal cooperative purchasing. Next, we describe typical advantages and disadvantages of the concept. Finally, we discuss whether horizontal cooperative purchasing differs from cooperating in other fields.

1.1.1. Definitions

We define purchasing groups as organizations in which horizontal cooperative purchasing processes take place, either formally or informally, or through a third party. We define

[1] Parts of this chapter are based on Schotanus, F., Telgen, J., 2007. Developing a typology of organizational forms of cooperative purchasing. Journal of Purchasing and Supply Management 13 (1), 53–68 and on Walker, H.L., Eßig, M., Kivisto, T., Schotanus, F., 2007. Co-operative purchasing in the public sector. In: Knight, L.A. et al. (Eds.). Public procurement: International cases and commentary.

horizontal cooperative purchasing as the operational, tactical, and/or strategic cooperation between two or more organizations in one or more steps of the purchasing process by pooling and/or sharing their purchasing volumes, information, and/or resources in order to create symbiosis. Examples of symbiotic relationships are mutualism and parasitism (Johnson et al., 1997). We label a purchasing group mutualistic if all group members experience a positive effect. If at least one member experiences a negative effect, then the purchasing group is labeled parasitic.

In purchasing groups, preferably mutualistic relationships are created in which all members benefit in a fair way by cooperating. If the members benefit in a fair way, then this may motivate them to engage in group-oriented behavior (Tyler, 1999), thereby being conducive of cooperation (Tyler and Degoey, 1995; Vugt and Cremer, 1999).

Horizontal cooperative purchasing has so far been loosely defined in the literature. It is referred to as horizontal cooperative purchasing, group purchasing, collaborative purchasing, joint purchasing, and this list goes on to more than one 150 terms as illustrated in Table 1.1. Thus, despite the fact that the concept of horizontal cooperative purchasing is as old as ancient Egypt and Babylon (Wooten, 2003), the terminology is broad and not yet fully stabilized (Eßig, 2000; Kivisto et al., 2003). In the literature, group purchasing and cooperative purchasing are among the most frequently used terms. In the remainder of this thesis, the terms 'cooperative purchasing' and 'purchasing group' are used. In Section 1.1.4, we further discuss the term 'horizontal'.

Table 1.1 Cooperative purchasing terms

No.	Term	No.	Term	No.	Term
1	Group purchasing	58	Partnership purchasing	115	Conglomerate buying
2	Joint procurement	59	Purchasing co-op	116	Interorganizational procurement
3	Joint purchasing	60	Common sourcing	117	Procurement cluster
4	Buying group	61	Third party buying	118	Procurement union
5	Cooperative purchasing	62	Unified procurement	119	Sourcing consortium
6	Combined purchasing	63	Purchasing collaborative	120	Coalition purchasing
7	Purchasing group	64	Third party procurement	121	Coalition sourcing
8	Procurement group	65	Sourcing partnership	122	Communal buying
9	Collaborative procurement	66	Cooperative sourcing	123	Concerted procurement
10	Collective purchasing	67	Pool buying	124	Buying cluster
11	Purchasing cooperative	68	Procurement collaborative	125	Buying conglomerate
12	Common procurement	69	Consortium procurement	126	Cluster purchasing
13	Group buying	70	Group sourcing	127	Purchasing cluster
14	Purchasing consortium	71	Pool procurement	128	Purchasing combination
15	Shared procurement	72	Pooled buying	129	Buying collaborative
16	Purchasing pool	73	Buying co-op	130	Cluster procurement
17	Buying consortium	74	Union buying	131	Communal procurement
18	Purchasing consortia	75	Buying alliance	132	Concerted purchasing
19	Collective buying	76	Procurement alliance	133	Interorganizational purchasing
20	Common purchasing	77	Consortia procurement	134	Pooled sourcing
21	Unified purchasing	78	Alliance purchasing	135	Procurement pool
22	Cooperative procurement	79	Unified buying	136	Buying combination
23	Combined buying	80	Bundled procurement	137	Coalition buying
24	Purchasing alliance	81	Purchasing collective	138	Combination procurement
25	Cooperative buying	82	Sourcing alliance	139	Procurement coalition
26	Group procurement	83	Co-op purchasing	140	Sourcing collective

No.	Term	No.	Term	No.	Term
27	Procurement partnership	84	Alliance sourcing	141	Sourcing consortia
28	Joint buying	85	Co-op buying	142	Sourcing cooperative
29	Collaborative purchasing	86	Combined sourcing	143	Syndicate buying
30	Consortium purchasing	87	Alliance procurement	144	United sourcing
31	Buying cooperative	88	Procurement cooperative	145	3rd party procurement
32	Pooled procurement	89	Shared buying	146	Amalgamated buying
33	Pooled purchasing	90	Mutual purchasing	147	Bundled sourcing
34	Buying consortia	91	Sourcing collaborative	148	Cluster buying
35	Shared purchasing	92	Collective sourcing	149	Cluster sourcing
36	Sourcing group	93	Sourcing pool	150	Combination sourcing
37	Partnership sourcing	94	Consortium sourcing	151	Conglomerate purchasing
38	Collaborative sourcing	95	Bundled purchasing	152	Consortia sourcing
39	Combined procurement	96	Buying union	153	Co-op procurement
40	Partnership procurement	97	Partnership buying	154	Multiparty buying
41	Buying pool	98	Purchasing union	155	Procurement co-op
42	Collective procurement	99	Alliance buying	156	Purchasing league
43	Procurement consortia	100	Buying partnership	157	Sourcing coalition
44	Shared sourcing	101	Buying collective	158	Sourcing combination
45	Procurement consortium	102	Mutual sourcing	159	Sourcing union
46	Union procurement	103	Union purchasing	160	Buying league
47	Common buying	104	Buying coalition	161	Coalition procurement
48	Consortia purchasing	105	Buying syndicate	162	Combination buying
49	Pool purchasing	106	Concerted buying	163	Co-op sourcing
50	Third party sourcing	107	Mutual buying	164	Interorganizational buying
51	Joint sourcing	108	Procurement collective	165	League purchasing
52	Consortium buying	109	United buying	166	Multi-party procurement
53	Purchasing coalition	110	Mutual procurement	167	Procurement combination
54	Collaborative buying	111	Unified sourcing	168	Purchasing conglomerate
55	Purchasing partnership	112	Amalgamated purchasing	169	Syndicate purchasing
56	Third party purchasing	113	Bundled buying	170	Union sourcing
57	Consortia buying	114	Combination purchasing	171	United procurement

Note: The terms are ranked on frequency of use in combination with the term ‘economies of scale’ on the Internet

1.1.2. Advantages and disadvantages

Typical advantages of cooperative purchasing are more or less similar to advantages of coordinated or centralized purchasing in an organization. The advantages follow from factors such as economies of scale (Rozemeijer, 2000), a reduced number of transactions between suppliers and buyers (Tella and Virolainen, 2005), improved relationships with suppliers and other organizations in a purchasing group, and stronger negotiation positions. Examples of advantages of cooperative purchasing are reduced purchase prices (Nollet and Beaulieu, 2003), learning from each other (Nollet and Beaulieu, 2005), sharing experiences and information, higher product and service quality, reduced (supply) risks, better access to resources and markets, and reduced workloads and transaction costs.

Reported disadvantages of cooperative purchasing follow from factors such as an increased complexity of the purchasing process (Tella and Virolainen, 2005) and loss of flexibility and control. Examples of disadvantages of cooperative purchasing are increased coordination costs (Johnson, 1999), member commitment issues (Doucette, 1997), possible interference by anti-trust legislation (Hendrick, 1997), disclosure of sensitive information (Polychronakis and Syntetos, 2007), supplier resistance (Hendrick, 1997), the fear of free-

riding group members (Hendrick, 1997), set-up costs, having to change specifications, and losing existing relations with suppliers. In addition, a purchasing group can have a negative impact on the supply market in the long run. A large group may cause suppliers to withdraw from the market or merge with other suppliers (Nollet and Beaulieu, 2005) and new suppliers might encounter market entry barriers (Zweig and Zellner, 1998). Also, under certain circumstances, the purchase price can increase due to cooperative purchasing. This can be the case when a purchasing group becomes so large that only a very limited number of suppliers is able to supply the group. In such situations, advantages besides lower purchase prices are decisive motives for cooperative purchasing. Otherwise, individual purchasing might be more interesting than cooperative purchasing.

1.1.3. An emerging concept

Cooperative purchasing is an emerging concept in several sectors, more and more private and public organizations combine their purchasing power for increased economies of scale and reduced transaction costs (Carter et al., 2000; Doucette, 1997; Hendrick, 1997; Johnson, 1999; Nollet and Beaulieu, 2003, 2005; Polychronakis and Syntetos, 2007; Rozemeijer, 2000; Sickinger, 1996; Tella and Virolainen, 2005; Zentes and Swoboda, 2000). In some sectors, the concept of cooperative purchasing has already been established and has been proven to be beneficial. Examples of such sectors are the health sector in the United States (US) and the higher education sector and library sector in the US, the United Kingdom, and Australia (Walker et al., 2007).

Indicated reasons for the trend towards cooperative purchasing are:

- Increased awareness and importance of purchasing (Ellram and Carr, 1994);
- Increased levels of organizational cost pressure (Hendrick, 1997; Johnson, 1999; Nollet and Beaulieu, 2005);
- Increased wishes to counterbalance the power of large suppliers (Kamann et al., 2004; Nollet and Beaulieu, 2005);
- Not all purchasing activities are core activities of organizations and can be outsourced (Ramsay, 2001). Some non-core purchasing activities can be outsourced by means of cooperative purchasing;
- Shifting organizational agendas from a short-term view and internal focus to a long-term view and external relationship focus (Dobler, 1996; Eßig, 2000; Leenders, 1998);
- The development of e-procurement (Corsten and Zagler, 1999; Huber et al., 2004).

1.1.4. Horizontal cooperation versus vertical cooperation

In the literature, several general types of cooperation are distinguished. A main distinction between the types of cooperation can be made by distinguishing between horizontal buyer-buyer or seller-seller cooperation and vertical buyer-seller cooperation. When referring to horizontal cooperation, concepts apply such as shared service centers, horizontal alliances, and horizontal cooperative purchasing. When referring to vertical cooperation, concepts apply such as co-makership, vertical alliances, and public-private partnerships.

In this thesis, we focus on horizontal cooperation between buying organizations. Horizontal cooperative purchasing distinguishes itself from cooperating in other fields – as buyer-seller alliances – by, among other things, the number of cooperating organizations. For instance, the number of cooperating organizations is often low in vertical technical alliances. In such

alliances, the focus is not so much on scale (i.e., scale alliances), but on complementing technical capabilities (i.e., link alliances). To obtain economies of scale in horizontal buyer-buyer relationships, purchasing groups may have a (very) large number of participating organizations. Typically, it is more difficult to manage many cooperating organizations than a very limited number (Hoffmann and Schlosser, 2001). In addition, as we discuss in this thesis, the wide range of possible numbers of members of a purchasing group plays a role in different purchasing group types.

An additional difference between horizontal and vertical cooperation concerns the cooperation theme. In vertical buyer-seller cooperation, among other things, new technologies or skills may be developed and processes may be improved or geared to one another. In horizontal buyer-buyer cooperation, (the development of) specific purchasing themes plays an important role, such as spend analyses. In addition, as we discuss in this thesis, quantity discounts and the allocation of cooperative savings involve some specific issues for purchasing groups.

Summarizing, the literature on vertical alliances and vertical relationships may not be fully applicable to horizontal buyer-buyer cooperation. Nevertheless, in this thesis, we take into account the relevant existing knowledge on alliances, such as knowledge on interorganizational trust and free-riding issues.

1.2. Previous research

Cooperative purchasing is not new, both in practical application and scientific research. According to Eßig (2000), Mitchell (1927) and Gushée and Boffey (1928) already referred to cooperative purchasing.

The long tradition of cooperative purchasing has led to two outcomes. On the one hand, there seems to be a lot of literature mentioning purchasing groups or purchasing consortia. On the other hand, research on cooperative purchasing is still in its infancy (Eßig, 2000). Most sources on cooperative purchasing are found in textbooks and professional publications are often descriptive. Thus, especially compared to vertical buyer-seller cooperation, horizontal buyer-buyer cooperation has not been a major research area until now (Ellram, 1991; Eßig, 2000; Laing and Cotton, 1997; Patterson et al., 1999; Tella and Virolainen, 2005).

Academic research that has been done on cooperative purchasing has contributed to describing and analyzing several cooperative purchasing topics under different settings and circumstances[2]. The existing research findings are categorized as follows:

- Advantages and disadvantages of cooperative purchasing (Ball and Pye, 2000; Evans, 1987; Hone, 1974; Johnson, 1999; Nollet and Beaulieu, 2005; Stinchcombe, 1984; Tella and Virolainen, 2005);
- Coordination structures of purchasing groups (Enthoven, 1994; Galaskiewicz, 1985);
- (Critical) success factors, drivers, and preconditions for cooperative purchasing (Doucette, 1997; Eßig, 2000; Exworthy and Peckham, 1998; Hendrick, 1997; Huber et al., 2004; Laing and Cotton, 1997);

[2] In Chapter 2, the existing literature is discussed in more detail.

- Development of purchasing groups over time (D'Aunno and Zuckerman, 1987; Johnson, 1999; Nollet and Beaulieu; 2003).
- Formation of purchasing groups in electronic marketplaces (Granot and Sošic, 2005; Yuan and Lin, 2004);

The academic sources described above do cover relevant topics. Still, some gaps exist in the cooperative purchasing literature. We found gaps in the research method used, as little large-scale empirical research exists. Gaps are also apparent in several research areas, as we found no academic publications related to, among other things, the following research questions:

- **Communication**
  In their study, Laing and Cotton (1997) found that communication was almost uniformly viewed as problematic by purchasing groups. A related research question is: How to develop an effective and efficient communication structure for a purchasing group?
- **Economics**
  According to Kalinzi (2005), several studies have concluded that retail prices of some essential drugs are higher in developing countries than in developed countries (MOHU et al., 2004; MSF and HAI, 2000). This is attributed to high overhead costs paid on importation, clearing, handling, verification, and license charges. Cooperative purchasing might reduce such costs. Thus, the following research question can be formulated: How can cooperative purchasing benefit organizations in developing countries?
- **Entrepreneurship**
  Small and Medium-sized Enterprises (SMEs) are often interested in the concept of cooperative purchasing, but many SMEs believe that SME purchasing groups are not feasible (Quayle, 2002a). Therefore, an interesting research question seems: How can cooperative purchasing benefit SMEs?
- **Finance and accounting**
  Reasons reported for failure or stagnation of purchasing groups, such as lack of commitment (Doucette, 1997), group instability (Heijboer, 2003), and fear of free-riding group members (Hendrick, 1997) are often related to the way the purchasing group's savings are allocated (Heijboer, 2003). Therefore, we pose the research question: How to allocate the savings of a purchasing group between the members of the group?
- **General and strategy journals**
  There is little evidence on how purchasing groups evolve over time on a micro-evolutionary level (i.e., a detailed level), which leads to a lack of understanding of purchasing group development. This is unfortunate as dynamics are important in collaboration processes (Ring and Ven, 1994). Thus, an interesting research question seems: How do purchasing groups develop over time on a micro-evolutionary level?
- **Human resource management**
  Cooperative purchasing can reduce duplications of efforts and activities (Tella and Virolainen, 2005), thereby affecting employment negatively. It can also bring learning opportunities (Nollet and Beaulieu, 2005) and new challenges to employees involved in a purchasing group, thereby affecting employment positively. Overall, the research question remains: What is the impact of cooperative purchasing on employment?
- **Innovation**
  According to Laing and Cotton (1997), there is a tendency for decision making towards compromises in purchasing groups. This stifles innovation in terms of contracting.

Therefore, a possible question for further research is: How to stimulate innovation in cooperative purchasing?

- **Management science, production, and operations journals**
  To our knowledge, no instruments have yet been developed which can determine the optimal size of purchasing groups under different circumstances (e.g., different markets, price elasticity, etc.). The involvement of many members will lead to higher transaction costs. On the other hand, the involvement of few members will lead to less economies of scale. A related research question is: What is the optimal size of a purchasing group?
- **Marketing**
  Electronic Purchasing Groups (EPGs) provide information and communication technology-based infrastructures and electronically conduct tasks that are necessary for the management of demand aggregation of two or more organizations (Huber et al., 2004). Huber et al. note that while cooperative purchasing and its electronic implementation are increasingly practiced in the public sector, more academic work still needs to be carried out if the use of this type of electronic network is to be more widely adopted in industry. For this reason, the following research question can be posed: How to increase the sales of EPGs in industry?
- **Organizational behavior**
  So far, there has been little discussion about critical factors of purchasing group success in the literature. This applies especially to success factors regarding the management of a purchasing group. To our knowledge, it is also not known which motives play an important role in why organizations choose to join or not to join a group. This is unfortunate as an improved understanding of these issues can help organizations in decisions related to whether or not to cooperate and in managing purchasing groups. Thus, interesting research questions seem: What are the critical success factors for managing purchasing groups and what are the differences between organizations involved and not involved in a purchasing group regarding motives for cooperative purchasing?
- **Purchasing and supply**
  To our knowledge, a typology of purchasing group types does not exist in the literature. This is unfortunate because such a typology can be used to design an effective and efficient purchasing group. In other words, a typology can prescribe how to organize different purchasing group types. A related research question is: What is the relationship between the organizational dimensions of a purchasing group and its performance?
- **Social**
  Sustainable purchasing is becoming increasingly popular in practice. Recent studies suggest that cooperative purchasing can benefit sustainable purchasing (e.g., Fletcher, 2007). Still, research to this topic is in its infancy. Hence, an interesting question for further research seems: How can cooperative purchasing benefit sustainable purchasing?

Even though some of these research questions have been discussed in professional journals, conference proceedings, and/or in dissertation proposals, the questions show that there are several academic research opportunities in cooperative purchasing. In Chapter 2 to Chapter 10, we aim to answer a selection of the research questions described above. In the next sections, we discuss our research objectives in some more detail.

1.3. Research objectives

As mentioned in the previous sections, economies of scale, lower transaction costs, stronger negotiation positions, lower supply risks, learning from others, and gaining access to more procurement expertise are all theoretical advantages related to purchasing groups. Theoretically, these advantages should outweigh set-up and management costs and drawbacks such as anti-trust (legal) issues, disclosure of sensitive information, supplier resistance, and the 'fear of free-riding group members' in a large number of cases. However, it seems that purchasing and cooperating do not always get along well. Premature endings of existing purchasing groups occur and some groups do not flourish (Jorritsma-Lebbink, 2000; Vliet, 1998). Unfortunately, there is little knowledge on what causes these mishaps. So, the question could be put: Could these causes be prevented by an adequate organization and set up of the purchasing group?

The overall research objective of this thesis is to analyze, model, and improve the establishment and management of purchasing groups. The approach will aim at delivering results in terms of empirically tested propositions and formal models. For some specific research objectives, we even aim at mathematically rigorous theorems. Knowledge from mathematical as well as social sciences will be combined to create an integrative and multidisciplinary approach.

The specific research objectives are as follows and are discussed in some more detail in the next section:

- To develop a set of research propositions about cooperative purchasing, thereby laying a research basis for this thesis (Chapter 2);
- To describe the main purchasing group types, to develop a typology of purchasing group types, and to position the group types with respect to each other (Chapter 3);
- To find out how Chapter 3 can be extended by a dimension concerning the allocation of the gains and costs of a purchasing group (Chapter 4);
- To describe the main micro-evolutions that take place in intensive purchasing groups over time (Chapter 5);
- To identify differences between organizations involved and not involved in a purchasing group regarding motives for cooperative purchasing and to identify critical success factors for managing purchasing groups (Chapter 6);
- To describe a general Quantity Discount Function (QDF) defined by a limited number of parameters, to test how well the QDF represents different types of quantity discount schedules, and to develop several practical QDF indicators (Chapter 7);
- To find out how and under which conditions the so-called Equal Price gain allocation method leads to theoretically unfair outcomes given a QDF (Chapter 8);
- To find out how to allocate purchasing group gains and costs in a theoretically fair manner among the members of a group given a QDF (Chapter 9);
- To obtain more insights into effectively dealing with allocation problems by comparing theoretical fairness and realization to perceived fairness and understanding (Chapter 10).

1.4. Research outline

For the purpose of analyzing, modeling, and improving the establishment and management of purchasing groups, two main approaches are employed in this thesis:

- **Empirical approach (qualitative and quantitative)**
  An empirical approach that serves both as an inspiration and background for an analytical approach. The empirical approach also provides the opportunity for empirically testing propositions. As cooperative purchasing is especially popular in the public sector, most of the empirical data is gathered from this sector. A qualitative empirical approach is used in chapters with an explorative character. A quantitative empirical approach is used in chapters with a confirmative character (see also Section 2.3);
- **Analytical approach**
  An analytical approach in which we build on existing knowledge in general management and purchasing literature. We focus on operational research and game theoretical models to further develop knowledge about purchasing groups.

Clearly, the analytical and empirical lines are intertwined. The analytical line feeds the empirical line with models and rules to improve the performance of purchasing groups, whereas the empirical line feeds the analytical line with data enabling the validation of models. In addition, the empirical line poses research questions for the analytical line. In Fig. 1.1, an overview of this thesis is presented.

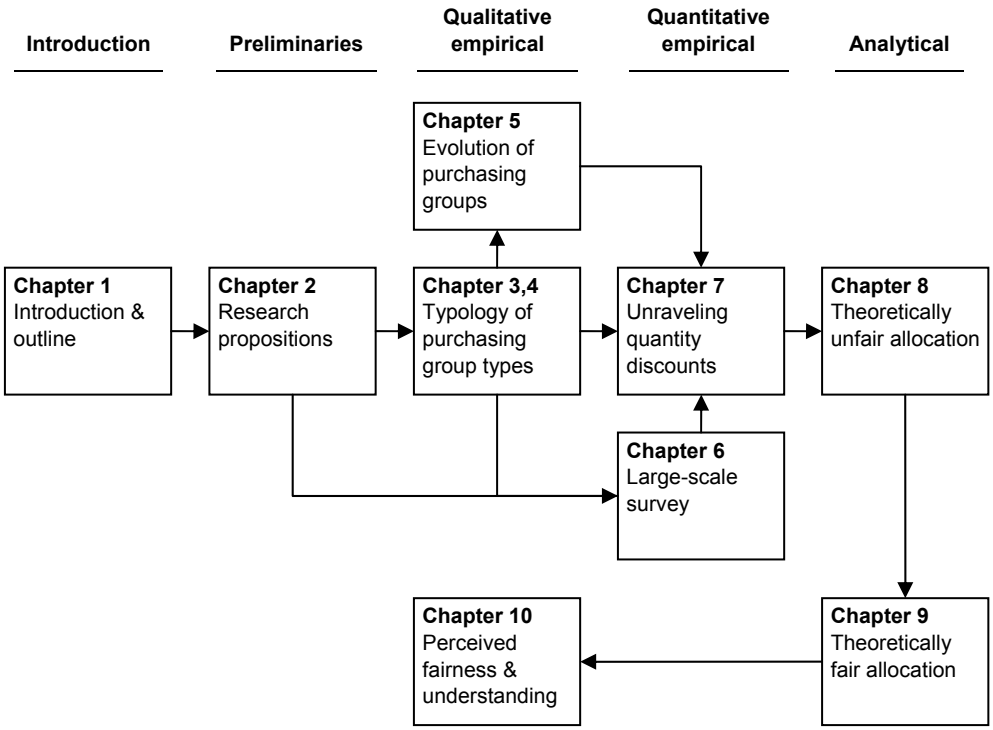

Fig. 1.1 Research outline

In the remainder of this thesis, we begin each chapter with a short summary. In addition, in each chapter, we discuss the chapter's importance, relevant theories, methodology, discussion, and conclusions in more detail. Thus, the thesis is structured in such a way that the individual chapters can be read in isolation as well[3]. Below, we provide a brief overview of the topics discussed in this thesis.

1.4.1. Part I Preliminaries

In Chapter 2, it is our objective to develop basic knowledge on cooperative purchasing, thereby laying a research basis for this thesis. We derive this research basis from a literature study and an empirical study of purchasing groups in the United Nations. One of the results of this chapter is a set of research propositions. We build on most of these propositions in Chapter 3 to Chapter 10. Most of the content of Chapter 2 has been published as a conference paper (Schotanus, 2005).

1.4.2. Part II Qualitative empirical approach

Chapter 3 is mainly based on interviews and focus group meetings. In this chapter, our research objectives are to describe the main purchasing group types, to develop a typology of purchasing group types, and to position the group types with respect to each other. Most of the content of this chapter is accepted for publication in the Journal of Purchasing and Supply Management (Schotanus and Telgen, 2007).

Chapter 4 is mainly based on a literature analysis. In this chapter, our research objective is to find out how a proposed extension of the typology from Chapter 3 can help to increase the usefulness of the typology in determining the way to manage the relationships between group members involved and more specifically, the allocation of gains and costs of a purchasing group. Most of the content of this chapter has been published as a conference paper (Waltmans et al., 2006).

In Chapter 5, which is based on three case studies, it is our research objective to describe so-called micro-evolutions that take place in so-called macro-phases in purchasing groups. In other words, we study interorganizational management dynamics of purchasing groups at a detailed level. While Chapter 3 and Chapter 4 have a static cross-sectional perspective, Chapter 5 has a dynamic longitudinal perspective. More specifically, in Chapter 5, we build on our earlier results and examine how a specific purchasing group type develops over time. The results also include solutions to several cooperative purchasing problems. Still, it turns out that some cooperative problems are hard to solve. Among other things, this applies to calculating (see also Chapter 7) and allocating the gains and costs of a purchasing group among its members (see also Chapter 8 to Chapter 10). Most of the content of Chapter 5 has been published as a conference paper (Schotanus et al., 2007a).

1.4.3. Part III Quantitative empirical approach

In Chapter 6, we test some of the propositions developed in the previous chapters in a large-scale survey. In Chapter 6, our first main research objective is to identify so-called negative motives for cooperative purchasing. We do this by comparing differences between organizations involved and organizations not involved in a purchasing group. Our second

[3] The structure of the thesis is inspired by the work of, among others, Boer (1998), Cruijssen (2006), Glatthorn and Joyner (2005), and Heijboer (2003).

main objective is to identify critical success factors for managing purchasing groups. We do this by comparing successful and unsuccessful purchasing groups. One of the identified critical success factors is the fair allocation of gains and costs. In the analytical part of this thesis, we discuss this topic in more detail.

In Chapter 7, we mainly have a quantitative empirical focus. We focus on the buyer's perspective on quantity discounts, which is an important perspective for all purchasing group types (see also Chapter 3). Our first objective is to describe a general Quantity Discount Function (QDF) defined by a limited number of parameters. Our second objective is to test how well the QDF represents different types of quantity discount schedules found in practice. An additional objective is to develop several practical QDF indicators. We build on the QDF in the next chapters. Most of the content of this chapter has been published as a competitive conference paper (Schotanus, 2006).

1.4.4. Part IV Analytical approach

In the analytical Chapter 8, it is our objective to find out how and under which conditions the so-called Equal Price (EP) gain allocation method leads to theoretically unfair outcomes. In Chapter 2 to Chapter 6, we indicate that this is an important issue for purchasing groups. In Chapter 8, we develop the so-called 25% and 38%-rules. These rules can be used to assess whether the EP method is unfair in specific scenarios. Most of the content of this chapter is accepted for publication in the European Journal of Operational Research (Schotanus et al., 2007b).

In the analytical Chapter 9, we study the theoretical fairness of several allocation methods for purchasing groups. As indicated in Chapter 2 to Chapter 6, this is an important issue for purchasing groups. In Chapter 9, it is our objective to find out how to fairly divide purchasing group gains and costs among the members of a purchasing group. We compare the methods by using several so-called properties of fairness. Parts of this chapter have been published as a conference paper (Schotanus, 2004).

1.4.5. Part V Qualitative empirical approach

In Chapter 10, we return to a qualitative empirical approach in which we empirically test some of our analytical results. It is our research objective to obtain more insights into effectively dealing with allocation problems. We do this by comparing theoretical fairness and realization (an applied mathematics perspective) to perceived fairness and understanding (an applied social psychology perspective) in several steps of the allocation process. In addition, we develop several practical steps for dealing with allocation problems. In the chapter, we build on the allocation methods discussed in Chapters 8 and 9. Most of the content of this chapter has been published as a competitive conference paper (Schotanus et al., 2006).

1.4.6. Part VI Summary and outlook

In Chapter 11, we review our main findings. Among other things, the research objectives are revisited collectively and recommendations for further research are provided.

1.5. Research line

This thesis builds further on the University of Twente research line on quantitatively examining purchasing decisions initiated by Telgen (1994). This research line led to previous theses by de Boer (1998) and Heijboer (2003). The results from de Boer's research project are published in the Ph.D. thesis 'Operations research in support of purchasing: Design of a toolbox for supplier selection'. De Boer's thesis considers the applications of methods from operations research in purchasing. In addition, a toolbox is designed to link appropriate decision models to different purchasing situations.

The next step in the research line was made by means of the Ph.D. thesis 'Mathematical and statistical analysis of initial purchasing decisions' of Heijboer. In Heijboer's research project, mathematical models are designed and analyzed for initial purchasing decisions. Also, tools supporting practitioners in making those decisions are developed. One of Heijboer's chapters deals with the allocation of gains and costs among the members of purchasing groups.

This thesis extends the line of research to the development of models for purchasing groups. In Chapter 2, we take a closer look at the literature on cooperative purchasing. In that chapter, we discuss how this thesis extends existing knowledge on cooperative purchasing.

PART I

PRELIMINARIES

In this part, it is our objective to develop basic knowledge on cooperative purchasing, thereby laying a research basis for this thesis. One of the results of this part is a set of propositions for further research. We build on most of these propositions in the next parts of this thesis.

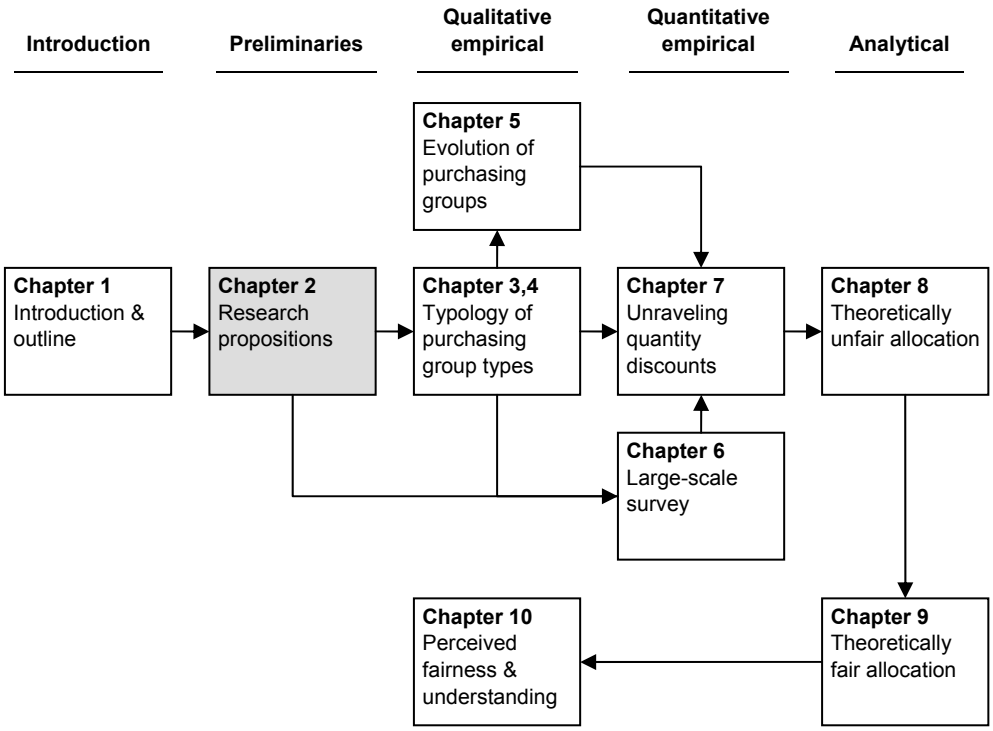

Fig. I.1 Research outline

Chapter 2

Research propositions

In the previous chapter, we have briefly sketched the existing literature on cooperative purchasing. In this chapter, it is our objective to develop basic knowledge on cooperative purchasing, thereby laying a research basis for this thesis. In particular, the chapter functions as an 'introduction' to Chapter 6 in which parts of the research basis are tested on a large scale. Chapter 2 is summarized as follows.

We develop basic knowledge from studying purchasing groups in the United Nations, the literature, and theory. Based on these sources, we develop several propositions related to different purchasing group types, negative motives[4], and critical success factors for cooperative purchasing.

It turns out that important negative motives are a lack of 'management support' and 'cooperation opportunities'. A 'lack of trust' is a less important negative motive for public organizations. To facilitate management support and improve the viability of cooperation, we also address issues related to critical success factors, such as 'choosing suitable items', 'the competence level of purchasing functions', 'control', and a 'fair allocation of savings'. In order to improve the potential for cooperative purchasing, we suggest putting adequate saving allocation methods into place to make more purchasing group types more interesting for clusters of organizations that differ in terms of size. In the next chapters, we test and/or build on several propositions developed in this chapter[5].

2.1. Introduction

Cooperation in general is as old as human society and has been studied extensively in the private sector (Harrigan, 1985) and public sector (Leach, 2006). Cooperation between buying organizations is less well studied. Still, as noted in the previous chapter, it is becoming increasingly popular, especially in the public sector (e.g., Johnson, 1999).

The popularity of cooperation between buying organizations in the public sector can be explained by several factors. First, it seems an interesting concept for public organizations as there is no or almost no mutual competition between them. Thus, there are fewer or no issues regarding confidentiality of information or the will and need to outperform other organizations in the purchasing process. In addition, public organizations often have similar structures, networks, purchasing needs, (almost) no competition, a common environment, and ought to have one common goal: to maximize the value of the taxpayers' money.

[4] Negative motives are organizational motives not to purchase cooperatively.

[5] Parts of this chapter are based on Schotanus, F., 2005. Cooperative purchasing within the United Nations. IPSERA conference proceedings, Archamps (France), 961–973 and on Schotanus, F., Telgen, J., 2007. Developing a typology of organizational forms of cooperative purchasing. Journal of Purchasing and Supply Management, 13 (1), 53–68.

Usually, factors such as one common goal and similar interests make it easier to cooperate (Klein Woolthuis, 1999). For further discussions of cooperation stimuli, see Ariño and Torre (1998), Barkema et al. (1997), Chung et al. (2000), Cruijssen et al. (2007), Doucette (1997), Galaskiewicz (1985), Ireland et al. (2002), and Nollet and Beaulieu (2005).

2.2. Previous research

Academic articles – published in recognized journals – dealing explicitly with cooperative purchasing are quite rare. This is illustrated in the following table, in which the main academic contributions to cooperative purchasing are provided. Books are not included in this table since the content of relevant books mostly overlaps with the academic publications. The table, with eight recent publications on a total of eighteen, shows that the academic attention for cooperative purchasing is increasing. We refer to Ireland et al. (2002) for an overview of the main academic contributions to strategic alliances.

Table 2.1 Cooperative purchasing publications

Title (authors)	Main contribution to the field of cooperative purchasing
Communication journals (1)[a]	
Library purchasing consortia: The UK periodicals supply market (Ball and Pye, 2000)	The authors describe the operations of some purchasing group types. Their survey findings include: • Most purchasing groups in their early stages are organized informally; • Among other things, suppliers to groups cite volume of trade as an advantage; • Besides hidden savings, purchase prices will always remain an issue for public money spending organizations.
Economics journals (1)[b]	
Multinational corporations and multinational buying groups: Their impact on the growth of Asia's exports of manufactures-myths and realities (Hone, 1974)	Based on export data, the author argues that large retail buying groups in the US, Europe, and Japan were the most important motor of manufactured export growth in Asia. In the future, the focus of buying groups on very low purchase prices may raise problems for the supply side.
General and strategy journals (2)	
A life-cycle model of organizational federations: The case of hospitals (D'Aunno and Zuckerman, 1987)	Based on the literature, the authors propose a large purchasing federation development model in steps of (1) group emergence, (2) transition to a federation, (3) federation maturity, and (4) critical cross roads. The authors develop 15 hypotheses that mainly focus on the group emergence step.
Influences on member commitment to group purchasing organizations (Doucette, 1997)	The author notes the importance of large purchasing groups in some sectors in the US, such as health care. In a survey, significant positive associations are found between group member commitment and information exchange, trust, and the perceived commitment of other members. The suitability of alternative purchasing groups showed a significant negative relationship with commitment. It is argued that when a member believes that the other members are committed, the member will commit itself. To this end, some strategies are suggested.

Title (authors)	Main contribution to the field of cooperative purchasing
Information systems and knowledge management journals (2)[c]	
Credit based group negotiation for aggregate sell/buy in e-markets (Yuan and Lin, 2004)	The authors note that group negotiations are becoming essential in electronic business and that the Internet makes it easier for consumers to join such negotiations. They present a group formation approach that is called credit based group negotiation. This approach facilitates the grouping of buyers and sellers and reaches favorable prices for both buyers and sellers.
Purchasing consortia and electronic markets: A procurement direction in integrated supply chain management (Huber et al., 2004)	The authors used two surveys to assess the advantages of Electronic Purchasing Groups (EPGs). They tested nine hypotheses and developed an EPG-adoption model. Among other things, they show that: • Pressures from the business context do not have a significant impact on EPG importance to the purchasing strategy of organizations; • EPGs are positively correlated with the arm's length buyer-supplier relationship; • Purchasing maturity and size of organizations are important EPG drivers.
Management science, production, and operations journals (3)	
The pattern of evolution in public sector purchasing consortia (Johnson, 1999)	The author develops a five stage conceptual model based on four cases of cooperative purchasing in steps of (1) internal, (2) informal external, (3) developing external, (4), formal external, and (5) redevelopment. The author notes that purchasing groups show a lot of changes over time. They may become larger and become active in other fields than purchasing. In addition, several advantages (price reduction, reduced transaction costs, ability to attract new suppliers, support specialization of staff, greater resources, and stronger management capabilities) and disadvantages (complexity, coordination costs, uncertainty, standardization and compliance, free-riding, governance, and declining cost savings) of purchasing groups are described.
Formation of alliances in internet-based supply exchanges (Granot and Sošic, 2005)	The authors note that competing organizations are more and more combining buying power in small e-marketplaces. An organization that joins an e-group shares its suppliers with other organizations, which may lead to more supplier competition. Questions raised are, when would an organization prefer to take part in a group, when would it prefer that competing organizations join, and what are the consequences of joining? Among other things, experimental findings show: • If competing organizations have non-substitutable products, then the highest profit for each organization is realized in a group with all competing organizations; • The decrease in wholesale prices and processing costs realized by groups has a relatively minor effect on members' profits; • If all group members benefit equally, the group could be stable.
Motives behind purchasing consortia (Tella and Virolainen, 2005)	The authors review theoretical approaches explaining the cooperative purchasing rationale. The results of interviews indicate that the main motives of small purchasing groups are cost savings and the collection of information on supply markets. Cost savings are mainly due to reduced transactions and increased negotiation power, what may lead to lower purchase prices.

Title (authors)	Main contribution to the field of cooperative purchasing
Public sector journals (3)[d]	
Public health insurance: The collective purchase of individual care (Evans, 1987)	The author notes that public health insurance is a mechanism for the cooperative purchasing of care on a large scale. The paper contrasts public coverage with private coverage. It is shown by comparative case studies how public coverage, used as a cooperative purchasing agency, has led to both better coverage and lower costs than private coverage.
On the ideal market structure for third-party purchasing of health care (Enthoven, 1994)	According to the author, the market structure for large-scale third party purchasing in the health care must be managed by cooperative purchasing agents. These agents should structure and manage the enrolment process, create price-elastic demand, manage risk selection, and create and administer equitable rules of coverage. In the paper, undesirable political arrangements to be avoided are discussed as well.
The contribution of coterminosity to joint purchasing in health and social care (Exworthy and Peckham, 1998)	The authors study the contribution of coterminosity (i.e., the coincidence of geographical boundaries between organizations) to cooperative purchasing. It is concluded that coterminosity has a contribution, but increasingly at a local level. The manifestation of coterminosity may minimize the effects of fragmentation and encourage cooperation sensitive to local needs. Coterminosity is not considered as a precondition to cooperative purchasing, but is does carry some contributions.
Purchasing and supply journals (4)	
Patterns of inter-organizational purchasing: Evolution of consortia-based purchasing amongst GP fundholders (Laing and Cotton, 1997)	The author describes that General Practice (GP) fundholders responded to the complexities of contracting by cooperative purchasing. Based on interviews, three key issues of importance to the success of purchasing groups are found: • Common objectives and interests should exist; • Despite its recognized importance, communication was almost uniformly viewed as problematic. In part, these problems are attributed to political rivalry and the long established autonomy of practices. It is also argued that groups, being de facto compromise between centralized and decentralized purchasing, face as a consequence the worst aspects of communication problems inherent in both approaches; • There was an inevitable tendency for decision making towards compromises. This stifled innovation in terms of contracting.
Purchasing consortia as symbiotic relationships: Developing the concept of consortium sourcing (Eßig, 2000)	The author discusses that symbiosis is a precondition for cooperative purchasing. In addition, the cooperative purchasing terminology is described and the concept is compared to other sourcing types, such as single and multiple sourcing.
The development of group purchasing: An empirical study in the healthcare sector (Nollet and Beaulieu, 2003)	The authors develop a conceptual phase model for large purchasing groups in steps of (1) birth, (2) growth, (3) maturity, and (4) concentration. Based on interviews, the authors identify several factors that may change over time: payers' intervention (e.g., legislation influences), nature of benefits, procurement strategy (e.g., diversification), nature of the relationship with suppliers (e.g., partnership), structure (e.g., confederal; autonomous), and resources (e.g., electronic catalogue).

Title (authors)	Main contribution to the field of cooperative purchasing
Should an organization join a purchasing group? (Nollet and Beaulieu, 2005)	The authors provide a framework to deal with a purchasing group. Based on interviews, it was found that despite its benefits (lower prices, reduced administration costs, easy access to knowledgeable personnel, and sharing information), a purchasing group also constitutes an extra link in the supply chain with related drawbacks (price focus, potential supplier mergers, reduced supplier services, costs to maintain group cohesion, information confidentiality, determining common objectives among members, and unclear beneficiaries might increase tensions).
Social journals (2)	
Third party buying: The trend and the consequences (Stinchcombe, 1984)	The author notes that the trend towards large-scale buying of health insurance, life insurance, pension, and/or annuity plans through employers brings up problems of consumer sovereignty, problems of the incentives of service providers, and problems of availability of services which are only available through cooperative purchasing through employers.
Interorganizational relations (Galaskiewicz, 1985)	In cooperative purchasing, analysts have focused on power dependency and overcoming environmental uncertainty. The author notes that organizations have found a wide variety of ways to solve cooperative purchasing issues, ranging from coordination by market to hierarchy.

[a] The topics are based on the journal list of Harzing (2005), purchasing and supply has been added
[b] Publications and notes from law journals have been left out of the selection; interested readers can go back as far as 1924 for notes dealing with the legal aspects of cooperative purchasing in Harvard Law Review
[c] The publications from Chen et al. (2002), Kauffman and Wang (2001), and Li et al. (2004), which deal with bid strategies in group buying auctions, have been left out of the selection
[d] These journals are all health management related journals

Summarizing the table, academic publications dealing explicitly with cooperative purchasing are rare. Even rarer are academic publications that build on quantitative empirical research. We found a total of three relevant publications. Two of these quantitative studies (Hendrick, 1997; Huber, 2004) were carried out in the private sector. Doucette (1997) carried out a quantitative study in the public sector and looked specifically at the commitment of cooperating organizations. Thus, despite the popularity of cooperative purchasing, little quantitative qualitative material is available yet. Throughout this thesis, we refer to most of the publications in Table 2.1 and aim to add to this existing knowledge.

The organization of the chapter is as follows. First, we discuss the research objectives and their relevance. Subsequently, we describe the UN system and discuss the methodology. In the findings section, we develop several propositions about cooperative purchasing. In the final sections, we discuss the limitations and draw our conclusions.

2.3. Specific research objectives

In this chapter, our main research objective is to develop basic knowledge on cooperative purchasing, thereby laying a research basis for this thesis. As we explore cooperative purchasing issues, this chapter is written in the theory career stage context of discovery (i.e., having new ideas (Gigerenzer, 2000)), a classical perspective established by Reichenbach (1938). Although we do find some significant results, we emphasize that this chapter is not written in Reichenbach's (1938) context of justification (i.e., testing

(Gigerenzer, 2000)). In other words, it is not our objective to accept or reject propositions in this chapter. We develop propositions, which are based on the existing literature, theory, and on qualitative and quantitative case study data of purchasing groups in the United Nations (UN). The quantitative case study data is used to support the qualitative data. Note that Chapter 6 is written in the context of justification. In that chapter, we empirically test some of the propositions developed in this chapter.

Although there is an extensive amount of literature dealing with interorganizational relationships, a comprehensive theory of interorganizational relationships has not yet emerged (Hoffmann and Schlosser, 2001). According to Hoffmann and Schlosser, current theories provide at least two main explanations for interorganizational relationships: transaction cost economics and partnership and alliance theory. In this chapter, our research objectives build on these theories. Drawing on transaction cost economics, it is stated that a purchasing group is viable when the total transaction costs of the group members involved are lower when they work together (based on Kamann et al., 2004; Picot et al., 1996, Williamson 1991, 2000). Partnership and alliance theory describes what to do to establish and manage (alliance) partnerships (based on Frankel et al., 2000). The related (alliance) partnership literature provides knowledge about how partnerships affect innovation and relationships (e.g., see Ireland et al., 2002). Spekman et al. (1998) note that the emphasis in existing studies has mostly been on the formation of partnerships and the reasons why organizations form partnerships. For further discussions of theories explaining why organizations are involved in a purchasing group, see Bakker et al. (2006a), Eßig (2000), Kamann et al. (2004), and Tella and Virolainen (2004).

As mentioned earlier, our main objective is to lay a research basis for this thesis. Our three specific research objectives link to this main objective and build on the theories described above. Our first specific objective focuses on analyzing different purchasing group types. This is an important topic as different group types may be organized differently. However, existing research has focused on the general concept of cooperative purchasing and not on different purchasing group types.

Previous research has already contributed to the knowledge on so-called positive motives for partnerships. Our second specific objective is to analyze motives not to purchase cooperatively (i.e., negative motives). This is important as negative motives are less well-known than positive motives (Smith et al., 1995). Still, insight into negative motives seems useful to understand why organizations (do not) join purchasing groups.

Previous research has also contributed to the knowledge on forming partnerships. Spekman et al. (1998) suggest that there exists a gap between the understanding of (alliance) partnership formation and the practice of partnership management. This is unfortunate as insight into factors that influence the practice of managing partnerships seems useful to understand how partnerships (can) perform efficiently and effectively. Therefore, our third specific objective is to analyze critical success factors for managing purchasing groups.

As little quantitative material is available on cooperative purchasing, we develop several propositions to facilitate more quantitative research. We develop propositions for each specific objective. Note that in the literature, there has been little agreement on the meaning of the terms proposition and hypothesis (Cooper and Schindler, 1998). Still, hypotheses are

often defined as assumptions to be tested with the objective of making statistical decisions based on a scientific procedure (e.g., Heerden, 2001; Willemse, 1990). In this chapter, we use the term proposition as we do not statistically test all assumptions in this thesis.

In this chapter, we mostly use transaction cost economics and partnership and alliance theory to develop and discuss purchasing group types, motives, and critical success factors for cooperative purchasing. Furthermore, we make an explicit distinction between the sizes of cooperating organizations. Issues regarding such differences in size have been mentioned by Granot (2005) and Heijboer (2003), but a quantitative empirical foundation for their work is still lacking. We also make a distinction whether the respondents have been involved in a purchasing group. Differences between organizations involved and not involved in a purchasing group may help us better understand why some organizations choose (not) to join a group. Such differences have been studied by Hendrick (1997), but his study focused on a limited number of motives and large private organizations only.

2.4. Method

In this section, we discuss the methods used. First, we describe the data source and the data collection. Next, we describe the research procedure and the data set.

2.4.1. Data source

We conducted an exploratory case study within the UN system. Nearly every nation in the world belongs to the UN, with membership now at 191 countries (United Nations, 2005). The main purposes of the UN are to maintain international peace, security, and to cooperate in solving international problems. The UN system encompasses a wide variety of agencies and covers an eight billion US dollar purchasing market (United Nations, 2006). Each of the larger agencies has their own purchasing entity. Many UN agencies have also delegated authority to their country offices to undertake purchasing up to a certain financial limit (Walker and Harland, 2004). This complex set of massive, multinational, very political organizations is reputedly bureaucratic.

Humanitarian aid agencies and development agencies have different purchasing requirements. Nevertheless, the agencies purchase many of the same (common) products and services, such as motor vehicles and office equipment. Furthermore, resources are scarce, public expectations are high, and there is a continuing need to improve agency performances. For these reasons, the UN agencies have been practicing cooperative purchasing for decades. The agencies are frequently investigating cooperative purchasing opportunities. For instance by facilitating e-procurement solutions to cooperative purchasing (e.g., http://www.unwebbuy.org) or by collecting long-term agreements from individual agencies and making them available to the entire UN system.

When studying the UN system, we have to take into account the international and bureaucratic nature of the UN. For instance, the geographical availability of items may be an important issue to UN purchasing groups. Still, the UN system makes a suitable case study for accomplishing our research objectives given their versatile experiences with cooperative purchasing. Another interesting aspect of the case is that the UN agencies vary considerably in size. This is important for our study as we make an explicit distinction

between the sizes of cooperating organizations. Finally, similar to public hospitals, schools, municipalities, and other public organizations in many countries:

- The major emphasis in the UN system is to achieve best value for money through a transparent purchasing process (Harland et al., 2003);
- The UN system operates with public funds;
- There is no single line of control for purchasing in the UN system.

2.4.2. Data collection and procedure

In order to get a more complete understanding of cooperative purchasing in the UN, we studied several documents on purchasing in the United Nations (Harland et al., 2003; United Nations, 2004a, 2004b, Walker and Harland, 2003, 2004). To verify and complement these data sources, we carried out several semi-structured interviews with key persons at the Inter-Agency Procurement Services Office (IAPSO). IAPSO serves as a focal point for the UN system on (cooperative) purchasing issues (United Nations, 2004a). To triangulate the documents and interview data, we built a draft questionnaire that used a mix of question types (i.e., open, multiple choice, and true/false questions). The questionnaire consisted of four parts:

Part (1): The first three questionnaire questions dealt with the background of the respondents;

Part (2): The next five questions were about the organization of the purchasing function of the respondent's agency;

Part (3): The next nine questions dealt with the current cooperative purchasing activities of the respondent's agency;

Part (4): The final thirteen questions were about future cooperative purchasing activities, motives of agencies, and success factors for managing purchasing groups. In this chapter, when studying motives, the unit of analysis is the individual agency. When studying success factors, the unit of analysis is the purchasing group.

The questionnaire was first sent to a focus group to test the questions. After this, the wording of some questions was changed. Also, some questions were removed and the related necessary information was obtained by additional documents (e.g., United Nations, 2005). After this step, the questionnaire was sent to all members of the United Nations Inter Agency Procurement Working Group (UN/IAPWG), consisting of the heads of purchasing across 47 agencies. A total of 19 questionnaires were returned, representing a response rate of 40%. If a respondent did not answer a question, then the respondent was removed from the analysis of that particular question. Thus, missing values were excluded listwise.

To compensate for nonresponse bias and possible misinterpretations, the final phase of our study consisted of sending a draft report on the survey to all UN/IAPWG members and a presentation and discussion of the findings at a UN/IAPWG meeting. The final report of the study was distributed to all UN/IAPWG members with a final request for feedback on any perceived discrepancies and key issues to further compensate for nonresponse bias and possible misinterpretations. Finally, this chapter in draft form was distributed to IAPSO to verify the final results. All the data collection was carried out in 2004.

Denzin and Lincoln (1998) describe different forms of triangulation; our research involved data triangulation by using different sources of information and methodological

triangulation by using questionnaires, interviews, and document analysis. By using triangulation methods, we enhanced the reliability and internal validity of the study.

2.4.3. Data description

In Table 2.2, we show some properties of the 47 UN agencies (United Nations, 2005). The table also shows the response rates of different groups of agencies. As we make an explicit distinction between organizational sizes, we categorized the agencies according to their size. Because of missing data regarding the numbers of (purchasing) personnel of several UN agencies, we categorized the agencies according to their annual purchasing volume.

Note that the definitions of the small, medium, and large groups of agencies are subjective to some extent and that the annual purchasing volume of an agency may differ per year. Changes in the group definitions or in the annual purchasing volume of an agency may result in a different classification. Therefore, we tested whether it would make a difference if we classified 'relatively large' small agencies as medium-sized agencies, 'relatively small' medium-sized agencies as small agencies, and so forth. We found that a reclassification of these agencies only results in minor changes in the results of our study.

Table 2.2 Annual purchasing by UN/IAPWG members and response rates

Size	Annual purchasing in million US dollars	Total number of members in 2004	% Total members	% Total purchasing of members in 2004	% Response
Large	200 ≤ 2,000	8	17	83	63
Medium	20 ≤ 200	13	28	16	38
Small	≤ 20	26	55	2	35
Total		47	100	100	40

Most of the responding UN agencies are already actively involved in a purchasing group (74%). Purchasing groups in the UN system are considered to be an important source of cost savings, learning opportunities, and resources. These results confirm those in an earlier study by Harland et al. (2003) among mainly different respondents than in our study. Harland et al. found that 76% of the IAPWG member agencies use shared contracts and 47% lead contracts on behalf of other agencies.

All large responding agencies are involved in one or more purchasing groups. Large agencies are involved in more purchasing groups than small agencies. We found a significant difference between the means of the normal distributed ratings with unequal variances of large and small agencies at $p = .051$ in an independent samples 2-tailed t-test. In this chapter, we assume unequal variances when $p \leq .10$ in Levene's (1960) test for equality of variances. Indicated reasons for the difference between small and large agencies are that large agencies have more resources and purchase a wider range of products and services. Previous alliance studies show similar results (Frank, 1994; Hagedoorn and Schakenraad, 1994). These studies note that the propensity of small and medium sized organizations to cooperate is significantly less than that of large organizations.

Most UN agencies indicated being interested in sharing information (74%) and (supplier) experiences (89%). Most of the purchasing groups are growing or stable in total purchasing volume (86%). In all categories, growing groups have the upper hand. Table 2.3 shows more contextual factors of the respondents.

Summarizing, the data characteristics show the data possesses desirable representativeness, which is even more important than the response rate (Yang, 2005).

Table 2.3 Contextual factors of agencies analyzed

Factor	Description
Job title	Most respondents have the job title head procurement or chief procurement (69%). Some respondents of small (25%) and medium sized (20%) agencies are directors.
Purchasing personnel	84% of the respondents indicated that they have less than 10 strategic Full Time Employees (FTEs) in the purchasing function. 79% indicated having less than 20 tactical FTEs and forty operational FTEs.
Purchasing spend under control	All large responding agencies indicated having reasonable (61% to 80%) to good control (81% to 100%) over their purchasing spend. Most small agencies (75%) also indicated having good control. Medium agencies rate somewhat lower (66% reasonable to good control).
Purchasing competence	42% of the respondents indicated being more competent in purchasing than most other agencies. 42% indicated being even very good. 16% indicated being average.
Organizational structure	Almost all small agencies are organized centrally. Medium and large agencies are organized decentrally with lead buyers or are organized centrally.

Note: $n = 19$

2.5. Research propositions

In this section, we discuss the empirical findings and develop several propositions. The propositions are based on the empirical findings and the relevant literature. In the next chapters, we frequently refer to the propositions and test several of them.

2.5.1. Different purchasing group types

Based on new institutional economics and transaction cost economics, a wide range of purchasing group types exists between coordination by hierarchy and market (Galaskiewicz, 1985)[6]. We identified three main group types in the UN: lead buying, piggy-backing, and third party purchasing. Lead buying typically involves outsourcing purchasing activities to one of the members of a purchasing group: each item is purchased by the most suitable party. Piggy-backing typically involves a large agency that establishes a contract on its own specifications. This contract may be used by other agencies under (almost) the same contract conditions. Third party purchasing mostly involves long-term piggy-backing made possible by organizations such as IAPSO. IAPSO may establish new contracts for common items on behalf of all agencies. Thus, for a small fee, IAPSO focuses on obtaining a large scale and it carries out most of the purchasing activities. Some of the activities may be carried out in cooperation with the respective major buyers (Harland et al., 2003). If a group member does not contribute to the group, either by a financial contribution or by doing some of the work, then this is referred to as free-riding (Rokkan and Buvik, 2003).

2.5.2. Intensive purchasing group types

Similar to the range from hierarchy to market, purchasing group types range from non-intensive to intensive group types. Here intensiveness is defined as the extent to which a

[6] In Section 3.7.1, we discuss coordination by hierarchy and market in more detail.

group member is compelled to perform an active role in a purchasing group. As a result of this active role, the group members can influence the group activities. In a third party purchasing group, the members are not very active as the work is mostly done by a third party. Thus, a third party purchasing group is a non-intensive purchasing group type.

Intensive group types are uncommon in the UN. Indicated reasons for this are organizational dissimilarities, such as size differences, geographical distances, and related coordination costs. A comparable argument has been made by Kamann et al. (2004), who claim that the more integration of the purchasing processes of group members takes place, the more the aspects mentioned in partnership and alliance theory apply. This means that if a purchasing group is non-intensive, then alliance theory aspects, such as organizational similarities, similar objectives, and similar interests (e.g., Laing and Cotton, 1997), are less important. We study different purchasing group types in more detail in the next chapters.

> **P_1:** Intensive purchasing group types are less viable when group members differ strongly in terms of partnership and alliance theory.

2.5.3. The piggy-backing problem

The larger the agency, the less profitable it will be to piggy-back on another organization's contract, because more specific contracts are often necessary. Small agencies often prefer to be involved in third party purchasing group or piggy-backing on contracts of large agencies (based on Quayle, 2002a), as they lack economies of scale and specific purchasing expertise. Also, piggy-backing drastically reduces the duplication of efforts and activities. Thus, for small agencies, it can be interesting to piggy-back on contracts of large agencies. However, for large agencies, there is no direct incentive to allow small agencies to piggy-back on their contracts. Sometimes, large agencies manage to negotiate a lower purchase price, but this is often the exception rather than the rule. Allowing others to piggy-back may even involve some costs for the large agency, such as extra negotiation costs with the supplier to make piggy-backing possible. We define this problem as the piggy-backing problem (i.e., in contrast to the piggy-backing organization, the organization that allows piggy-backing does not gain).

Despite the piggy-backing problem, large agencies still allow piggy-backing in some cases. We argue that this could be due to a 'do good' approach. After all, all UN agencies should contribute to the shared UN goals. So, even if a large agency does not benefit individually from cooperating, but small agencies do, the large agency contributes indirectly to the shared UN goals. Still, as noted earlier, small UN agencies are involved in less purchasing groups than large agencies.

The use of fair allocation methods is likely to lead to more cooperation (based on Kim and Mauborgne, 1998; Korsgaard et al., 1995). An appropriate allocation method could compensate an unfair allocation of benefits and make allowing piggy-backing more interesting for large agencies. Compensation could take place by reallocating some of the gains of the smaller agencies to the larger ones (see the analytical part of this thesis). Note that if the savings are small and the costs of an allocation method (e.g., negotiating terms) are high, then it would not make sense to use an allocation method. Nevertheless, the savings of piggy-backing may be considerable for small agencies.

P_{2a}: Reallocating some of the gains of piggy-backing organizations to organizations that allow piggy-backing leads to more organizations involved in piggy-backing.

P_{2b}: More usage of the concept of piggy-backing by using a saving allocation method results in more savings for both small and large organizations.

2.5.4. Positive and negative motives

As mentioned earlier, we are especially interested in negative motives for cooperative purchasing. The positive motives are only collected to place the negative ones in perspective. Thus, our further motive analysis is mostly focused on negative motives.

Table 2.4 shows that there are several motives for cooperative purchasing. The motives can be explained by transaction cost economics and partnership and alliance theory. Drawing on transaction cost economics, an example of a positive motive is a reduction of transaction costs. An increase of coordination costs is an example of a negative motive. Drawing on partnership and alliance theory, a positive motive is risk reduction. An example of a negative motive is losing control. Based on the theoretical concepts, Table 2.4 shows more motives. The table also shows the indicated importance of the motives for the respondents.

Table 2.4 Motives for cooperative purchasing

Positive motive	Average	Negative motive	Average
Bundle purchasing volumes		**Expect no improvements**	
1. Financial gains	4.8	13. Resistance to changing suppliers	3.4
2. Spread and reduce risks	3.6	14. Lose control	3.2
		15. Decreased flexibility	3.2
Information sharing		16. Expecting high coordination costs (N=1.3** < I=3.6)[a]	3.0
3. (Price) information sharing	4.2		
4. Learn from other agencies	4.0	17. Supplier resistance	1.8
Share resources or processes		**Lack of support of own agency**	
5. Reduce transaction costs	4.6	18. Lack of resources	2.9
6. Reduce workload	4.1	19. Lack of commitment (S=3.6* > L=2.0)	2.8
7. Improve suppliers cooperatively	3.9		
8. Share expertise	3.7	20. Lack of supporting culture	2.5
9. Specialize in typical items	3.4	21. Lack of management support (S=3.0* > L=1.8) (N=3.0** > I=2.2)	2.4
Other motives			
10. Extend cooperation	3.1	**Lack of trust or support of other organizations**	
11. Budget cuts	2.9	22. Lack of trust in others' competences (N=2.0** < I=2.6)	2.5
12. As a means to reorganize	2.8		
		23. Disclosure of sensitive information	2.3
		24. Anti-trust (legal) issues	2.3
		25. Fear of free-riding organizations	2.2
		Lack of priority or cooperation opportunities	
		26. Lack of cooperation opportunity (S=3.4** > L=1.3) (N=4.5** > I=2.1)	2.5
		27. Lack of cooperation priority (S=2.8*, M=3.0* > L=1.0)	2.3

$^{*}p < .05$; $^{**}p < .10$

[a] This means that the average rating of group N is 1.3 and the average rating of group I is 3.6.

Note: Measured on a 5 point Likert scale from 1 (unimportant) to 5 (important), n = 8 for group S, n = 4 for group M, n = 5 for group L, n = 4 for group N, and n = 13 for group I

The most important positive motives cover all different aspects of our definition of cooperative purchasing. These motives are 'financial gains', '(price) information and (supplier) experience sharing', and 'reduced transaction costs'. Thus, although lower purchase prices are indicated as the most important positive motive, cooperative purchasing has other important motives as well. These other motives are especially important in markets with low purchase price elasticity or when cooperating organizations already have economies of scale on their own. In such situations, price motives are less important.

The most important negative motives are 'resistance to changing current suppliers', 'losing control over the purchasing process', 'decreased flexibility', and 'expecting costs to be high'. We argue that when trying to stimulate the concept of cooperative purchasing or when considering joining or expanding a purchasing group, these negative motives should be dealt with in the first place and should be weighed up against the positive motives.

Avoidance of parallel competition on purchasing key items at peaks of emergencies is not included in the table, but was indicated as a typical UN motive by some respondents. With parallel competition at peaks of emergencies, we refer to 'competition' between UN agencies for limited resources. During emergency peaks, several agencies may have similar excessive purchasing needs that cannot easily be met by suppliers. In an ideal situation for the UN, it should be avoided that agencies compete for limited resources and drive up prices.

Another motive not mentioned in the table is the reduction of tender process throughput time. Normally, when UN agencies purchase a new item, they have to comply with several procedures. When piggy-backing on a contract of another agency, these procedures are not necessary and tender process throughput time may be reduced.

2.5.5. Trust between public organizations

According to, among others, Das and Teng (2001b), Klein Woolthuis (1999), and Nooteboom (1996), the objects of trust are competence and goodwill. Competence trust refers to trust in another organization's competences and ability to execute activities as agreed upon. Goodwill trust refers to trust in another organization's loyalty and honesty. In case of goodwill trust, cooperating organizations treat each others' interests with care and concern (Klein Woolthuis, 1999).

In our study, the respondents indicated that if there are trust problems, then these are related to 'a lack of trust in other organization's competences'. Negative goodwill motives, such as 'disclosure of sensitive information' and 'fear of free-riding organizations', are indicated as less important. Therefore, lack of interorganizational trust in loyalty and honesty seems a relatively unimportant negative motive for the agencies.

In the private sector, trust in loyalty and honesty are usually indicated as important issues, particularly when competitors consider to cooperate (Gulati, 1995; Quayle, 2002a; Sydow, 1998). We try explaining this difference between public and private organizations by taking a closer look at trust stimuli. Interorganizational goodwill trust flourishes when organizations are familiar with each other (Klein Woolthuis, 1999), are members of existing networks (Waddock, 1989), communicate openly, have mutual respect, and share similar values (Robertson, 1998).

Often, aspects of public organizations correspond to the aspects mentioned above. In addition, as discussed in Section 2.1, competition, conflicting interests, opportunism, and the pursuits of profits are less likely to frustrate cooperation in the public sector. Building more goodwill trust between public organizations seems therefore less important than focusing on other negatives motives. So far, however, little research attention has been paid to the (un)importance of building goodwill trust between public organizations. Existing research on trust in the public sector has focused primarily on workplace trust within public organizations (e.g., Carnevale and Wechsler, 1992), trust between public and private organizations (e.g., Erridge and Greer, 2002), and trust in public organizations among citizens (e.g., Thomas, 1998).

> **P_3:** Lack of trust in loyalty and honesty are less important negative motives for cooperative purchasing between public organizations than between private organizations due to shared values and interests, open communication, existing networks, familiarity, and a nonprofit motive.

Testing P_3 in further research may be difficult because of endogeneity and the causality direction. One way of dealing with these problems is studying the privatization of a public service or the nationalization of a private service over time. Based on P_3, we expect that when privatizing (nationalizing) a service (i.e., competition increases (decreases)), goodwill trust between organizations involved will decrease (grow) over time.

2.5.6. Organizational size and priorities

By data analysis techniques, we tested whether there are significant differences for negative motives between the mean ratings of small, medium, and large agencies. The differences between the mean ratings of normal distributed ratings are found in Fisher's (1949) protected least-significant difference post hoc test after analysis of variance (ANOVA), with $p < .10$ considered to be significant. Significant differences are found for 'lack of organizational commitment', 'lack of managerial support', 'lack of cooperation priority', and 'lack of opportunities to cooperate (e.g., if an agency is not aware whether it can cooperate with other organizations, then the agency may experience a lack of opportunities to cooperate)'. These negative motives are more important to small agencies than larger agencies. These findings are consistent with those of Quayle (2002a), who found that small organizations are reluctant to participate in a purchasing group. This is notable given the piggy-backing opportunity. When reasoning from this opportunity, small agencies should embrace purchasing groups.

The prime concerns of small organizations that Quayle (2002a) found were the possibility of competitors in the purchasing group and insufficient commonalities of purchases to provide purchasing power for the group. However, these issues are not relevant to small UN agencies. As mentioned earlier, the agencies do not compete and purchase many of the same items. Thus, there seem to be other concerns of small organizations that play an important role. One explaining factor might be a lack of opportunities to piggy-back for even common products and services, which supports P_{2a}. Aspects as losing control and insufficient resources could also play a role. In the interviews, respondents indicated that smaller organizations might be more vulnerable to these aspects than large ones because of their smaller size. More research will be necessary to study the influences of these aspects.

P_4: Small organizations give a lower priority to cooperative purchasing than large organizations due to lower organizational support, commitment, resources, and an increased vulnerability to losing control.

2.5.7. Organizational size and competences

A solution to size issues is to let small organizations cooperate with small organizations. However, this might not always be possible. One possible problem could be that none of the small cooperating organizations has a sufficiently competent purchasing function to manage relatively complex cooperation processes. Recently, a benchmarking study in the Dutch public sector (NEVI/PIA, 2005) has shown that small public organizations usually have a lesser developed purchasing function than large organizations. This could be due to, among other things, a lack of economies of scale. We refer to Gelderman and Weele (2005) for further discussions of competent purchasing functions.

If none of the members of a purchasing group has a sufficiently competent purchasing function, then it becomes difficult to manage relatively complex cooperation processes. In this case, a third party might be necessary to initiate purchasing groups. Subsequently, existing or new staff members of a group could manage the cooperative processes.

P_{5a}: The limited number of small organizations with a sufficiently competent purchasing function to manage relatively complex cooperation processes leads to fewer purchasing groups consisting of organizations that are all small.

P_{5b}: More usage of third parties to initiate purchasing groups and new (or existing) staff members to manage these groups results in more groups consisting of organizations that are all small.

2.5.8. Organizations involved or not involved in a purchasing group

As mentioned earlier, we also make an explicit distinction whether the respondents have been involved directly in a purchasing group. Thus, as shown in Table 2.4, we tested for differences between the mean ratings of agencies not involved (*N*) and agencies involved (*I*) in a purchasing group. Again, we assume equal variances when $p > .10$ in Levene's (1960) test for equality of variances.

We found several significant differences between the means of the normal distributed ratings of group *N* and group *I* in independent samples 2-tailed t-tests. Higher ratings for group *N* than for group *I* are found for a 'lack of managerial support' and a 'lack of opportunities to cooperate'. These might be decisive negative motives why agencies in group *N* do not purchase cooperatively. Again, we note that goodwill trust does not seem to be a decisive negative motive for public organizations, which supports P_3. In Chapter 6, we study the differences between group *N* and group *I* in more detail.

P_{6a}: Lack of organizational support and opportunities to cooperate are decisive negative motives for organizations not to become involved in a purchasing group.

Higher ratings for group *I* than for group *N* are found with 'expecting costs to be high' (e.g., due to costs of changing suppliers) and 'lack of trust in competences of other organizations'. Apparently, these are not important negative motives for group *N*. But in

practice, these aspects might be more difficult to deal with than expected, because agencies in group *I* rate these aspects higher than agencies in group *N*.

> **P_{6b}:** Expecting coordination costs to be high and lack of trust in other organizations' competences are more difficult to deal with than expected in cooperative purchasing.

2.5.9. Critical success factors for managing purchasing groups

Critical success factors for cooperative purchasing can be explained by transaction cost economics and partnership and alliance theory. Drawing on transaction cost economics, an example of a success factor is a fair allocation of costs and gains (see the analytical part of this thesis for further discussions of allocation methods). Drawing on partnership and alliance theory, an example is commitment (see Doucette (1997) for further discussions of commitment). Based on the theoretical concepts, Table 2.5 shows more success factors for managing purchasing groups. The table also shows the results of the analysis of the perceived importance of the success factors. For this analysis, we only incorporated the answers of agencies involved in a purchasing group. We have not incorporated the success factor 'team champions' in our survey, but this factor was indicated as important by one of the participants of a follow-up discussion meeting. It seems to be important that at least one of the participating agencies acts as a champion. It is suggested that factors such as organizational competence, sufficient resources, dedication, commitment, and (top) managerial support should be high for an agency that acts as a champion.

Table 2.5 Critical success factors for managing purchasing groups

Viewpoint purchasing group	Average	Viewpoint individual agencies	Average
Products and services		**Commitment and internal support**	
1. Choose suitable products and services	4.8	13. Need and will to cooperate	4.6
Interorganizational trust		14. Sufficient resources	4.6
2. Mutual trust and open relationships	4.6	15. Dedication and commitment	4.4
Formality		16. (Top) managerial support	4.4
3. Performance measurement and reporting	4.3	**Knowledge on how to cooperate**	
4. Commit appointments to paper	3.9	17. Competent purchasing function	4.6
5. Safeguards to prevent anti-trust issues	3.0		
Communication			
6. Communicate and keep up-to-date	4.3		
7. Promote successes and quick wins	3.8		
Organization			
8. Voluntary participation	4.2		
9. Purchasing group not too large or small	3.2		
Uniformity of the members			
10. Similar organizations and philosophy	4.0		
Knowledge on how to cooperate			
11. Know how to deal with supplier resistance	3.9		
Allocation of gains and costs			
12. Fair allocation of gains and costs	3.7		

Note: Perceived importance measured on a 5 point Likert scale from 1 (unimportant) to 5 (important); $n = 11$

When analyzing the results in Table 2.5, we first of all emphasize the importance of 'choosing suitable products and services'. Most of the relevant literature (Hendrick, 1997; Hoffmann and Schlosser, 2001; Ireland et al., 2002) focuses on critical success factors such as mutual goodwill trust, achieving savings, and managerial support.

The table shows moreover that it is not only important to take care of the organization of the purchasing group itself, but also that the individual agencies should take care of relevant internal issues, such as 'sufficient resources'. We argue that these individual internal issues apply particularly to intensive purchasing group types (see also P_1).

Additionally, both content-oriented success factors (e.g., 'commit appointments to paper') and process-oriented success factors (e.g., 'mutual trust and open relationships') seem to play an important role in cooperative purchasing. This is also indicated by Hoffmann and Schlosser (2001) and Ireland et al. (2002) in general alliance performance studies.

Our results confirm that to maximize cooperation, a trust-based relationship among the cooperating organizations must be developed (Ireland et al., 2002). Still, note that as mentioned earlier, lack of goodwill trust is not indicated as an important negative motive by the UN agencies (see also P_3). In other words, the respondents indicate that mutual trust is an important success factor and that it is already present within the UN system.

For the critical success factors, we found no significant differences between the mean ratings of small, medium, and large agencies of normal distributed ratings with ANOVA, with $p < .10$ considered to be significant. We did not expect to find significant differences here as a lot of UN purchasing groups contain different sized agencies in the same group. Apparently, all these agencies rate the success factors of their purchasing groups about the same. In Chapter 6, we study success factors for cooperative purchasing in more detail. In that chapter, we do not ask for the perceived importance of the success factors, but we measure the differences between successful and unsuccessful purchasing groups regarding the success factors.

> **P_7:** Critical success factors for managing purchasing groups are related to choosing suitable items, interorganizational trust, commitment and internal support, knowledge on how to cooperate, formality, communication, voluntary participation, uniformity of the members, and fair allocation of gains and costs.

2.5.10. Fair allocation methods

The indicated importance of a 'fair allocation of gains and costs' in Table 2.5 seems low[7]. Especially as it is indicated by several respondents that some agencies have to deal with the burden of a purchasing group, have higher transaction costs, and lower savings. These effects could be compensated by using a commonly accepted saving allocation method (see also P_1 and P_2). However, during a follow-up discussion meeting, the participants indicated experiencing difficulties with reaching agreement on the perceived fairness of allocation rates.

[7] In a large-scale study in Chapter 6, we find that a 'fair allocation of gains and costs' is an important critical success factor.

Having a competent individual purchasing function is indicated as important by all responding agencies. Nevertheless, agencies with a lesser developed purchasing function could especially learn and gain from cooperative purchasing. The limiting condition is that at least one agency in a purchasing group should have a competent purchasing function. We argue that such an agency should be compensated for extra cooperative efforts. We study the (perceived) fairness of allocation methods in the last two parts of this thesis.

> **P_8:** The development and application of fair allocation methods and increased insight into the (perceived) fairness of allocation methods leads to more successful purchasing groups consisting of organizations that strongly differ.

2.5.11. Products and services

As 'choosing suitable items' is indicated as an important success factor in Table 2.5, we discuss this factor in more detail in this section. Most of the items purchased cooperatively in the UN belong to the major items procured by the UN. Both low value and high quantity items and high value and low quantity items are indicated as suitable for cooperative purchasing. Table 2.6 gives the indicated properties that make items suitable for cooperative purchasing. In Chapter 6, we study these properties in some more detail.

Table 2.6 Properties that make items suitable for purchasing groups

Property that makes items suitable for cooperative purchasing	**% Respondents mentioning the property**
1. Similar needs, requirements or specifications	76%
2. Total gains should outweigh (coordination) costs	54%
3. Standardized and/or not customized items	46%
4. Items which are required on an ongoing basis	31%
5. Stable markets[a]	15%
6. Geographical availability of items	15%
7. No preference for local needs and/or supplier items	8%
8. Program activity synergy in various agencies	8%

[a] This means that purchasing groups often respond slower to market changes than individual organizations, because it may be more difficult to reach consensus

Note: $n = 13$

A remarkable outcome concerns the property 'items which are required on an ongoing basis'. Items not required on an ongoing basis are purchased cooperatively in several purchasing groups according to a study in the Dutch public sector (Schotanus et al., 2004). In this study, the total savings of these purchasing groups are proven to be high as none of the group members possesses enough skills on their own for purchasing exceptional items. One of the restrictions of such groups is that all group members should have similar needs in a certain time frame.

> **P_9:** The most important properties that make products and services suitable for cooperative purchasing are similar needs of cooperating organizations, standardized items, and/or not customized items.

2.6. Limitations

A number of limitations need to be considered regarding the present study. One of the limitations of our empirical findings lies in the fact that we used data analysis techniques on a small data set. With a small data set, caution must be applied, as tests for significance are problematic. However, it is not our objective to accept or reject hypotheses. We develop propositions, thereby laying a basis for this thesis. As mentioned earlier, hardly any quantitative empirical material about cooperative purchasing is yet available to build our propositions. Therefore, we build our propositions on theory, related literature, and on qualitative and quantitative case study data. The quantitative data is used to support the qualitative data.

Other limitations are that we do not distinguish between different purchasing group types and that we do not make a distinction between successful and not successful organizations and purchasing groups. More research will be necessary to study the effects of these aspects (see Chapter 6). Finally, some specific factors may apply only to UN agencies and not to organizations in general (e.g., parallel competition at peaks of emergencies). Still, as mentioned before, there are many similarities between purchasing groups, such as purchasing groups of hospitals, schools, municipalities, UN agencies or other organizations. In principle, as long as the properties of Table 2.6 are met, it is not that important what specific items are bought by a purchasing group (e.g., hospital food, school books, energy, humanitarian aid items, etc.). It turns out to be more important for the success of a purchasing group that the items are bought in a suitable purchasing group type (see Section 2.5.1), for the right motives (see Section 2.5.4), and that the critical success factors are met (see Section 2.5.9).

2.7. Conclusions

In this chapter, we lay a research basis for this thesis based on a UN case study, on the literature, and on theory. We develop several propositions that are mostly related to different purchasing group types, motives, and success factors for managing purchasing groups.

We propose that intensive purchasing group types are less viable when potential group members differ strongly in terms of partnership and alliance theory (P_1). An alternative non-intensive purchasing group type is what is labeled piggy-backing. Small organizations could profit from piggy-backing on contracts of large organizations. For large organizations, there may be no incentive to allow piggy-backing though. Appropriate saving allocation methods could attenuate this piggy-backing problem, increase the opportunities for cooperative purchasing, and generate more purchasing savings for both small and large organizations (P_2). In addition, the development of fair allocation methods and increased insight into the (perceived) fairness of methods could lead to more heterogeneous purchasing groups (P_8). Thus, P_8 could reduce the importance of P_1.

We suggest that ‘coordination’ and ‘lack of trust in others’ competences’ are more difficult to deal with than expected in a purchasing group. We propose that decisive negative motives for organizations are ‘a lack of management support’ and a ‘lack of cooperation opportunities’ (P_6). To facilitate this, we suggest paying attention to ‘organizational

support', 'commitment', 'resources', and 'control' (P_4). Small organizations may be more vulnerable to losing control than large organizations. This could lead to fewer groups consisting of organizations that strongly differ in terms of size. A limited number of small organizations with a sufficiently competent purchasing function could lead to fewer groups consisting of organizations that are all small. In such cases, a third party could help initiating purchasing groups (P_5).

Most of the literature in the area of critical success factors focuses on organizational support and goodwill trust. However, in the public sector, 'lack of goodwill trust' may not be an important negative motive (P_3). Based on our study, we propose that the most important critical success factors for managing purchasing groups are 'choosing suitable items', 'commitment and internal support', 'interorganizational trust', 'knowledge on how to cooperate', 'formality', 'communication', 'voluntary participation', 'uniformity of the members', and 'fair allocation of gains and costs' (P_7). The most important properties that make items suitable for cooperative purchasing are 'similar needs of cooperating organizations', 'standardized items', and/or 'not customized items' (P_9).

As this chapter serves as a basis for this thesis, further research is necessary for further exploring and justifying our propositions. To this end, we study different purchasing group types in more detail in Chapter 3 to Chapter 5. In Chapter 6, we study critical success factors and cooperative purchasing motives in more detail. We study the (perceived) fairness of allocation methods in Chapter 7 to Chapter 10.

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PART II

QUALITATIVE EMPIRICAL APPROACH

In this part, we describe and analyze different purchasing group types while using a qualitative empirical approach. The first two chapters of this part have a static cross-sectional perspective. The final chapter of this part has a dynamic longitudinal perspective. In Part III to Part V, we build on the knowledge obtained in this part of the thesis.

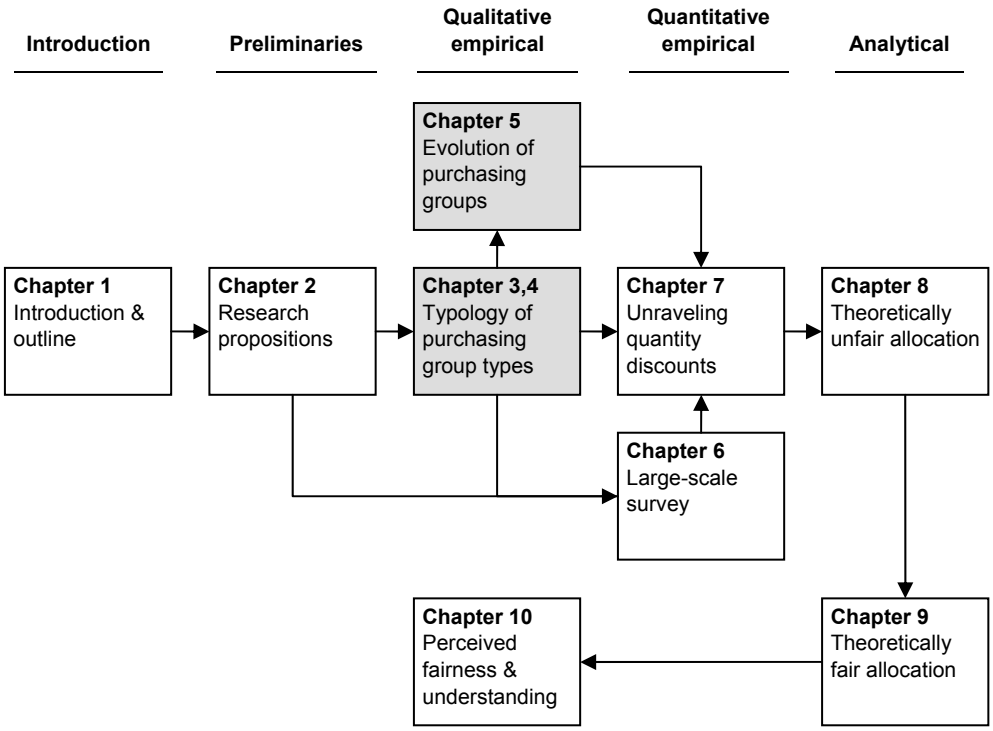

Fig. II.1 Research outline

Chapter 3

A typology of purchasing group types

In the previous chapter, we have noted that more research to different purchasing group types could be worthwhile. This chapter develops a typology of purchasing group types and is summarized as follows.

In the typology, five main purchasing group types are distinguished based on seven main dimensions. The five main group types are positioned in a matrix according to two distinguishing dimensions. These two dimensions are the 'influence by all members on the group activities' and the 'number of different group activities'. Underlying the two-dimensional matrix, there are five other dimensions that do not distinguish all group types from each other, but further detail them.

The typology can serve as a guideline for purchasing groups when a suitable group type needs to be chosen. In a suitable group, the dimensions of a group have certain typical scores. For instance, some purchasing group types perform best as long-term groups (dimension 'life span of the group') with few members (dimension 'size'). Other purchasing group types perform best as long-term groups as well, but have many members. We discuss these typical dimension scores in more detail in this chapter. In addition, we discuss that different purchasing group types imply different research models and may have different advantages, disadvantages, and critical success factors.

In the next chapter, we extend the typology with an extra dimension. In Chapter 5, we study the development over time of a specific purchasing group type. Finally, throughout the thesis, we frequently use this chapter to position our research results[8].

3.1. Introduction

This chapter focuses on developing a typology of purchasing group types. Developing such a typology is important for two main reasons. First, it can be used to clearly define and position different purchasing group types with respect to each other. Second, a typology can be used to design an effective and efficient purchasing group as the typology prescribes how to organize different purchasing group types. In addition, the typology indicates when to use which group type. In Section 3.3, we further discuss the importance of a typology of purchasing group types.

[8] This chapter is largely based on Schotanus, F., Telgen, J., 2007. Developing a typology of organizational forms of cooperative purchasing. Journal of Purchasing and Supply Management, 13 (1), 53–68.

3.2. Specific research objectives

The three main objectives of this chapter link to the aspects mentioned above. The objectives are (1) to describe the main purchasing group types, (2) to develop a typology of purchasing group types, and (3) to position the main purchasing group types with respect to each other in an orderly matrix.

This chapter focuses on the main purchasing group types. For this reason, this chapter does not expand much on hybrid purchasing group types (i.e., group types that are positioned somewhere in between two main group types). In addition, this chapter does not focus on aspects and critical success factors that typically apply to all types of cooperative purchasing to about the same extent. An example of such a success factor is voluntary cooperation. In general, different purchasing group types perform best when they are voluntary (see also Chapter 2 and Chapter 6).

The organization of the remainder of this chapter is as follows. The next section discusses the research relevance. The methodology is described in Section 3.4. Section 3.5 aims to achieve the first objective. There, the main types of cooperative purchasing are described. Section 3.6 aims to achieve the second objective by developing a typology of purchasing group types. Section 3.7 aims to achieve the final objective. In that section, the main types are positioned in a matrix. In the final section, conclusions are drawn and some recommendations are provided.

3.3. A typological perspective

This chapter focuses on research opportunities that link to existing research and several research questions from Section 1.2. The existing research findings discussed in the previous chapter and the answers to several research questions in Section 1.2 depend on the purchasing group type.

Different purchasing group types should be organized differently and are applicable to the accomplishment of different tasks, objectives, and strategies (based on Powell and Dowling, 2006; Sheaff et al., 2004; Thompson et al., 1991). For instance, based on Mintzberg's (1979, 1983) theory of organizational structure, we expect that the answer to the communication question[9] in Section 1.2 depends on the purchasing group type. We expect that a very large and successful third party purchasing group has a different communication structure than a very small and successful intensive purchasing group. A similar argument can be applied to the existing research findings in the previous chapter and to the answers to several other questions in Section 1.2[10]. Here we conclude that many existing research findings depend on the purchasing group type.

Despite the fact that it is not possible to put all different purchasing group types in one box, several researchers dealing with cooperative purchasing do not clearly define and position

[9] How to develop an effective and efficient communication structure for a purchasing group?

[10] The answers to the following questions differ per form. How to allocate the costs and gains of a purchasing group between the members of the group? What is the optimal size of a purchasing group? How to increase the sales of electronic purchasing groups? What is the relationship between the organizational dimensions of a purchasing group and its performance?

the purchasing groups studied. This makes it difficult to compare the research findings of different researchers and to conduct reliable research. For instance, if the purchasing group types are not clearly defined and positioned, then it is difficult for academics and practitioners to identify which advantages, disadvantages, critical success factors, drivers, and preconditions apply to which group type(s).

Additionally, not clearly positioning purchasing groups studied can influence the effects studied. This is shown in an article of Long and Marquis (1999). They describe an example of a lack of distinction between different purchasing group types. Long and Marquis found that some of the effects studied fell short of their expectations. They thought that this may be because they did not make a distinction between different purchasing group types. In their article, Long and Marquis claim that they found much stronger effects when they considered different group types separately in another study. Here we conclude that it is important to clearly define and position the purchasing group type studied.

A typology of organizational purchasing group types can serve as a guideline for the aspects described above. A typology identifies multiple group types, each of which represents a unique combination of organizational dimensions that are believed to determine an optimal result (Doty and Glick, 1994). Here the grand theoretical assertion is that a certain combination of dimensions leads to organizational effectiveness of certain purchasing groups. This theoretical assertion implies that if the dimensions of a purchasing group are not coherent, then this may lead to failure or a relatively low performance of the group. For instance, a typology can show that a very large purchasing group managed by a third party is a suitable type when many organizations have the same generic purchasing need and agree to outsource most of the purchasing steps to an external party. A small and intensive group is a suitable type when a small number of large organizations have a similar purchasing need for a specific product or service and all organizations need to be able to influence the specifications and supplier choice.

A typology can also serve as a guideline when the aim is to solve managerial problems in a purchasing group. For instance, the managers of an intensive purchasing group in which the total number of members is growing and the roles of the members turn out to differ a lot may decide to gradually change the purchasing group type to a less intensive type. Thus, a typology can be used to understand, design, and manage purchasing groups.

We note that existing interorganizational cooperation classifications, taxonomies[11], and typologies mostly apply to vertical interorganizational relationships or strategic cooperation in general (e.g., Grandori, 1997). These models have not been developed for the specific context of cooperative purchasing and can not always be used for cooperative purchasing. This is because there are some unique characteristics involved in cooperative purchasing (see Section 1.1.4). Still, when applicable, this chapter builds on the existing models.

Some empirical research has already been done on different purchasing group types (Arnold, 1996a; Aylesworth, 2003; Bakker et al., 2006a; Hendrick, 1997; Kamann et al., 2004; Kivisto et al., 2003; Nollet and Beaulieu, 2003). However, most of the relevant

[11] Doty and Glick (1994) note that classifications and taxonomies refer to classification systems that categorize phenomena into mutually exclusive and exhaustive sets with a series of discrete decision rules.

literature describes only one or two purchasing group types without clearly positioning the type(s) studied. In addition, the existing literature mostly considers a limited number of main dimensions. This chapter builds on all these existing main dimensions, which are:

- Extent of the costs and gains for the members (based on Nollet and Beaulieu, 2003);
- Influence by all members on the activities of the group (Galaskiewicz, 1985);
- Number of different activities for the group (based on Dyer and Singh, 1998);
- Organizational design of the group (based on Enthoven, 1994);
- Member characteristics (based on Klein Woolthuis, 1999);
- Size of the group (Nollet and Beaulieu, 2003);
- Life span of the group (D'Aunno and Zuckerman, 1987; Johnson, 1999; Nollet and Beaulieu, 2003).

3.4. Method

In this section, we discuss the methodology which we used to achieve our objectives. First, we describe the data source and data collection. Next, we discuss the research procedure.

3.4.1. Data source and data collection

In order to get a more complete understanding of different purchasing group types, 21 semi-structured interviews were carried out in 2003 and 2004 among purchasing managers of fifteen different purchasing groups in the Dutch public sector. These groups were chosen with an attempt to represent a variety of groups. The groups consisted of hospitals, municipalities, universities, government departments or police stations and varied in, among other things, organizational structure, size, and life span.

One purchasing group was studied in more detail by also observing the meetings of the group for over three years. Additional interviews were carried out with the members of the group to discuss the group events in more detail.

The literature and the empirical study have contributed to our understanding of the dimensions, activities, organizational structure, development, disadvantages, advantages, and the critical success factors of different purchasing groups. The outcomes of this research phase were lists of properties of different purchasing groups.

Based on these outcomes, a practical book was written about cooperative purchasing (Schotanus et al., 2004). Three purchasing managers were involved in this book project by describing additional case examples about their purchasing groups. Two more purchasing managers were involved in the project by describing case examples about why they made an explicit choice not to join a purchasing group. These case descriptions further improved our understanding of different purchasing group types. To validate, improve, and evaluate the progress and content of the project, there were two meetings with a focus group of four purchasing managers. These purchasing managers were actively involved in different purchasing groups consisting of municipalities or hospitals. The purchasing managers involved were considered to be practical experts in cooperative purchasing.

3.4.2. Procedure

One of the main objectives of the book project was to develop an initial typology of purchasing group types. This typology has been developed in the context of discovery

(Reichenbach, 1938) and pursuit (Laudan, 1977). Because the project focused on finding typical purchasing groups, the research procedure was highly iterative. Data and theory were continuously compared until patterns clearly emerged and additional data and theory no longer added to the refinement of the typology (Eisenhardt, 1989; Kirk and Miller, 1986; Shenhar, 1998). The main steps of the research procedure were as follows.

Based on the main dimensions mentioned in Section 3.3, several subdimensions that play an important role within purchasing groups were identified. These subdimensions were identified based on our theoretical and empirical findings extended with subdimensions described in academic publications dealing explicitly with cooperative purchasing (see also Table 2.1). The selection of subdimensions was completed by including subdimensions from the literature on cooperation and management in general. Section 3.6 explicitly refers to the sources of the subdimensions.

The scores on the dimensions for the different purchasing group types were determined by theoretical specification. The theoretical specification required expert raters to develop the ideal scores for the different purchasing group types (based on Doty et al., 1993; Segev, 1989). During our interviews and focus group meetings, dimension properties and dimension scores were therefore discussed with practical and academic experts in cooperative purchasing. Simultaneously, the theoretical foundations of the scores were developed (see also Section 3.5). In the typology, only dimensions that have different scores for different group types were included. By doing so, several main purchasing group types were determined.

The final phase of the research project consisted of a presentation of our findings at an annual conference for practitioners in the public sector. Our findings were distributed to 4,000 members of a purchasing association and are available online with a request for feedback on the key issues and any perceived discrepancies. From practitioners, academics, and graduate students, several responses were received which were used to further refine the typology.

3.5. Descriptions of purchasing group types

In this section, five main purchasing group types are discussed. For each type, the main dimensions described in Section 3.3 and several subdimensions are discussed. The five group types are called piggy-backing groups, third party groups, lead buying groups, project groups, and program groups. For all these group types, road transport is used as an analogy. Note that this chapter has a static cross-sectional perspective. Chapter 5 has a dynamic longitudinal perspective and studies the development over time of a specific intensive purchasing group type.

3.5.1. Piggy-backing groups

Piggy-backing groups are informal purchasing groups and focus on keeping the cooperation as simple as possible. In some cases, this purchasing group type only involves the sharing of purchasing information and knowledge with other organizations in a large network. But most of the times, it involves a relatively large organization which establishes a contract on its own specifications. The contract may be used by some smaller organizations under

(almost) the same contract conditions. This concept is known as piggy-backing (see also Section 2.5.3).

For piggy-backing organizations, the concept can be quite beneficiary due to reduced transaction costs and reduced purchase prices. However, for the hosting organization, there is no direct incentive to allow others to piggy-back on its contracts. Sometimes, the host manages to negotiate a somewhat lower purchase price due to the somewhat larger purchasing volume, but this is often the exception rather than the rule. Allowing others to piggy-back even involves some costs for the host, such as extra negotiation costs. Therefore, to make a piggy-backing group work on the long term, the host should preferably receive some compensation.

A difficulty of piggy-backing is the availability of information. Often, organizations are not aware they have the possibility to piggy-back on contracts of others. In addition, in several countries, legislation makes it more difficult for public organizations to allow piggy-backing. This is the case when the purchasing volume with a current supplier would increase a lot due to piggy-backing, while this potential increase is not mentioned in the original public tender. If this is not mentioned, then prospective suppliers did not have full information at their disposal. This contravenes with aspects such as transparency and equal treatment. A final difficulty is that suppliers do not always allow smaller organizations to piggy-back on the contract of a large organization under the same conditions. This aspect can be solved by a somewhat higher purchase price with the other conditions unchanged. Despite this higher purchase price, there still remain reduced tender process times and transaction cost savings, which are advantageous both to the buyers and the supplier (Arnold, 1996a). Another advantage for the supplier is that it might be beneficial to supply a whole region of cooperating organizations in one sector.

An analogy for piggy-backing is hitchhiking. Piggy-backing organizations usually cannot influence the purchasing specifications and supplier choice, such as a hitchhiker on the road usually cannot influence the final destination of its ride. Therefore, the coordination costs of piggy-backing are low, but the concept is not always applicable.

A practical example which resembles a relatively intensive piggy-backing group is the purchasing group of the municipality of Groningen and several other local governments in three different provinces in the Netherlands. This purchasing group has been active for more than two decades[12] *and covers about 20 common products and services. Groningen is relatively large compared to the other organizations and allows the others to piggy-back on its contracts. When purchasing managers of Groningen negotiate a new contract for their own organization, they ask the supplier whether it is possible for the smaller governments to piggy-back on the contract. The smaller governments are free in their choice to piggy-back and to make use of the scale and expertise of Groningen. Groningen receives a small fee from the suppliers to cover some of the expenses related to the purchasing group, such as helpdesk costs.*

[12] Hoffmann and Schlosser (2001) discuss that some studies consider an alliance's longevity a benchmark for success (based on Hagedoorn and Schakenraad, 1994; Mitchell and Singh, 1996).

3.5.2. Third party groups

Third party groups mostly involve long-term piggy-backing made possible by public or private external parties or central authorities with devoted resources. A third party is a for-profit organization or a non-profit organization and may be owned by the members of the purchasing group. The third party may host forum websites for purchasing discussions and establish new contracts for common products and services on behalf of and for use through e-procurement or direct use by all the group members. Thus, the third party focuses on achieving a large scale and it carries out most of the purchasing activities by itself. Typically, the purchasing activities are based on the (expected) aggregate purchasing volume and are carried out with the specific purchasing expertise of the external party (based on Harland et al., 2003).

The group members do not have to communicate with each other. So, just like in a piggy-backing group, the members do not have to form a high involvement relationship with each other, nor do they have to discuss the purchasing specifications (based on Aylesworth, 2003). The members only have to have a formal relationship with the hosting organization or the third party.

A disadvantage of third party groups is that the members usually have hardly any control over the purchasing process. Thus, the group members cannot really influence the purchasing specifications and supplier choice. Finally, it may be difficult for SMEs to supply to very large third party groups. This can be solved by dividing some of the purchasing needs into smaller parts and by buying from multiple suppliers (based on Linthorst and Telgen, 2006). For further discussions of how electronic third party groups work, see Corsten and Zagler (1999) and Huber et al. (2004). For further discussions of how third party groups may develop over time, see D'Aunno and Zuckerman (1987), Johnson (1999), and Nollet and Beaulieu (2003).

An analogy for a third party group is a bus service. Most of the times, there is no limit to the total number of members of a third party group (i.e., the total number of bus travelers), but the members do have to pay a membership fee (i.e., a bus ticket) to cover the costs made by the third party.

Practical examples of third party-like groups are regional or national purchasing organizations or member-owned service bureaus (Aylesworth, 2003). Third party groups are especially popular in the health sector in the US. This sector has a long history of cooperative purchasing. Currently, third party groups cover a large percentage of the products and services purchased by health care institutions in the US.

3.5.3. Lead buying groups

A lead buying group involves outsourcing purchasing activities to one of the members of the group: each item is purchased by the most suitable organization or external party according to their expertise, resources or purchasing volume. This concept enables the members of a group to specialize in purchasing typical items. Some consideration and evaluation meetings will be necessary to determine which member should carry out which activities. These meetings also allow the members to influence to some extent the tenders put out by the others.

It is possible to apply the concept of lead buying to a one-time event. However, this is often difficult as in a one-time lead buying group (i.e., a charter group), chances are high that the leading members are not fully compensated for their efforts. To our knowledge, one-time lead buying groups are not often used. Therefore, we do not consider this concept as a main purchasing group type.

The advantages and disadvantages of lead buying are similar to the advantages and disadvantages of outsourcing purchasing activities in general. For instance, a disadvantage of a lead buying group is that the members become dependent on the knowledge and skills of the other members.

As more consultation is necessary with lead buying than with third party purchasing, lead buying groups usually have fewer members. In addition, in lead buying groups, the members have at least some similarities, such as the same geographical location or a similar network.

A more intensive purchasing group type than lead buying is necessary when all members have to work together on purchasing complex products or services. Section 3.6 mentions some similarities and differences between lead buying groups and more intensive groups.

An analogy of lead buying is carpooling. Sometimes, one organization drives the group members to a certain destination. Another time, another organization provides the car and the driver.

A practical example which resembles a relatively large lead buying group is the purchasing group of the Dutch regional police forces. Most of the purchasing departments of the Dutch police force are represented in this group. In subgroups, some of the members lead purchase together on a relatively small scale for tendering commodities such as cleaning services. On a larger scale, products like police cars are purchased cooperatively. Lower purchase prices and reduced transaction costs have been achieved in this purchasing group. However, some organizations with an advanced purchasing function indicate that it is difficult to share purchasing activities with organizations that have a less advanced purchasing function.

3.5.4. Project groups

Typically, a project group is an intensive one-time purchasing group for a shared purchasing project. The members of the group bundle their forces for one time and together they carry out the purchasing activities. Typically, the members focus on a shared problem and try to learn from each other during the project. In addition, the members share supply risks and knowledge.

The members meet regularly during the project, but as the purchasing group is a one-time event, the organizational structure is quite simple. For instance, a steering committee is usually not necessary.

Because a typical project group is a one-time event, the number of different cooperative activities for the group is limited. The group usually breaks up after the project ends, but if the project is successful and the members share more purchasing needs, then the project

group could be continued as a lead buying group (see Section 3.5.3) or a program group (see Section 3.5.5).

In contrast to long-term intensive purchasing groups, project groups usually do not ask for much bonding (Kamann et al., 2004). Project groups do involve a lot of consultation between the members to bring the specifications up to the same level and to agree with one another on the supplier choice.

It can be difficult to work together with members who do not know each other very well. Particularly in a project group, one should prevent potential free-riding problems or at least try to limit its effects. If an organization is still carrying out more work than the other organizations, then this organization should preferably be compensated.

An analogy of a project group is a convoy on the road. Here a convoy is defined as a unique combination of independent trucks. Together, the trucks bundle their forces and drive to the same destination for one time.

A practical example which resembles a project group combined with a piggy-backing group is OT2000. OT2000 was a very large purchasing group for telephony services involving 311 public organizations. A small number of these organizations were involved in the actual tendering process in a steering committee. As the other organizations piggy-backed on the cooperative contract, it was difficult to involve all the final users of the telephony services during the tendering processes. Another difficulty was that the organizations involved in the actual tendering process were mostly located near one municipality. Piggy-backing organizations in regions further away were not supplied as well as the organizations near the municipality. Despite the difficulties, substantial average savings on the purchase price were gained and the overall service level was improved. The coordination costs were high though and mostly allocated to the organizations actively involved in the tendering process in the steering committee. Some organizations evaluated the purchasing group as quite successful. Others evaluated it as hardly successful or not successful at all.

3.5.5. Program groups

Intensive purchasing groups, such as program groups, often involve representatives of the management teams of the cooperating organizations meeting regularly in a steering committee to discuss cooperative projects. The members have high involvement relationships with each other and all can influence specifications and supplier selections.

Cooperative projects are usually carried out by at least one member of the steering committee together with representatives of all cooperating organizations. Together, they carry out several steps of the purchasing process. Thus, the members share the administrative work and focus on learning from each other and on reducing transaction costs.

Program groups and lead buying groups often have a similar organizational structure. In addition, to be able to work effectively, several purchasing processes are usually standardized or synchronized in both group types. Still, there is a major difference. The activities for a cooperative project for a lead buying group are carried out by the personnel

of one organization and not by different organizations. In a lead buying group, there are therefore fewer learning opportunities. Because the cooperative processes are less complex in a lead buying group, there are also less transaction costs and the group can have more members.

Regarding the formality of an intensive purchasing group, we note the following. Formal purchasing groups can be separate legal entities owned by their members. Formal groups can also be highly structured groups without legal entities. Criteria for formality are regular organized meetings and the use of several procedures and rules, such as duties and rights, joining rules, and leaving rules. Usually, the more trust, commitment, need, experience or knowledge on how to work together is available, the less formality is necessary (Klein Woolthuis, 1999). More formality is necessary with enforced cooperation, higher financial or legal risks and interests, mutual competition, less organizational similarities or when one or more members have a formal culture.

Program groups regularly make use of a private or public external party to coordinate some of the activities. A program group can have one contract between the group and the supplier for a product or service, but typically, each member has an individual contract with the shared supplier.

A typical difficulty for program groups in the private sector is the sharing of confidential information. Typical difficulties for all program groups are communication problems (Laing and Cotton, 1997) and the allocation of gains and costs (see also Section 2.5.10). The allocation of gains and costs can be difficult when the members differ in several aspects, such as organizational size or purchasing skills. In any case, allocation methods can be used to compensate unequal roles of members or inequalities between members.

As already mentioned in Section 2.5.2, the more integration of the purchasing processes of the members of a group takes place, the more the aspects mentioned in partnership and alliance theory apply (Kamann et al., 2004). This means that if the cooperation is very basic and non-intensive, then partnership and alliance theory aspects, such as transparency and commitment, are less important. Intensive purchasing groups ask for more organizational similarities and mutual communication. Therefore, for a program group, the relative coordination costs are higher and the total number of members is lower than for non-intensive purchasing groups such as third party groups.

An example of a cooperative agreement used in relatively small purchasing groups is a best price agreement: if one member receives a better price from a supplier for a shared item while renegotiating a contract, then all members also buying from this supplier should receive this reduced price from this supplier.

Large organizations active in cooperative purchasing are often involved with (relatively) intensive purchasing groups, such as a program group. The larger the organization, the less profitable it will be to piggy-back on another organization's contract as more specific contracts are often necessary. Cooperating small organizations are usually involved with third party purchasing and piggy-backing (based on Quayle, 2002a), because they lack economies of scale on their own. As mentioned in Chapter 2, note that small organizations are less active in cooperative purchasing than large organizations. This leaves several

opportunities for improvement as most companies are small, but represent the largest part of the total turnover of all companies (Ramsay and Wagner, 2007).

An analogy of a program group is an F1-team. Program groups and F1-teams are intensive forms of cooperation. Everyone involved in such forms of cooperation plays an important role.

A practical example of a program-like group is Netwerkstad Twente, a purchasing group of four municipalities. Despite some organizational differences, the municipalities share several contracts. The municipalities found several opportunities for cooperative purchasing by analyzing and diagnosing their purchasing spend. Difficulties arise occasionally due to some organizational differences. For instance, the municipalities find it to be difficult to cooperatively improve the professional level of their purchasing functions. It is also difficult to calculate the cooperative gains and costs. This is because the gains and costs have a complex structure. Still, the members evaluate the group as successful as most of the shared projects lead to lower purchase prices and/or better quality of the purchased products and services.

3.5.6. Publications on purchasing group types

Table 3.1 classifies the academic publications that deal directly or indirectly with the main purchasing group types. Interested readers can find typical aspects and some more information about the main group types in these articles.

Table 3.1 Academic publications and purchasing group types

Group type	Academic publications	
Piggy-backing	Exworthy and Peckham (1998)	
Third party	Ball and Pye (2000)	Huber et al. (2004)
	D'Aunno and Zuckerman (1987)	Johnson (1999)
	Doucette (1997)	Nollet and Beaulieu (2003)
	Enthoven (1994)	Nollet and Beaulieu (2005)
	Evans (1987)	Stinchcombe (1984)
	Exworthy and Peckham (1998)	Yuan and Lin (2004)
Lead buying	Ball and Pye (2000)	Johnson (1999)
	D'Aunno and Zuckerman (1987)	Laing and Cotton (1997)
	Exworthy and Peckham (1998)	Tella and Virolainen (2005)
	Granot and Sošic (2005)	
Project	Exworthy and Peckham (1998)	Granot and Sošic (2005)
Program	Ball and Pye (2000)	Granot and Sošic (2005)
	D'Aunno and Zuckerman (1987)	Laing and Cotton (1997)
	Exworthy and Peckham (1998)	

3.6. A typology of purchasing group types

In Table 3.2, the ideal scores on several dimensions are provided for the different purchasing group types. Based on the arguments given in Section 3.5 and the studies mentioned in Table 2.1, the scores for the dimensions were determined on a range from low to high.

Table 3.2 A typology of purchasing group types

Dimensions	**Group type**				
	Piggy-backing	**Third party**	**Lead buying**	**Project**	**Program**
1. Objectives (based on Nollet and Beaulieu, 2003)[a]					
Total gains for all members	low-med	med-high	med	low-med	med-high
Total costs for all members	low	med	med	med	med-high
2. Influence by all members on the activities of the group (Galaskiewicz, 1985)					
Complexity for all members	low	low	med	high	high
Equal roles within the group	low	low	med	high	high
Independency on the skills of others	low	low	med	high	high
Intensiveness for all members	low	low	med	high	high
3. Number of different activities for the group (based on Dyer and Singh, 1998)					
Diversity of activities for the group	low	high	med	low	high
4. Organization (based on Enthoven, 1994)[a]					
Formalization of the group	low	high	low-med	med-high	low-med
Free-riding prevention mechanisms	low	low	low-med	med-high	low-med
Group adaptation to specific needs	low	low-med	med	high	high
Group resources[a]	low-med	high	low-med	med	low-med
Self-management[b]	low	low	med	high	high
Standardization of member policy, etc.	low	low	med-high	low	med-high
5. Member relationships (based on Klein Woolthuis, 1999)[a]					
Min. level of commitment of members	low	low-med	med-high	high	high
Min. level of coterminosity of members	low-med	low	med-high	med-high	med-high
Min. level of homogeneity of demand	high	med-high	med-high	med	med
Min. level of uniformity of members[c]	low	low	med	med-high	med-high
Min. level of trained member personnel	low	low	med-high	high	high
6. Size (Nollet and Beaulieu, 2003)					
Activities (number of)[a]	low	med-high	low-med	low	low-med
Members (number of)[a]	low-med	high	low-med	low	low
7. Group life span (D'Aunno and Zuckerman, 1987; Johnson, 1999; Nollet and Beaulieu, 2003)					
Expected life span of the group	low-med	high	high	low	high

Note: The subdimensions are based on: gains and costs (Nollet and Beaulieu, 2003), complexity (Johnson, 1999), independency (Eßig, 2000), intensiveness (Klein Woolthuis, 1999; Williams, 2005), devoted resources (Bakker et al., 2006b; Nollet and Beaulieu, 2003), formalization (Ball and Pye, 2000; Dyer and Singh, 1998; Johnson, 1999), free-riding prevention (Dyer and Singh, 1998; Johnson, 1999), saving allocation methods (Heijboer, 2003; Chapter 2), self-management and decentrality (Bakker et al., 2006b; Williams, 2005), control (Chapter 2), joint decision making (Laing and Cotton, 1997), standardization (Bakker et al., 2006b), committed members (Williams, 2005), coterminosity (Exworthy and Peckham, 1998), homogeneity of demand (Bakker et al, 2006a; Rozemeijer, 2000), and number of members (Bakker et al., 2006a; Nollet and Beaulieu, 2003)

[a] These dimensions are discussed in more detail in Chapter 5

[b] Can also be defined as joint meetings, control, decisions by all members, and/or decentrality

[c] For instance, uniformity of organizational structure, size, policy, market, and life span

Based on Table 3.2, it is noticed that within the purchasing group types several differences may exist. For instance, program groups can be more or less informally or formally structured. In addition, it is noted that not all dimensions are formulated at the same level. Some dimensions are more abstract than others.

Based on Doty and Glick (1994), it is noted that the typology can be tested on a large scale in further research. This can be done by examining the extent to which deviation from the ideal scores on the dimensions predicts failure or a relatively low performance of a purchasing group (based on Doty and Glick, 1994). In addition, Venkatraman (1989) argues that a high degree of adherence to an ideal profile should be positively related to performance. Venkatraman refers to this degree of adherence to an ideal profile as profile deviation.

Profile deviation requires developing weights for the dimensions based on their relative theoretical importance to the context. In some situations, it is assumed that each dimension is equally important (Segev, 1989; Venkatraman, 1989). In other situations, the weights are assumed to be unequal (Mintzberg, 1979, 1983). Table 3.2 has already distinguished main dimensions from subdivisions, but a more explicit distinction (in weights) could be made in further research. De Boer (1998) refers to several ways of deriving weights including analytical hierarchy process (Saaty, 1980). Alternatively, Venkatraman (1989) suggests using preference-mapping techniques (Carroll, 1973) or regression equations (Venkatraman and Prescott, 1990).

In further research, the final step in testing the typology is comparing the weighted theoretical dimension scores with the weighted dimension scores of successful and unsuccessful purchasing groups. To this end, Doty and Glick (1994) suggest several techniques for assessing profile deviation including coefficients of pattern similarity (Cattell, 1949), D-statistic (Cronbach and Gleser, 1953), and q-techniques (Miller, 1978).

3.7. The highway matrix

In Section 3.6, it is noticed that there are several differences within each purchasing group type. Still, there are also dimensions that distinguish the group types from each other. Section 3.7.1 discusses the theory behind two distinguishing dimensions. Section 3.7.2 positions the group types in a matrix according to these dimensions.

3.7.1. Distinguishing dimensions for purchasing group types

Based on new institutional economics and transaction cost economics (Williamson, 2000), a wide range can exist of different hybrid purchasing group types. These group types are defined as coordination by network and range between coordination by hierarchy and coordination by market (Arnold, 1996b; Galaskiewicz, 1985; Jones and Hill, 1988; Thompson et al., 1991). That is why purchasing groups can be organized in quite a number of different ways.

We argue that in some cases, a purchasing group type tending to coordination by hierarchy is a suitable type. For instance, this would be the case when several organizations work together in a large exceptional purchasing project and all need to agree on the specifications and supplier choice. In other cases, a purchasing group type tending to coordination by market would be more suitable. For instance, this would be the case when several organizations have the same purchasing need for a common commodity and agree to outsource most purchasing steps to an external party. In all cases, the members continue to exist as separate organizations, but they do combine their purchasing power.

The range between coordination by hierarchy and market relates to the intensiveness for the members of a purchasing group. Intensiveness is defined as the extent to which a group member is compelled to perform an active role in a purchasing group. In a third party group, the members are not very active as the work is usually done by the third party. In a program group, the group members perform an active role. As a result of this active role, the members of a program group can influence most of the purchasing activities of the group. The higher the intensiveness for the members in a purchasing group is, the more the group type leans to coordination by hierarchy. The lower the intensiveness is, the more the group type leans to coordination by market. All the dimensions related to the intensiveness dimension (see Table 3.2) are quite specific to the purchasing group types (i.e., they do not differ heavily within one or more of the group types). For this reason, this dimension is chosen as one of the axes.

Another dimension in Table 3.2, which does not differ heavily within one or more of the purchasing group types, is related to the actual activities of a purchasing group. This dimension is defined as the 'number of different activities for the purchasing group'. It ranges from undertaking 'one occasional cooperative activity' to 'continuously undertaking different activities'. These activities are carried out by an external party or by the group members themselves. Because this dimension is also specific to the purchasing group types, this dimension is chosen as the second axis.

3.7.2. A matrix for purchasing group types

To be able to position the different purchasing group types with respect to each other, a matrix was developed as illustrated in Fig. 3.1. A fitting matrix was found for all the group types by using the two dimensions which were discussed in Section 3.7.1. Underlying the two-dimensional matrix, there are several other dimensions (see Table 3.2) that do not distinguish all group types from each other, but further detail the types. For instance, program groups are typically long-term groups (dimension 'life span of the group') with few members (dimension 'size'). Third party groups are long-term groups as well, but have many more members than a program group.

The matrix can be used during the establishment of a purchasing group as follows. First of all, the desired intensiveness for the group members is considered as a limiting condition. For instance, if the members want to influence the group activities, then piggy-backing and third party groups are usually unsuitable group types. Thus, the desired intensiveness needs to be determined first. Next, depending on the number of different group activities, a comparative assessment needs to be made between typical disadvantages (e.g., free-riding, increased chance of supplier resistance, etc.) and advantages (e.g., learning from each other, reduced tender process throughput time, etc.) of the group type. For instance, it follows from Fig. 3.1 that a program group can be used when members want to be able to influence the group activities and learn from each other. In addition, a program group can be used for specific to generic purchasing needs. Similar arguments can be applied to the other dimensions and to the other group types. Finally, given a choice for a certain group type, Table 3.2 can be used to determine how to organize the purchasing group[13].

[13] Some purchasing group types can also be used as a preceding step to another group type. For instance, a project group can be used as a preceding step to a program or lead buying group.

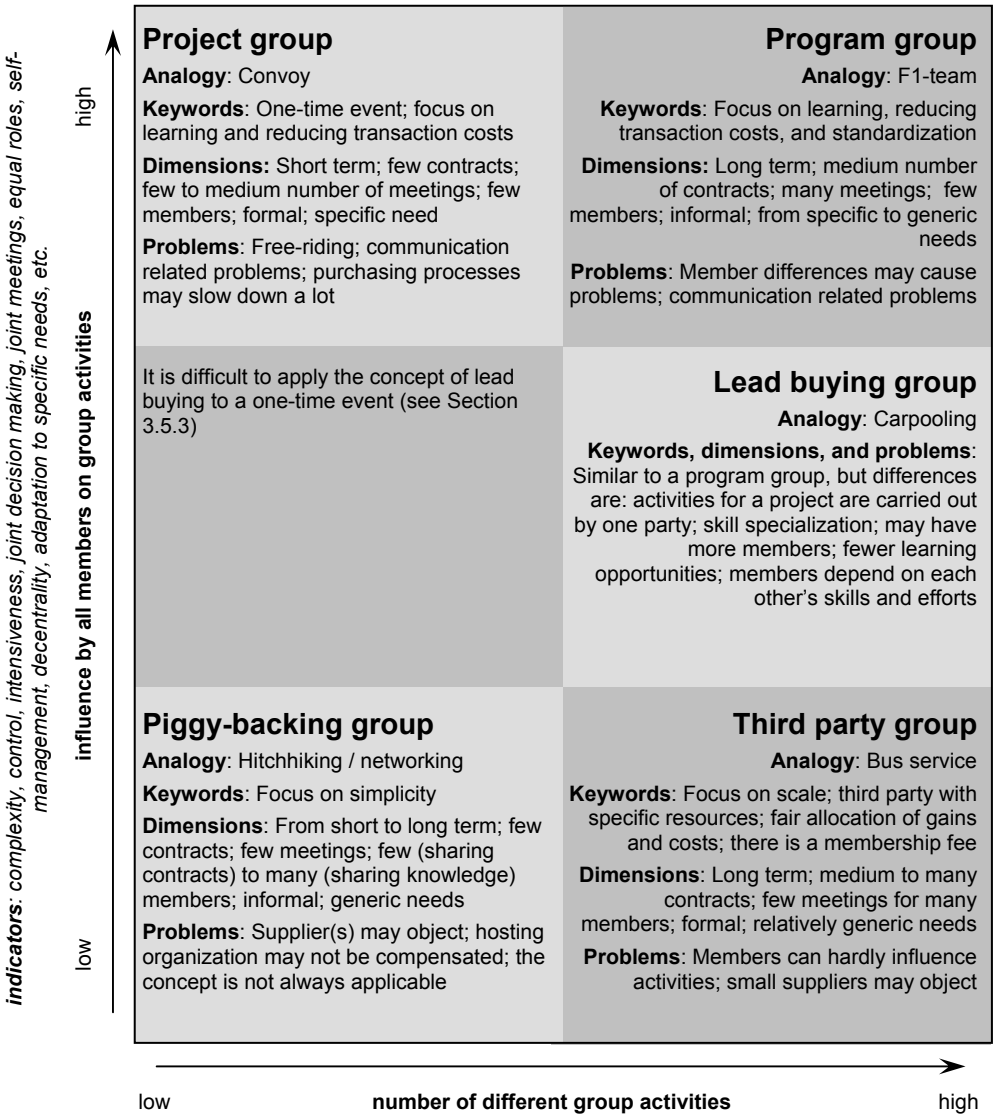

Fig. 3.1 The highway matrix

3.7.3. Hybrid and combined purchasing group types

For specific situations, hybrid purchasing group types can be set in place. Hybrid group types often occur between a lead buying group and a program group. In this hybrid group type, the activities for a cooperative project are carried out by a limited number of members. This hybrid group type can have more members than a program group.

Hybrid group types can also occur between a third party group and a lead buying or program group (i.e., a private bus service group). Private bus service groups can have more

members than a project or program group. In addition, these hybrid group types usually involve an external party or a steering party. This party carries out some of the work for the group.

Combinations between group types are also possible. For instance, project, lead buying, and program groups often allow piggy-backing. Here it is noted that the combined purchasing group OT2000 (see Section 3.5.4) was not a success for several of its members. One of the possible reasons for this was that the hosting organizations were not compensated for their efforts.

Another regularly occurring combination is the combination between a program group and a lead buying group. In this combined group type, the activities for a cooperative project are sometimes carried out by an external party or one member (i.e., lead buying). For other cooperative projects, the activities are carried out by all the members (i.e., program purchasing). For the members, it is important to cooperatively agree on when to use which group type. Usually, low-interest items, which are not custom-made, are suitable for lead buying. These items are suitable as the other members do not care much about the specifications and supplier choice. Usually, medium-interest items are more suitable for program groups.

In further research, a refinement of the matrix may be possible by discussing more detailed descriptions of hybrid group types. A further refinement of the matrix may be possible by adapting the two distinguishing dimensions or by introducing more dimensions.

3.8. Conclusions

The first objective of this chapter is to describe the main purchasing group types. Based on the literature, organizational structure theory, new institutional economics, and expert ratings, five group types are identified and described. These group types range from a relatively simple type as a piggy-backing group to a relatively complex type as a program group.

The second objective is to develop a typology of purchasing group types to better understand, design, and manage purchasing groups. The main identified dimensions of the typology are: (1) extent of the costs and gains for the members, (2) influence by all members on the activities of the group, (3) number of different activities for the group, (4) organizational structure of the group, (5) member characteristics, (6) size of the group, and (7) life span of the group. Table 3.2 gives the complete typology including the dimension scores per purchasing group type.

The third and final objective is to position the purchasing group types with respect to each other. To be able to position the types, a matrix is developed according to two distinguishing dimensions (see Fig. 3.1). The two distinguishing dimensions are dimensions (2) and (3). The other five dimensions provide more information about the group types, but do not distinguish all types from each other.

Clearly defining and positioning purchasing groups studied is important as different group types imply different research models and mechanisms. Critical success factors,

advantages, and disadvantages may differ per type as well. This implies that some of the group types are more suitable to certain situations than others.

This chapter adds to existing literature by providing more insight into several dimensions of different types, which is crucial to better understand why different types fit different situations. Nevertheless, more research to the evolution of some group types could be useful (see Chapter 5). More specifically, this applies to the right-hand side group types of Fig. 3.1. These group types are intensive or active and typically have a high expected life span.

The typology prescribes how to organize different purchasing group types and can serve as a guideline for (potential) purchasing groups when a suitable group type needs to be chosen. In a purchasing group, a certain combination of dimensions leads to organizational effectiveness. If the dimensions of a purchasing group are not coherent, then this may lead to failure or a relatively low performance of the group. For all purchasing groups, it is recommended to find a balance between the different dimensions. Finding this balance is something in which the typology may help. As long as this balance is present, purchasing groups can maximize cooperative advantages and minimize related disadvantages.

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Chapter 4

A symbiotic extension of the typology

In the previous chapter, we have developed a typology that makes a distinction between five purchasing group types. This chapter extends the typology to incorporate the relationships between the group members involved, by adding a so-called symbiosis dimension. This symbiosis dimension assists purchasing groups in the way they should manage the member relationships. More specifically, it provides information about the necessity for a formal allocation method for savings distribution. This is important as cooperative savings are not always fairly allocated among the members of a group (see also Chapter 2). This may put a strain on the relationships within some purchasing groups.

This chapter contains a re-analysis of 51 previously published case studies of cooperative purchasing, which provides initial support for the new symbiosis dimension in the extended typology. Based on the cases analyzed, it is discussed that some purchasing group types have relatively little need for a special allocation method for savings distribution, whereas others do in order to run the group successfully. We devote a separate chapter to the extension of the typology, as allocation methods are important elements of later chapters[14].

4.1. Introduction

For specific purposes, the typology discussed in Chapter 3 can be extended with more dimensions. One possible extension is the allocation of gains and costs (i.e., the allocation of savings). The allocation of savings within a purchasing group is not always perceived as fair by its members (see also Chapter 2). In a large purchasing group, for instance, a small member may receive more savings than a large member. This may put a strain on the interorganizational relationships within the purchasing group. Therefore, for a purchasing group, it is useful to be able to assess the fairness of the allocation of savings and thereby knowing whether relationship strains are likely to occur. However, the typology only implicitly considers the possible savings for different purchasing group types.

4.2. Specific research objectives

In this chapter, we aim to add a new dimension to the typology developed in Chapter 3. This dimension deals with the gains and costs of the relationships between members in different purchasing group types. More specifically, for each purchasing group type, we first aim to find out whether the gains and costs are typically allocated in a fair manner. Next, for each purchasing group type, we determine the necessity for a fair allocation method in order to run the purchasing group successfully.

[14] This chapter is based on Waltmans, B., Reunis, M., Schotanus, F., Santema, S.C., 2006. Group purchasing classification: Symbiotic relationships in horizontal purchasing cooperation. IMP conference proceedings, Milan (Italy).

The contribution of the new dimension lies in the fact that it provides information about the allocation of gains and costs within the different purchasing group types. It can thereby be seen as a proxy for the stability of the relationships within that group. Representatives of a group can use this information to try to prevent an unfair allocation of gains and costs. They may decide to enforce allocation methods as discussed in the analytical part of this thesis.

This chapter is organized in the following way. First, we use analogies from symbiotic relationships in biology to analyze whether the gains and costs are typically allocated in a fair manner in different purchasing group types. Next, 51 cases of cooperative purchasing from 23 different papers are analyzed to find empirical support for the corresponding symbiosis dimension of the different purchasing group types.

4.3. A biological perspective

Our proposed extension of the typology uses forms of potential gains and costs within symbiotic relationships in the field of biology. The biology perspective has been chosen because much research in this area on the subject of relationships among species has already been performed.

As organisms in nature, organizations have to deal with other organizations everyday. We argue that if two or more organizations decide to cooperate by means of a purchasing group, analogous symbiotic relationships from nature can be applied. The relationships between organisms in nature can be seen as analogous to the ones in business where organizations represent organisms and society represents nature (Eßig, 2000).

In biology, a symbiotic relationship refers to an interaction between two organisms that live in an intimate association. The 'populations' are limited to two types (the term 'host' is used for the largest organism, the smaller organism is called the symbiont, if applicable) and the results are operationalized as positive (+), negative (-) or neutral (0). The various forms of symbiosis include mutualism (+,+), commensalism (+,0), parasitism (+,-), amensalism (0,-), and neutralism (0,0) (e.g., Johnson et al., 1997). Mutualism, for instance, means that both organisms living in an intimate association gain by cooperating.

The analogy with cooperative purchasing is assumed to hold only for the first three forms of symbiosis, since, at least one member should be able to gain by cooperating. Otherwise, it is likely that the purchasing group changes form or even ceases to exist, which is plausible since none of the organizations is experiencing any gains from it (based on Smith et al., 1995).

4.3.1. A preliminary analysis

It is assumed that a purchasing group is considered a mutualistic form if and only if all group members experience a positive effect. If at least one member experiences a neutral effect, then the purchasing group is labeled commensalism; if at least one member experiences a negative effect, then the group is labeled parasitism. When determining the symbiosis dimension, we aim to take all different types of savings applicable to the purchasing group into account. For the main purchasing group types (see Chapter 3), the expected symbiosis dimensions are presented in Table 4.1. In the next sections, we substantiate these expectations.

Table 4.1 Preliminary analysis

Group type	Mutualism	Commensalism	Parasitism
Piggy-backing	–	–	✓
Third party	✓	✓	–
Lead buying	✓	✓	–
Project	✓	✓	✓
Program	✓	✓	–

4.3.2. Piggy-backing and third party groups

Considering the different purchasing group types mentioned in the typology, some remarks have to be made in the context of symbiosis. Piggy-backing, as a group type, is basically a form of parasitism, because piggy-backing mostly involves small members piggy-backing (i.e., parasiting) on contracts of one large member, the host.

Third party groups are basically also a form of parasitism, because third party groups involve long-term piggy-backing made possible by a third public or private party or central authorities. However, we expect that third party groups use gain and cost allocation methods to solve the problems that may arise from piggy-backing. In the case of third party groups, the cooperative activities undertaken by the purchasing group are based on a long time horizon such that appropriate allocation methods can be installed. In this way, third party groups that basically are of a parasitism kind transform to a commensalistic or a mutualistic type.

Piggy-backing groups usually do not involve many cooperative activities. In addition, the relationships between the members of a piggy-backing group are not intensive and are usually short-lasting. Therefore, for most piggy-backing groups, we do not expect that they use gain and cost allocation methods. Note that for this reason, we proposed in Chapter 2 that reallocating some of the gains of piggy-backing organizations to organizations that allow piggy-backing leads to more organizations involved in piggy-backing.

Despite the parasitic basis of piggy-backing, there might be some intangible gains for the organization which carries out the role of the host. For instance, the hosting organization might improve its reputation. So, not in all cases the piggy-backing relationship can be positioned easily as parasitism. Still, in general, we assume that piggy-backing groups are parasitic.

4.3.3. Lead buying and program groups

Purchasing group types such as lead buying groups and program groups are of a different nature and are expected to be of at least a commensalistic or even a mutualistic kind. Members cooperate more intensively than in the case of piggy-backing and third party groups. Typically, this leaves no room for parasites in the long run. It is noted that both lead buying groups and program groups sometimes allow piggy-backing on their cooperative contracts for other organizations. This can be considered as a separate purchasing group. Thus, such a group resembles a combination of lead buying and piggy-backing.

4.3.4. Project groups

A project group is an intensive purchasing group type as well. The higher likelihood of free-riding for this group type lies in its nature. Project groups are typically one-time

purchasing groups and this increases the risk of parasitism. Therefore, for this group type, parasitism as a symbiosis dimension is also expected to occur in practice besides commensalism and mutualism.

4.4. Method

In this section, we discuss the methodology that we used to find empirical support for the preliminary analysis discussed in the previous section. First, we describe the data source and data collection. Next, we discuss the research procedure.

4.4.1. Data source and data collection

In order to find support for the actual occurrence in practice of the expected symbiosis dimensions as presented in Table 4.1, 51 cases of cooperative purchasing have been analyzed. These 51 cases have been obtained from 23 different papers in which the object of analysis is a cooperative purchasing situation. Note that we have discarded 17 cases of a total of 68 because of lack of information to position them appropriately in Table 4.1 and in the high-way matrix. Again, this emphasizes the importance of clearly describing and positioning purchasing groups studied. If a purchasing group studied is not clearly described, then it is difficult or not possible to build on the research results derived from this purchasing group.

The selected cases provided enough information to position them according to the typology of purchasing group types and Table 4.1. This means the cases provided information about the way the purchasing group is structured and about the realized and or (future) potential savings for the purchasing group members.

An advantage of analyzing cases from published papers is that the cases are well-studied. In addition, the papers offer rich case descriptions from all over the world. A disadvantage is that the cases cannot be compared at a detailed level, because the case descriptions have different formats and discuss different issues. Therefore, we only carried out a cross-case analysis for the symbiotic extension of the typology.

4.4.2. Procedure

All the cooperative purchasing situations have been positioned according to the typology. Furthermore, each case has been appointed a symbiosis dimension which is considered most appropriate for that case. At least one and usually two researchers[15] positioned the cases. Some minor differences of opinion regarding the positioning of the cases were discussed and taking into account for all the other cases. In the end, the researchers agreed upon the positions of the cases. An overview of the cases analyzed and additional information of the cases is presented in Appendix 4.1.

The choices for the symbiosis dimensions are based on what savings have been reported for the different cases. Savings not only include financial savings such as price reductions, but they also include increased attention from suppliers, sharing inventories, sharing information and knowledge, and the ability to outsource the negotiation and contracting to a third party, who may have expert knowledge about a certain industry.

[15] Waltmans, B. and Schotanus, F.

The annual financial purchasing group savings that have been reported range up to 30% (Hendrick, 1997; Johnson, 1999)[16]. Since every dollar savings on purchasing contributes directly to the bottom line of an organization's income statement, purchasing groups seems attractive for many of its members.

4.5. Cross-case analysis

The results of analyzing the 51 cases are presented in Table 4.2. In the next sections, we discuss the results in more detail.

Table 4.2 Cross-case analysis

Group type	Mutualism	Commensalism	Parasitism
Piggy-backing	–	–	4
Third party	9	17	1
Lead buying	16	(4)	–
Project	1	1	1
Program	5	–	–

Note: In some cases, combinations of purchasing group types occur

4.5.1. Piggy-backing groups

As expected, Table 4.2 suggests that piggy-backing is a form of parasitism in practice. Four cases of parasitism have reported organizations piggy-backing on the contracts of other organizations. Sometimes, the organization that allows other organizations to piggy-back, receives some sort of compensation. Still, in none of the cases analyzed, there were clear savings for the organization that allows other organizations to piggy-back.

Not many cases have been found in the literature that describe purchasing groups as piggy-backing. Due to their parasitism kind, these groups may not last long and may therefore not be very common. Another explanation for the fact that we did not find many cases is that this purchasing group type is relatively 'simple'. Therefore, it might be less interesting to report on these purchasing groups.

4.5.2. Third party groups

In the cases analyzed, third party groups are two thirds of the time a form of commensalism and one third of the time a form of mutualism. A reason for this can be that third party groups involve many members and many activities. Therefore, it can become less likely that all parties gain. Furthermore, some of the third parties that actually carry out the tenders are non-profit organizations and do not profit from cooperative purchasing, although it does provide them a raison d'être. Also, allocation methods may not be sufficiently introduced to allocate the savings of the group fairly.

4.5.3. Lead buying and program groups

In some cases, lead buying is found to be a form of commensalism, but lead buying is mostly found to be a pure form of mutualism. The reason that commensalism does occur four times is that due to a lack of information, it did not become clear whether indeed all members gained. These have been indicated commensalism as well as mutualism in the

[16] Note that the savings reported seem rough estimates and are not always defined very clear.

table. Reasons for the fact that we did not found clear cases of commensalism could be the level of involvement of the cooperating organizations and a social control method.

Program groups are a form of pure mutualism. The reasons for this are the same as those for lead buying groups.

4.5.4. Project groups

A project group does not seem to be a common purchasing group type. Typically, it only exists for a limited period. Probably therefore, not many are found in practice. As indicated in the table, a project group can be of every dimension. Since project groups are one-time projects, the risk of free-riding increases (see also Section 4.3.2).

4.6. The extended highway matrix

For the data set, it turned out that, contrary to our expectations, lead buying groups and program groups are mutualistic and not commensalistic. The implication hereof is that we have adjusted the dimensions of lead buying groups and program groups to purely mutualistic. Results of the other purchasing group types confirmed our expectations.

Now the main question posed is how the extension of the typology can help to increase its usefulness in determining the way to manage the relationships between members involved. More specifically, the extension may provide an initial step towards a fair allocation of savings for purchasing groups. How this fair allocation can be realized is not studied here, but provides material for discussion and further research (see the analytical part of this thesis). Formal allocation methods may provide a solution to the problem of an unfair saving allocation. This may change the dimension of parasitic or commensalistic groups towards a mutual beneficial one. Note, however, that mutualism is not always a stable form of cooperation. If some organizations profit much more than other similar organizations, then this may also lead to allocation problems. So, even in purchasing group types which are typically mutualistic, there exists a (low) risk of allocation problems.

An illustrative example where this has happened in practice is provided by the Massachusetts Higher Education Consortium (MHEC) (see Chapter 10 for more examples). This purchasing group resembles a typical third party group. MHEC has over 80 members and undertakes many activities ranging from purchasing computers to caps and gowns (Bishop, 2002). The allocation method that has prevailed for 20 years was as follows. Dues were tied to the school's last three-year average of the purchased volume. Small schools that buy less pay less in dues, and big schools that buy more pay more. According to the 2004–2005 annual report of MHEC, this method has been found to be unfair by members of the MHEC and the basis for the dues structure has changed from a three-year average of purchased volume to a structure based on enrolment and staffing. A broad based committee has voted unanimously for this new method. In addition, to our knowledge, the method has prevailed since then. Hence, it seems reasonable to assume that this new method is of a perceived mutual gain. The dimension of the purchasing group seems to have shifted from commensalism towards a mutual beneficial one.

Since the symbiosis forms provide information on the allocation of savings, it implicitly also provides information about the necessity for a formal saving allocation method to run

the group successfully. This has been indicated in Fig. 4.1 by means of different colors. It is as with a health service – another analogy – which advises to get a vaccination when traveling to foreign countries (high risk of infection) or if it is something to take into consideration given the circumstances but not always necessary (lower risk of infection).

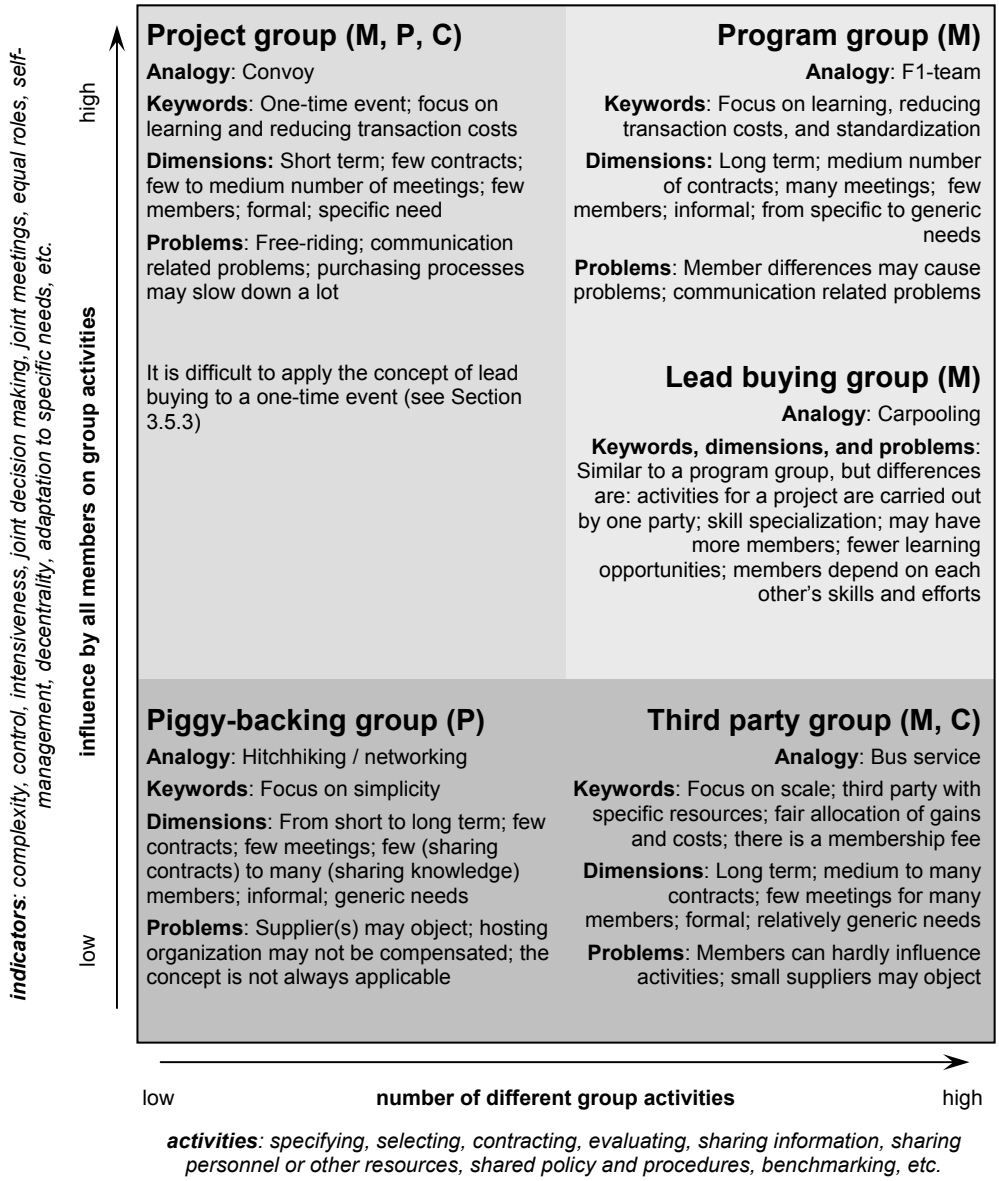

Fig. 4.1 The extended highway matrix

Fig. 4.1 can be used by managers to evaluate when it is necessary to change a purchasing group into a mutual beneficial one by means of a formal allocation method. For instance, the necessity for a formal allocation method in order to run a third party group successfully is relatively high. The necessity for a formal allocation method in a typical program group is relatively low. Still, if some members of a program group add much more value to the group than other members, then the need for a formal allocation method increases. Thus, a relatively low necessity does not imply that allocation methods are not useful for program groups.

Another issue to consider is the effect of delays of potential savings. For instance, an organization may not gain directly from allowing nearby organizations to piggy-back, but in a later stage, suppliers may value the actual purchases the piggy-backing group has made, thereby providing a better deal for the group later on.

Mutual altruism may also play a role in piggy-backing groups (Brehm et al., 2005). If you help somebody else, then they may help you later on. Thus, at first sight, the purchasing group seems to be parasitic, but to find out whether this is really the case asks for a longer time horizon of the analysis.

4.7. Limitations

A word of caution is necessary in the interpretation of the cross-case analysis. Based on the descriptions of the case studies, it remains difficult to draw hard conclusions about the way in which the group members involved actually gained from the purchasing group. In several cases, only a strong suggestion was created in the case description. Even more difficult – and mostly impossible – was the determination of the savings for individual departments within the cooperating organizations. Some departments may profit more than others by cooperative purchasing.

More in-depth research is necessary to determine the issues mentioned above. In this context, a clearer definition of what kinds of savings group members experience may, for instance, explain why some purchasing groups apparently allow parasitism.

4.8. Conclusions

This chapter has extended the typology of the previous chapter with a dimension to deal with the relationships in a purchasing group. It serves the purpose of developing a model that is better suited for the purpose of the assessment of the fairness of the allocation of savings within a purchasing group. An analogy with symbiotic relations in the field of biology has been used to specify the new dimension. After that, symbiosis positions for the different types of purchasing groups have been assumed and 51 rich case descriptions have been analyzed to find support for the new dimension.

It is discussed that program and lead buying groups have relatively little need for a special allocation method for savings distribution (low necessity), whereas piggy-backing and third party groups have a high need in order to run the group successfully (high necessity) (see also Fig. 4.1). Still, if some members of a program group add much more value to the group than other members, then the need for a formal allocation method increases. Thus, a

relatively low necessity does not imply that allocation methods are not useful for program and lead buying groups. The actual application of allocation methods for purchasing groups is discussed in more detail in Chapter 8 to Chapter 10.

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Appendix 4.1 Purchasing groups analyzed

No.	Purchasing group	Purchasing group type	Region	Mutu-alism	Commen-salism	Parasi-tism
1	Wisconsin technical IT&T consortium	Lead buying		✓	✓	
2	Voluntary hospitals of America	Third party	National		✓	
3	Hospital federation of nine hospitals in the Rochester area	Lead buying		✓		
4	Local network	Lead buying/ piggy-backing	Local/ regional	✓		✓
5	Volunteer confederation	Lead buying	Local/ regional	✓		
6	Regional purchasing agency	Intensive third party	Regional		✓	
7	Member-owned service bureau	Intensive third party	Regional		✓	
8	For-profit enterprise	Third party	National	✓		
9	Profession networks in the NHS of the United Kingdom	Lead buying		✓		
10	Pharmacy buying consortia	Lead buying		✓		
11	Confederations: similar as the group above	Lead buying		✓		
12	Collaborative procurement consortia in the National Health Service United Kingdom	Third party			✓	
13	The Massachusetts higher education consortium	Third party	Regional	✓		
14	Canadian association of university business officers	Lead buying		✓	✓	
15	Interuniversity services incorporated	Third party	Regional	✓		
16	Canadian universities reciprocal insurance exchange	Third party		✓	✓	
17	SUPC	Third party	Regional	✓		
18	CHEST	Third party	National		✓	
19	Central buying consortium	Lead buying	Local	✓	✓	
20	London universities purchasing consortium	Third party	Regional	✓	✓	
21	Corporate united	Third party		✓		
22	South Australia human services libraries consortium	Lead buying		✓		
23	Healthcare industry	Third party		✓		
24	No name	Program		✓		

No.	Purchasing group	Purchasing group type	Region	Mutu-alism	Commen-salism	Parasi-tism
25	Canadian electric power generator	Third party		✓		
26	Premier incorporated US purchasing consortium	Third party	National		✓	
27	Novation US hospital consortium	Third party	National		✓	
28	Amerinet	Third party	National		✓	
29	Consortia Catholic resource partners	Third party	National		✓	
30	Premier	Third party	National		✓	
31	Shared services, healthcare incorporated	Third party	National		✓	
32	Health insurance plan of California	Third party	Regional			✓
33	GPOs in the health care industry in the US	Third party	National		✓	
34	IAPSO	Third party	Inter-national		✓	
35	Small United Nations agencies piggy-backing on contracts of larger agencies	Piggy-backing	Inter-national			✓
36	No name, United Nations organizations	Lead buying	Inter-national	✓		
37	Groningen	Piggy-backing	Regional			✓
38	Dutch police force	Lead buying	National	✓		
39	Netwerkstad Twente program	Program	Local	✓		
40	Netwerkstad Twente piggy-backing	Piggy-backing	Regional			✓
41	OT2000	There were several piggy-backing organizations	National			✓
42	No name	Program	Regional	✓		
43	Steden3hoek	Program	Regional	✓		
44	Friesland care	Lead buying	Regional	✓	✓	
45	Intrakoop	Third party	National		✓	
46	Moerdijk	Program	Local	✓		
47	Papendrecht and others	Lead buying	Local	✓		
48	PIANOdesk	Third party	National		✓	
49	Vlaardingen and others	Lead buying	Local	✓		
50	Consortium of machinery manufacturers	Lead buying		✓		
51	OT2006	Project	National	✓	✓	

Chapter 5

Micro-evolutions of purchasing groups

In Chapter 3 and Chapter 4, we have showed that several types of purchasing groups exist. Some of these group types have a long expected life span and may develop on several dimensions over time. In this chapter, we aim to describe in more detail how a purchasing group (can) develop. In addition, we aim to describe how a purchasing group can establish a suitable purchasing group type. We focus on intensive long-term purchasing groups, such as program groups.

Summarizing the considerations above, this chapter deals with the evolution of purchasing groups. Although previous research has paid attention to the so-called 'macro-evolutionary' phases of purchasing groups, little attention has yet been paid to the intra-phase developments, the so-called 'micro-evolutions'. Insight into micro-evolutions is important to better understand how purchasing groups (can) develop over time.

Three in-depth case studies are conducted in different countries. We identified five interorganizational management dimensions of micro-evolutions in which development may take place: 'member relationships', 'objectives', 'activities', 'organization', and 'resources'. For each dimension, an overview is provided of micro-evolutions to guide purchasing groups in developing the dimension. Some problems described in this chapter, such as calculating and allocating the savings of a purchasing group among its members, are dealt with in Chapter 7 to Chapter 10[17].

5.1. Introduction

The theory of evolution explains how organisms change over time in terms of micro- and macro-evolution (Darwin, 1859). Micro-evolution deals with the occurrence of small-scale changes at or below the species level. Macro-evolution concerns the occurrence of large-scale changes above the species level that could result in the emergence of new life forms (Brooks and McLennan, 1991).

There is an ongoing debate about the advantages and disadvantages of applying an evolutionary approach to social science. For further discussions of this debate, we refer to Hodgson (2002). In this chapter, we acknowledge that biological and organizational evolution have differences, but that an analogy exists with the evolution of open complex systems, such as organizations (Barnett et al., 2000; Boulding, 1956; Nelson and Winter, 1982; Oliver, 2001; Schumpeter, 1962) and cooperatives (Hammerstein, 2003).

[17] This chapter is based on Schotanus, F., Bakker, E., Walker, H.L., Eßig, M., 2007. Cooperative purchasing micro-evolutions: A longitudinal international study. IPSERA conference proceedings, Bath (United Kingdom).

In organizational evolution, micro-evolutions account for small-scale changes in an organization. This type of change resembles first loop learning (Argyris and Schön, 1978), which is the adjustment of otherwise routine behavior (Nelson and Winter, 1982). Macro-evolution deals with the occurrence of large-scale changes in an organization that could result in the emergence of a new organizational form. These changes resemble second loop learning (Argyris and Schön, 1978) and can occur when outsiders with new ideas enter an organization or when routine behavior results in such negative feedback that it causes one to experience a 'critical incident' that drives a cultural change (Schein, 1985). In general, as human sensemaking is retrospective, only after having lived through an experience and receiving feedback, there is room for learning and cooperative initiatives can develop (Weick, 1979).

In the field of cooperative purchasing, some research has been conducted on macro-evolution phases in purchasing groups (D'Aunno and Zuckerman, 1987; Johnson, 1999; Nollet and Beaulieu, 2003). However, within the macro-phases at a micro-evolutionary level, little is known about when and under which circumstances which interorganizational problems can be expected and prevented in purchasing groups. We assume that such problems can cause groups to struggle and under-perform, to not survive a phase or to dismantle. Insight into micro-evolutions could benefit purchasing groups in their performance and could guide them in their development, if necessary. Nevertheless, there is even little evidence on how cooperation between organizations in general evolves over time on a micro-evolutionary level (Smith et al., 1995). More specifically, as noted, there is little evidence on how purchasing groups evolve on a micro-evolutionary level, which leads to a lack of understanding of purchasing group development. This is unfortunate as dynamics are important in cooperation processes (Ring and Ven, 1994).

5.2. Specific research objectives

To fill the research gap on micro-evolutions in the context of cooperative purchasing, we explore cooperative purchasing micro-evolutions. We build on previous research into macro-evolutions, which we use as a framework for exploring micro-evolutions. Our research question is: What are the main micro-evolutions that take place in macro-phases in purchasing groups? Thus, we study interorganizational management dynamics of purchasing groups at a more detailed level than previous studies.

This chapter is organized in the following way. First, we discuss the existing literature on macro-evolutions. Next, we discuss a micro-evolutionary framework in the context of cooperative purchasing. Subsequently, we describe three case studies, the data collection, and the research procedure. In the results section, we aim to identify micro-evolutions for several interorganizational management dimensions for purchasing groups. The last sections discuss the implications, limitations, and conclusions.

5.3. A macro-evolutionary perspective

Three macro-models have been developed in the context of cooperative purchasing. These macro-models are based on the literature (D'Aunno and Zuckerman, 1987), four case studies (Johnson, 1999), and 73 interviews (Nollet and Beaulieu, 2003). The models were developed independently from one another, but overlap substantially. For instance, all

models recognize four similar macro-phases. In addition to the macro-phases, Nollet and Beaulieu (2003) recognize several interorganizational management dimensions. In addition to specific cooperative purchasing evolution models, purchasing literature shows examples of the evolution of the purchasing function within organizations (e.g., Cousins and Marshall, 2000; Reck and Long, 1988; Weele, 2001). As a purchasing group can be seen as a way of organizing (i.e., setting up an organization to procure), this literature is important to purchasing groups as well.

We integrated the three macro-models and the general (purchasing) evolution literature into one typology (see Table 5.1). The labels of the macro-phases in the table are based on the results of D'Aunno and Zuckerman (1987). The labels of the dimensions are based on the results of Nollet and Beaulieu (2003). Roughly, we can link the macro-phases in the table to the purchasing group types discussed in Chapter 3 and Chapter 4. The first two macro-phases correspond more or less to lead buying or program groups. The last two macro-phases correspond more or less to third party groups.

We acknowledge that macro-phases can only be assessed retrospectively and that boundaries between phases are not clear-cut (and are hence often subjectively drawn). Additionally, the boundaries do not manifest themselves physically in reality. Nevertheless, they are believed to form a useful concept to describe what happens over time and learn from it (Greiner, 1972).

The core theoretical assertion of purchasing group development macro-models and micro-models is that purchasing groups pass through predictable phases. Thus, strategies, structures, and activities of a group correspond to the phases (D'Aunno and Zuckerman, 1987). Nollet and Beaulieu (2003) note that a purchasing group does not have to start in the first macro-phase, nor that the final macro-phase should be aimed at as a key objective. In addition, based on the general management literature (e.g., Burns and Stalker, 1961; Lawrence and Lorsch, 1967; Woodward, 1958, 1965), more developed purchasing group types do not always have to be the best group types, as different types are appropriate in different circumstances.

Table 5.1 is a useful typology on a macro-level, but it does not specify how purchasing groups develop at a micro-evolutionary level. For instance, a purchasing group in the first phase may encounter several problems due to limited resources and a group in the third phase may encounter several problems due to the growing number of members. Another disadvantage of a macro-evolutionary model is that it is rather difficult and subjective to make claims concerning the point in time a group passes from one macro-phase into another phase. We show in this chapter that a flexible micro-evolutionary model can partially fill in these voids.

Table 5.1 A macro-evolutionary typology for purchasing groups

Dimensions	**Macro-phases**			
	1. Informal group emergence	**2. Formal cooperative transition**	**3. Cooperative maturity**	**4. Cross-road**
Size	Small, usually few members	Medium, usually more members	Medium to large, may have a lot of members	On the one hand, central decision making may increase, what enables the group to further expand; on the other hand, members may withdraw as the group reduces the autonomy of the members
Member relationships	Low-involvement relationships between members; members share similar ideologies and dependencies	Relationships between members become closer	Group becomes more capable in addressing all member concerns equitably; sustain member commitment	
Objectives	Lobby and start finding fields to cooperate; price reduction, transaction cost benefits, and increased product quality; environmental changes may initiate the group	Price reduction and increased product quality; start professionalizing purchasing processes	Total cost reduction; emphasis on efficiency and maintenance; increase value for the complete supply chain	
Activities	Purchase simple generic commodities cooperatively; share purchasing information	Purchase also more complex commodities; increase in number of commodities managed	Offer also more diversified commodities and services to the members; cooperative supplier development; integrate systems of members	
Organization	Decentral; little planning and coordination; more or less hierarchy coordination; communication and structure is informal	From decentral to central; between hierarchy and market coordination; there are membership criteria; from informal to formal	Central; more or less market coordination; may be a private enterprise; stable structure; multidisciplinary; contracts may include mandatory participation clauses; formalization of rules	
Group resources	Members manage all aspects; members are volunteers	Group develops separate resources	E-catalogues and e-links with members; group develops very competent resources	
Supplier relationships	Bid competition; operational and tactical buying		Develop strategic supplier partnerships, joint working and drive innovation	

Note: The macro-phases are based on D'Aunno and Zuckerman (1987), Johnson (1999), and Nollet and Beaulieu (2003). Note that the macro-phases correspond to the life-cycle phases of individual organizations (i.e., birth, growth, maturity, and decline or redevelopment phases) discussed by, among others, Gray and Ariss (1985). The macro-phases also correspond to the entrepreneurial, collectivity, formalization and control, and elaboration of structure phases discussed by Quinn and Cameron (1983)

5.4. A micro-evolutionary perspective

In this section, we position the interorganizational management dimensions of Table 5.1 in the general supply chain management literature. Purchasing groups can be interpreted as networks of organizations. Adding the supplier perspective, purchasing groups are part of 'network sourcing' (Hines, 1996). As a result, the general framework for cooperative purchasing micro-evolutions must be closely connected with a network management approach, such as discussed by Mentzer et al. (2001). Managing networks is discussed in the context of supply chain management (e.g., Cooper et al., 1997) and industrial marketing and purchasing (e.g., Ford et al., 2003; Håkansson and Ford, 2002). Bringing together logistics and purchasing in the network context (Tan, 2001) seems the ideal approach for researching purchasing groups, because it includes knowledge about interorganizational relationships, integration and management of cooperative processes, and the purchasing function.

In the general supply chain management literature, a much-used general management model has been developed by Lambert and Cooper (2000). This model distinguishes supply chain network structures, processes, and management components. In Table 5.2, we have integrated the dimensions from Table 5.1 with this model.

Table 5.2 A micro-evolutionary framework for purchasing groups

Dimension	Description
Structure	**Who are the members with whom to link processes?**
1. Size	Establishing the size of the group
2. Member relationships	Establishing relationships between members
Processes	**What processes should be linked with each of the members?**
1. Objectives	Establishing the objectives of the group
2. Activities	Establishing what to do together
Management components	**What integration and management level should be applied for each process link?**
1. Organization	Establishing an organizational structure for the group
2. Group resources	Establishing resources for the group
3. Supplier relationships	Establishing relationships with suppliers

Note: This table is adapted from Table 5.1 and Lambert and Cooper (2000)

To identify micro-evolutions, in the next sections, we draw on the framework from Table 5.2 and organizational learning theory. As mentioned in the introduction, micro-evolutions resemble occasions of first loop-learning (Argyris and Schön, 1978). In organizational learning theory, micro-evolutions are also referred to as examples of organizations' – like purchasing groups – 'learning by doing' (Senge, 1990). The theory explains that learning new reactions may occur by positive or negative feedback, such as problems, drivers, and limiting conditions. The question then is how an organization should learn from these experiences and evolve to manage its organization and achieve its objectives. In the next section, we discuss the implications of this theory for our research procedure. In the results section, we aim to identify micro-evolutions for the dimensions mentioned in Table 5.2.

5.5. Method

In this section, we discuss the methodology which we used to achieve our objective. First, we describe the data source. Next, we discuss the data collection and research procedure.

5.5.1. Data source and description

We conducted three case studies, as multiple case studies enhance external validity and allow for replication in multiple settings (Johnston et al., 1999). To build up a complete picture of the evolution of a purchasing group, detailed data collection is necessary and access is often a constraint. Hence, we chose to use existing contacts to ensure we gained a good understanding of the evolutionary process. Our existing contacts include public sector cooperative purchasing groups. Based on prior knowledge through our contacts, the three cases were chosen as we were aware that they had been in existence for several years and they represented relatively young, yet developed purchasing groups. This enabled us to look back over several macro-phases. The advantage of studying the development of relatively young purchasing groups is that the first macro-phase of the groups took place only a couple of years ago. Therefore, a similar study of the creation of contemporary purchasing groups should not produce much different results (Miller and Friesen, 1984). As we had ongoing relationships with the groups, we could also return to them if additional information was required to build a rich picture of their development.

The three purchasing groups have been active for at least five years and none of the groups use the concept of shared service centers (see Bergeron (2003) for definitions and further information about shared service centers). So, all groups are considered to be 'full' purchasing groups and not hybrid organizational forms between shared service centers and purchasing groups. In the next three subsections, we describe the three case studies in more detail.

Study 1 investigates a purchasing group consisting of about 50 healthcare organizations in the United Kingdom. The members differ in size, among other things. The group is a separate organization, although not a separate legal entity. It started informally in 2000 with building a framework for the organization of the group. The group started formally in 2001 after securing funding from six members. The services of the group include strategic involvement with members and taking over all the purchasing activities of some members. Members invest in the group against a promised return on investment, which is laid down in a service level agreement. The main objectives of the group are obtaining better leverage and compliance to contracts. Currently, the group is governed by a board of directors representing about 50 members. It also has a chief executive officer that is responsible for day-to-day operations. Annually, performance targets are set, including achievements of tangible savings for the members. The focus of the group lies in regional and local health purchasing, but attention is also paid to cross-government regional purchasing and the uptake of national contracts.

Study 2 investigates a purchasing group consisting of five Dutch municipalities. The group is about six years old and is not a separate legal entity. The members are all located in the same region. By analyzing purchasing spends, the members found several opportunities for cooperative purchasing. Difficulties arise occasionally due to organizational differences,

making it difficult for members to cooperatively improve the professional level of their purchasing functions and to find agreement on specifications of commodities. Still, all members evaluate the group as successful. Most cooperative projects lead to lower prices, improved process quality, and improved product quality. Currently, the group has a steering committee, which coordinates the cooperative projects. During the steering committee meetings, the initiation and progress of cooperative projects is discussed. The group employs a part-time manager and in some cases, the group uses a private external party to carry out some operational activities.

Study 3 investigates a purchasing group consisting of fifteen scientific-technical and biological-medical German research centers. The centers, which are legally independent bodies, pursue long-term research goals on behalf of the state and society as autonomous scientific bodies. Some of the research centers operate sites all over Germany. Others operate locally, but all of them are already part of a registered association which loosely integrates strategic directions. The purchasing managers of the research centers participate in a management board, which meets twice a year to discuss topics concerning the purchasing function. After the liberalization of the energy markets, this board initiated the cooperative purchasing of electricity. Electricity can be bundled easily due to its high degree of standardization. The rotating leader of the board organizes and administers the cooperative purchase of electricity. The group, which is not a separate legal entity, carried out three tenders for electricity in five years' time. Difficulties arose occasionally due to differences in required contract terms. Nevertheless, cost reductions were achieved and duplication of efforts and activities was prevented. The group ended after five years due to problems with one of the suppliers during the supplier selection process for a new cooperative contract.

5.5.2. Data collection

In order to understand how problematic factors interrelate in organizations, it is necessary to study the historical evolution of an organization by utilizing methods of longitudinal analysis (Miller and Friesen, 1984; Smith et al., 1995). Therefore, we collected several sources of data over the complete timelines of the purchasing groups. The data sources include minutes, reports, business letters, administration data, and practical articles written about the groups.

We also carried out semi-structured interviews with different stakeholders. These interviews were carried out to verify and complement the other data sources. We verified our interpretations of the interviews with the interview respondents. For study one, six interviews were carried out with representatives from the purchasing group. Three interviews were carried out with senior policy level employees from a central healthcare buying agency that supported the development of the purchasing group. In addition, numerous e-mails were sent to the interviewees to ask for verification or ask additional questions. For study two, 28 meetings of the purchasing group were attended, four interviews were carried out, and two focus group meetings were held. For study three, all meeting minutes and tender records of the purchasing group were intensively analyzed. Additionally, three in-depth interviews were carried out with the lead buyer association and its top purchasing management.

Denzin and Lincoln (1998) describe different forms of triangulation; our research involved (1) data triangulation by using different sources of information, (2) methodological triangulation by using interviews and document analysis, and (3) investigator triangulation as each researcher analyzed the summarized data of each case study and analyzed the combined results of the case studies (see Table 5.3 to Table 5.7 and Appendices 5.1 to 5.4). We went on refining the combined results until the findings from the different researchers aligned. By using triangulation methods, we enhanced the reliability and internal validity of the study.

5.5.3. Procedure

Our research procedure was as follows. First, we created a detailed timeline for each purchasing group from their start to the time of collecting the data. We created the timelines by using second loop learning and similar procedures as those described by Ariño and Torre (1998), Beverland and Bretherton (2001), Dey (1993), Miles and Huberman (1994), and Miller and Friesen (1984). This means that every time a driver, condition, objective, problem, reaction or achievement was mentioned in one of the data sources, we added this as a point to the timeline. We excluded general management and purchasing problems that do not differ much for purchasing groups and individual organizations. For instance, if a purchasing group starts using concepts such as multiple sourcing, then this may bring along related challenges and problems. For such problems, we refer to the related literature. Thus, we only incorporated interorganizational problems, which are problems that largely arise from the difficulty of coordinating activities of several different group members, each of which has its own goals and established routines (Montjoy and O'Toole, 1978).

Second, we searched for patterns in the timelines of the three case studies by using similar procedures as those described by Miller and Friesen (1984) and Miles and Huberman (1994). We identified similarities and differences between the cases and coded all issues found. We used different codes for drivers, conditions, objectives, problems, reactions, and achievements. For instance, we used codes as ‘driver number one’, ‘achievement number one’, and ‘achievement number two’. For similar issues, we used the same codes. For instance, we used the same code for all problems regarding the issue that the members of a purchasing group have different needs.

Third, we classified the codes by using the dimensions shown in Table 5.2. For instance, we classified the code for ‘flexible agreements with suppliers’ as the dimension ‘supplier relationships’.

Fourth, for each dimension, we placed all codes of the three case studies in chronological order in one document. This document allowed us to position the codes by using the macro-phases shown in Table 5.1 (see Appendix 5.1 for a summary of the results of this analysis). The chronological order of the codes turned out to be predictable. In other words, it rarely happened that the order of the codes in one case was much different from the order in another case.

Based on the results of the analysis described above, we identified several cooperative purchasing micro-evolutions for each dimension and for each macro-phase. We used the format of the development model of Monczka et al. (Axelsson et al., 2005; Leyenaar et al., 2005) to describe the micro-evolutions (see also Table 5.3 to Table 5.7). This format turned

out to be suitable for orderly expressing the micro-evolutions. Still, as it is only a format, it did not influence the actual content of our results. By building the timelines, we integrated the different data sources. In addition, we radically reduced the size of the data set to three orderly timelines. The largest timeline (Study 2) consisted of 132 points, such as drivers or problems. The smallest timeline (Study 3) consisted of 75 points. The summarized timelines of the studies are shown in Appendices 5.2 to 5.4.

5.6. Micro-evolutions of purchasing groups

In this section, we first describe the macro-evolutions that took place in the case studies. This description is short as we do not focus on macro-evolutions. Next, we describe the micro-evolutions in more detail.

The three purchasing groups started with simple objectives, such as reducing purchase prices and transaction costs, preventing duplication of efforts and activities, and sharing information. On a macro-evolutionary level, Studies 1 and 2 developed from an ad hoc and purchasing focus to a general business focus. These groups also started to professionalize purchasing processes that take place within the purchasing departments of the members. On a macro-level, the groups developed for several dimensions (e.g., 'objectives') from an informal group to a mature group (see also Table 5.1). For some other dimensions, this was not the case (e.g., 'size'). Evidence of such developmental differences between dimensions support our argument for a more flexible micro-evolutionary approach in which the dimensions can be considered independently.

For our flexible approach, we identified several achievements, problems, and possible reactions that may occur within the first three macro-phases (none of the studies reached the final macro-phase yet). In the next tables, we describe the micro-evolutions for several dimensions. As the groups did not develop much on the dimensions 'size' and 'supplier relationships', we omitted them from our analysis. For the dimension related to managing 'supplier relationships', this particularly involved a lot of issues that for purchasing groups are similar to individual organizations. For each of the other dimensions, we have integrated the achievements, problems, and reactions to problems in Table 5.3 to Table 5.7. In other words, the five tables summarize the development of the purchasing groups on five different dimensions. For instance, a purchasing group in micro-phase 3 typically increases bonding between its members, has some top management support, compares basic quantitative spend analyses, clearly divides tasks, and has its own website.

Table 5.3 Establishing relationships between members

M[a]	Number and description
M1	0. Although the members share similar ideologies, no attention is paid to member relationships.
	1. The **members are not very experienced** in cooperating and do not know each other very well. Identity and autonomy problems are resolved by **not enforcing cooperation**. Cooperative results are not immediately apparent and therefore, there may be some internal resistance.
	2. **Differences in needs are resolved** by flexible cooperative arrangements with suppliers and members, such as a formal declaration of intent. It is made clear what all members expect and the arrangements are based on an understanding of member needs. To **prevent motivation problems and inequality**, rotation of tasks could be set in place.
	3. Like 2, but the **group increases bonding** to improve the interpersonal relations between senior managers and purchasers of the members. This can be done by informal meetings. It turns out to be **difficult to allocate gains, costs, and risks equitably** among members.
M2	4. Like 3, but the members **know each other well** and/or the group's personnel knows the members well.
	5. Like 4, but membership **commitment is sustained** at senior manager and purchaser level. The senior managers of the members and the managers of the group periodically meet to address the cooperation.
	6. Like 5, but if the group size becomes larger, then it becomes more **difficult to manage the many member relationships**. Typically, the cooperation is **not free of engagement** anymore. The discussion may be started whether the current purchasing group type needs to be changed to a different type.
M3	7. Like 6, but the group becomes more capable in **addressing all member concerns equitably**.

[a] M = Macro-phase (see also Table 5.1)

Table 5.4 Establishing objectives

M[a]	Number and description
M1	0. There are no clear objectives for the purchasing group.
	1. The cooperative **objectives are general** and are often set by the purchasing managers. Objectives include price reductions, transaction costs reductions, increased product quality, and sharing information. The objectives are **oriented toward purchasing**.
	2. Like 1, but the cooperative **objectives are also set for specific projects**. The objectives are in line with the organizational objectives of the members. General objectives also include learning from each other and preventing duplication of efforts and activities. From now, the costs should be lower than the benefits.
	3. Like 2, but the **top managers of the members support** the general cooperative objectives. From now, all members share similar cooperative objectives.
M2	4. Like 3, but the **objectives are compared to the final results** and if necessary, corrective actions are taken.
	5. Like 4, but the objectives are also clearly **communicated to all stakeholders**
	6. Like 5, but it is also an objective to **improve the purchasing processes** of the members. In addition, the members make priorities between the objectives.
M3	7. Like 6, but the cooperative objectives and the organizational objectives of the members start to integrate. The objectives are **oriented toward logistics and general business**. The focus is on increased efficiency and **reduced total costs of ownership**.

Table 5.5 Establishing what to do together

M[a]	Number and description
M1	0. No structured decision making process exists for decisions concerning whether or not to cooperate.
	1. There is an **ad hoc approach**. The group is either driven by enthusiasts - champions -, they follow policy or copy what is believed to be best practice. If there is a shared purchasing need for **simple generic items** by chance, then the members tender cooperatively. It is not checked whether the members have sufficient mandate, internal support, resources, and knowledge to carry out the tenders. If the members lack specific knowledge, then consultancy services are used. The potential savings are rough estimates.
	2. There is a **quick win approach**. From now, new projects are triggered by shared problems or shared needs. Specifications, suppliers, contract terms, and calendars are synchronized. There is a strong focus on buying secondary and standardized products with no emotional charge. The members share several purchasing tips and tricks during the meetings of the group.
	3. Like 2, but the members compare **basic quantitative spend analyses** and benchmarks, giving insights in potential price and cost savings, similarities, differences, and potential problems. Spend analyses are difficult to compare as the systems of the members are not synchronized. It is more difficult to find lucrative cooperative areas. A **legal adviser** is consulted before tenders to prevent transparency and juridical issues.
M2	4. Like 3, but the members compare **extensive quantitative spend analyses**. The members know when they want to cooperate. Primary and future purchasing needs are considered for the cooperative purchasing of simple and **complex items**. Mutual differences are confronted in stead of ignored. So, more efforts are necessary for **synchronization** of purchasing procedures, plans, common procurement vocabulary codes, and purchasing conditions. Sometimes the group tenders in lots or does not synchronize everything. When tendering in lots and/or using the concept of multiple sourcing, the focus is not on lower purchase prices. In this case, cooperative objectives are reducing transaction costs, sharing knowledge, and pooling resources.
	5. Like 4, but the **pros and cons of new projects** are clearly calculated and communicated to each other. Complex tenders lead to **more differences** in needs. There may be an increased commercial focus.
	6. Like 5, but the members compare **quantitative and qualitative spend analyses** and **benchmark** their complete purchasing functions to find more cooperating and learning opportunities. If the group is relatively small, then purchasing systems and supporting services are synchronized. All main **stakeholders** are consulted before complex tenders. Purchasing policies and supporting services are also synchronized.
M3	7. Like 6, but the group starts offering more **diversified commodities and services** to the members. If the members lack specific knowledge, then workshops, education, and training sessions are offered by the group. This way, the purchasing competences of the members are further developed.

Table 5.6 Establishing an organizational structure

M[a]	Number and description
M1	0. There is no coordination between the members.
	1. Extra member resources are made available to carry out a **feasibility study** and set up a group. The members can sign requirements of confidentiality. For groups with many members or activities, a **steering committee** is set in place. The purchasing tasks are carried out by project groups. There is a direct link between the steering committee and the project groups.
	2. Like 1, but the members may use **trial periods** for new items in case they cope with change resistance. They may also get alongside individuals and tailor services to get support and people cooperating. The group uses **consensus decision making**. The members have made agreements about when and how to inform each other about past (expiry dates), current, and future projects.
	3. Like 2, but the **tasks are clearly divided** and there are some cooperative **procedures**. Each contract has a contract manager to obtain contract compliance and to keep the contracts up-to-date. Top management support is guaranteed by management **sponsors**. The members think about whether or not others may join.
M2	4. Like 3, but the group becomes more **multidisciplinary**. The group makes clear agreements about how to communicate with each other. There are clear procedures about how to obtain necessary information from the members for new joint tenders and there are membership criteria. The group has exit moments during cooperative tenders and binding contracts are considered to **prevent midway cancellations** by members. To prevent incomplete or inconsistent project evaluations, reminders are sent and evaluations are standardized and reported.
	5. Like 4, but the group kicks off new complex projects with all key persons as these projects have **multiple stakeholders**. Problems are proactively dealt with. Top management decides whether **central** (one member carries out the tasks) **or coordinated purchasing** (several members carry out the tasks) is suitable.
	6. Like 5, but **central purchasing is carried out by an external party** or by the group's personnel. This party or the group has specific expertise. 'Central' contracts have mandatory participation clauses.
M3	7. Like 6, but the group has a **stable structure** and may become a private enterprise. The group's personnel is multidisciplinary. For 'coordinated' items, the contracts may also have mandatory participation clauses.

Table 5.7 Establishing resources

M[a]	Number and description
M1	0. The group has no dedicated resources.
	1. The members start **newsletters** and records to inform each other about the progress of the group. The group has its own name. The available resources are often limited.
	2. Like 1, but the group also **reports** about savings and plans. It is difficult to calculate the cooperative savings.
	3. Like 2, but the group has its own **website** with information about members, the group, and cooperative activities. Supplier problems are handled on the group's behalf.
M2	4. Like 3, but the group employs one or more **managers/assistants**. The costs are shared.
	5. Like 4, but a **purchasing/contract management system/portal** is set in place to manage the activities and contracts of the group. All members have access to the contracts in which they participate.
	6. Like 5, but the group uses performance indicators to **automatically measure the performance** of cooperative activities and contract compliance. The administration and management team of the purchasing group may become independent and is **neutral**.
M3	7. Like 6, but the group uses **e-auctions and has e-catalogues and e-links** with its members. It has very competent resources regarding conducting tenders and cooperative activities.

5.7. Discussion and implications

5.7.1. Discussion

Our findings support the notion that it is possible to specify typical micro-evolutions that take place in purchasing groups. The micro-evolutions specified in this chapter help us to better understand the development of purchasing groups, which could ultimately improve purchasing group performance. This improved understanding can also help to build up trust in others' competences (see proposition P_{6b}[18] developed in Chapter 2) and if necessary, increase members' willingness to hand-over responsibility and allow the macro-level change from a local informal network into a more distant and structured purchasing group that takes over purchasing tasks and activities.

Across the cases, it appears that some cooperative problems are hard to solve. For instance, this applies to the problems that it is difficult to calculate and allocate the savings of a group among its members. The purchasing groups are still searching for feasible solutions. We discuss the problems of calculating and allocating savings in more detail in Chapter 7 to Chapter 10.

In the cases, some problems were identified as disadvantages of cooperative purchasing and the purchasing groups put up with it. For instance, sometimes, cooperative purchasing takes more time than individual purchasing due to synchronization issues. Here we note that different purchasing group types imply some differences in problems and disadvantages, such as free-riding problems that are typical problems of one-time purchasing groups (see also Chapter 3).

Our findings show that some cooperative problems can apply to several dimensions. Among other things, differences in specifications, supplier preferences, and contract terms can have an impact on the dimension 'activities' and on the dimension 'member relationships'. For instance, to be able to cope with mutual differences, the members may synchronize some differences (dimension 'activities') and/or use flexible cooperative arrangements (dimension 'member relationships'). In addition, for some dimensions, micro-evolutions can take place in a short period of time. For other dimensions, more time seems necessary. For instance, relationships between the members typically need time to evolve. Usually, the members of small purchasing groups need some experience in cooperative purchasing and need to know each other before complex tenders can be conducted.

Table 5.1 may suggest that groups have to develop the dimensions simultaneously to be able to develop to another phase. Our results do not imply this. Depending on the purchasing group type, it might be that a purchasing group develops on one dimension, yet not on another. In addition, it has to be realized that there are no clear-cut boundaries between macro-phases. For instance, the third case study only involved the cooperative purchasing of electricity. For this reason, resources such as a contract management system were not necessary. The group has therefore a low score on the dimension 'resources'.

[18] Expecting coordination costs to be high and lack of trust in other organizations' competences are more difficult to deal with than expected in cooperative purchasing.

Because the group did involve fifteen members, the group had to pay more attention to the dimension 'organization'. The group has therefore a higher score on this dimension.

Despite the fact that our findings are formulated at a micro-evolutionary level and the previous findings of D'Aunno and Zuckerman (1987), Johnson (1999), and Nollet and Beaulieu (2003) are formulated at a macro-evolutionary level, our findings seem to confirm most of the existing macro-phases. In addition, as the previous studies were carried out in healthcare and the education sector and our study also included different sectors through studying healthcare organizations, municipalities, and research centers, it seems reasonable to believe that the previous findings and our findings hold lessons for public practice in general.

5.7.2. Implications

Our research has several implications for the practice and process of cooperative purchasing. The research gives more insight into micro-evolutions within macro-evolutionary phases of purchasing groups. Potential problems and decision-making points are elicited, which can determine the future development of relatively young purchasing groups. In addition, for five dimensions, an overview is provided of micro-evolutions to guide purchasing groups in developing the dimension (see Table 5.3 to Table 5.7). If necessary, these tables can help practitioners to develop a purchasing group step by step.

If one wants to develop a purchasing group, then we argue that specific attention should be paid to the interorganizational management dimensions 'activities' and 'objectives'. Among other things, these dimensions concern the decision whether or not to cooperate. If a group does not develop in these dimensions, then we argue that it will be likely that the group does not get involved in the cooperative purchasing of complex or primary purchasing needs (see also Table 5.4 and Table 5.5).

5.8. Limitations

This study has some limitations, starting with the case studies selected. We conducted only three case studies in the public sector. Because we studied a limited number of case studies, we were able to research the case contexts in depth at a micro-evolutionary level. Still, our limited number of case studies will affect the generalizability of the findings, in particular when trying to match responses to specific problems and their applicability to the private sector. More case studies might reveal more problems and potentially more possible reactions to problems. In addition, the lengths of periods of analysis vary to some extent. Hence, it is not possible to draw conclusions about rates of change (Miller and Friesen, 1984). In our selection of cases, it is also difficult to compensate for survivor bias, as we only studied relatively successful groups. The dimensions we omitted from our analysis could also be included in future studies.

Further limitations concern the methodological approach and analysis adopted. We studied the evolution of the purchasing groups partly in retrospect. This may have affected the data and our findings, as people are selective and can be biased in what they remember.

The dimensions used are quite broad (e.g., 'activities', 'resources'), which - although they have given an initial insight into micro-evolutions - may need fine-tuning in further

research. In addition, in our analysis, we focused on the main problematic events and reactions for a limited number of dimensions. In further research, more steps, problems, and possible solutions could be studied and added to the results in Table 5.3 to Table 5.7. More longitudinal studies could also help to asses the validity of our findings, as they could enable us to observe closely what happens at the time when problems and changes occur.

5.9. Conclusions

Our results draw on the experiences of three purchasing groups and although we conducted an exploratory study, the results provide a new micro-evolutionary perspective on cooperative purchasing. More specifically, we add to existing literature on cooperative purchasing, in particular to the existing macro-evolutionary models. Our micro-evolutionary results are subdivided into five interorganizational management dimensions: 'member relationships', 'objectives', 'activities', 'organization', and 'resources'.

The results include solutions to cooperative purchasing problems and detailed descriptions of micro-evolutions that take place in the macro-phases in purchasing groups (see also Table 5.3 to Table 5.7). If necessary, these tables can help practitioners to develop a purchasing group step by step.

Across the cases, it turned out that some cooperative problems are hard to solve. For instance, this applies to the problems that it is difficult to calculate and allocate the savings of a purchasing group among its members. We discuss these problems in more detail in Chapter 7 to Chapter 10.

Our research results show that how purchasing groups score on the five dimensions can vary under different circumstances. Thus, purchasing groups do not have to develop the different dimensions simultaneously. This raises new and intriguing research questions related to which ideal combinations of dimension scores should be established under which circumstances. Further research is necessary to answers such questions.

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Appendix 5.1 Summarized development of the studies

Code[a]	Event description (case number)	Reaction (case number)
Structure dimension 'member relationships'		
P M1	Members do not want to lose identity/autonomy (1,2)	Do not enforce cooperation (1); do not merge (2)
P M1	Members have different needs (1,2,3)	Cooperate with no profound obligations (2); flexible cooperative arrangements (1,2,3)
P M1	Prevent motivation problems & inequality (3)	Leader rotation (3)
P M1	Difficult to allocate gains & costs (1,2,3)	
P M1	Risks are not spread equally among members (1)	Consider establishing private organization (1)
P M2	Office location may seem biased to members (1)	Move office to a neutral location (1)
Process dimension 'objectives'		
O M1	Set general objectives (1,2,3); set specific objectives (1,2)	
O M2	Add process improvement/professionalization (1,2)	
O M3	Change from purchasing to general business focus (1,2) & from reactive to proactive (1)	
Process dimension 'activities'		
A M1	Idea to cooperate due to drivers (1,2,3); carry out a feasibility study (1,2,3); identify potential projects (1,2,3)	
P M1	Due to incomplete data difficult to find new cooperative projects (1,2,3)	Carry out & compare spend analyses (1,2); use questionnaires to find new projects (3)
P M1	Not all products can be bundled easily (1,2,3)	Start with quick wins (1,2,3)
A M1	Kick-off of the first simple projects (1,2,3)	
P M1	Members have different specifications, suppliers, conditions, contracts or contract terms (1,2,3)	Synchronize (1); synchronize & adjust expected savings (2); synchronize contract terms; not all participate (3)
P M1	Losing flexibility to respond to market changes (3)	Longer contract periods (3)
P M1	Transparency, juridical & anti-trust issues (3)	Consult barrister; purchase individual (3)
P M1	Professional levels, experience & priorities differ (1,2)	Members benchmark to improve processes (2)
A M2	Kick-off of more complex projects (1,2) & broadening services (1)	
P M2	Members sometimes lack specific knowledge (1,2)	Offer consultancy services (1)
P M2	Complex tenders lead to more differences in needs (1,2)	Increased commercial focus (1); tender in lots; do not synchronize everything (2)
P M3	Members sometimes lack specific knowledge (1)	Offer workshops & training sessions (1)
Management dimension 'organization'		
P M1	Uncertainty & resistance to change (1)	Trial period for new products/suppliers (1)
P M1	Difficult to meet different needs (3)	Consensus decision making (3)
P M1	Hard to get internal support & people cooperating (1,2)	Get alongside individuals & tailor services (1); involve them, do not enforce compliance (2)
P M1	Hard to get top-management support (2)	Assign top-management sponsor (2)
P M2	Midway cancellations by members (1,2)	Consider binding contracts (1); define exit moments (2)
P M2	Evaluation is forgotten, incomplete or inconsistent (1,2)	Standardized evaluations (1); send reminders (2)

Code[a]	Event description (case number)	Reaction (case number)
P M2	Members are not sure what to communicate & members are not up to date of activities of others (2)	Make agreements about informing each other (2)
P M2	New complex projects have multiple stakeholders (2)	Kick off new projects with all key persons (2)
P M2	Necessary time & complexity underestimated (2)	Reduce meetings & clearly divide tasks (2)
Management component dimension 'resources'		
P M1	Prevent members not being well-informed about activities & progress (1,2,3)	Newsletters (1); newsletters, structural meetings & report savings (2); records to inform about progress (3)
P M1	Difficult to: compare single & joint lots (3); calculate savings (1,2,3); compare different systems in analyses (2)	
P M2	Difficult to manage contracts & to secure savings (1,2)	Purchasing/contract management system (1,2)

[a] Summarized codes are: A = Achievement; O = Objectives; M = Macro-phase (see also Table 5.1); P = (Potential) problem; these abbreviations have not been incorporated in the abbreviation section

Appendix 5.2 Summarized timeline of Study 1

Period[a]	Dim.	Code[b]	Event description	Code	(Non-)structural reactions
2000-4	L2	D	Initial drivers & preconditions		
	L2	A1	Initial idea to cooperate; carry out a feasibility study		
	L1	O	Set general objectives		
2001-1	S2	P1	Members do not want to lose identity/autonomy	R1	Do not enforce cooperation
	M1	P2	Members have different needs	R2	Flexible cooperative arrangements
	M1	A2	Set up organizational form		
	L1	O	Set specific objectives		
2001-3	M1	P4	Uncertainty & resistance to change	R4	Trial period for new products/ suppliers
	M2	P6	Prevent members not being well-informed	R6	Newsletters
	L2	A3	First identification of potential projects		
	L2	P8	Not all products can be bundled easily	R8	Start with quick wins
	M1	P12	Hard to get internal support & people cooperating	R12	Get along individuals & tailor services
	L2	A4	Kick-off of the first simple projects		
2002-1	L2	P2	Members have different specifications & suppliers	R2	Synchronize specifications & suppliers
	L2	P2	Professional levels, experience & priorities differ		
	S2	P17	Difficult to allocate gains equitably		
2003-2	M2	P16	Difficult to calculate savings		
	M1	P22	Evaluation problems & inconsistencies	R22	Standardized evaluation processes
	M1	A5	Start managing contracts & securing savings		
	L1	O	Add process improvement		
	L2	A4	Kick-off of more complex projects		

Period[a]	Dim.	Code[b]	Event description	Code	(Non-)structural reactions
	L2	A4	Broaden services		
2003-2	L2	P7	Due to cluttered data difficult to find new projects	R7	Carry out & compare spend analyses
	L2	P14	Members sometimes lack specific knowledge	R14	Offer consultancy services
2005-2	S2	P17	Risks are not spread equally among members	R17	Consider establishing private company
	L2	P2	Members have increasingly different needs	R2	Increased commercial focus
2005-3	M1	P18	Midway cancellations by members	R18	Consider legally binding contracts
	M3	P23	Prevent marketing & incurring costs for suppliers	R23	Handle suppliers on group's behalf
	M2	P24	Difficult to manage contracts & to secure savings	R24	Purchasing/contract management system
2005-4	S2	P25	Hard to manage many relationships due to growth		
	S2	P5	Office location may seem biased to members	R5	Move office to a neutral location
	L2	O	Change from purchasing to general business focus		
	L2	A4	Change from reactive to proactive		

[a] In this table, years are divided into four periods
[b] A = Achievement; D = Drivers and conditions; L = Linked process dimension; M = Management component dimension; O = Objectives; P = (Potential) problem; R = Reaction; S = Structure dimension; these abbreviations have not been incorporated in the abbreviation section

Appendix 5.3 Summarized timeline of Study 2

Period[a]	Dim.	Code[b]	Event description	Code	(Non-)structural reactions
1999-4	L2	D	Initial drivers & preconditions		
	L2	A1	Initial idea to cooperate; carry out a feasibility study		
	L1	O	Set general objectives		
2000-2	S2	P1	Identity/autonomy loss due to potential merger	R1	Set up a group in stead of a merger
2001-3	S2	P2	Members have different needs	R2	Cooperate with no profound obligations
	M1	A2	Set up organizational form		
	L1	O	Set specific objectives		
2001-4	M2	P6	Members not well-informed about activities	R6	Newsletters & structural meetings
	M2	P6	Members not well-informed about progress	R6	Measure & report savings
	L2	A3	First identification of potential projects		
2002-1	L2	P7	Due to incomplete data difficult to find projects	R7	Carry out & compare spend analyses
	L2	P8	Not all products can be bundled easily	R8	Start with quick wins
	L2	A4	Kick-off of the first simple projects		
	M1	P12	Hard to get internal support & people cooperating	R12	Involve them, do not enforce compliance
2002-2	M1	P12	Hard to get top-management support	R12	Assign top-management sponsor
	L2	P2	Specifications, conditions & contracts	R2	Synchronize; adjust expected

Period[a]	Dim.	Code[b]	Event description	Code	(Non-)structural reactions
			differ		savings
	M2	P16	Difficult to calculate savings		
	S2	P17	Difficult to allocate gains equitably		
	L1	O	Governmental plea for professionalization		
	L1	O	Add process professionalization objective		
2002-3	L2	P2	Professional levels, experience & priorities differ	R2	Members benchmark to improve processes
2003-2	M1	P18	Midway cancellations by members	R18	Protocol exit moments
	M1	P21	Difficult to determine who final calls will make		
	M1	P22	Sometimes evaluation is forgotten or incomplete	R22	Steering committee sends reminders
	M1	A5	Start managing contracts & securing savings		
2003-3	M3	P23	Supplier problems applicable to several members	R23	Handle these on behalf of the group
	M2	P6	Members are not up to date of activities of others	R6	Agreements about informing each other
	M2	P7	Difficult to compare different systems in analyses		
	L2	P10	By not cooperating at times members avoid EC-d	R10	Emphasize the benefits of EC directives
	M1	P11	Members are not sure what to communicate	R11	Agreements about informing each other
	L2	A4	Kick-off of more complex projects		
2003-4	M1	P13	New complex projects have multiple stakeholders	R13	Kick off with all key persons
	M1	P15	Necessary time & complexity underestimated	R15	Reduce meetings & clearly divide tasks
	L2	P14	Members sometimes lack specific knowledge		
	L2	P2	Complex tenders lead to more differences in needs	R2	Tender in lots; do not synchronize all
2004-3	M2	P24	Difficult to manage all contracts	R24	Contract management system
2005-1	L2	P26	Difficult to professionalize purchasing functions		
	L2	A4	Change from purchasing to general business focus		
2006-2	L2	P14	Members sometimes lack specific knowledge	R14	Offer workshops & training sessions

[a] In this table, years are divided into four periods

[b] A = Achievement; D = Drivers and conditions; EC = European Commission; L = Linked process dimension; M = Management component dimension; O = Objectives; P = (Potential) problem; R = Reaction; S = Structure dimension; these abbreviations have not been incorporated in the abbreviation section

Appendix 5.4 Summarized timeline of Study 3

Period[a]	Dim.	Code[b]	Event description	Code	(Non-)structural reactions
1998-2	L2	D	Initial drivers & preconditions		
	L2	A1	Initial idea to cooperate; carry out a feasibility study		
	L1	O	Set general objectives		
	M1	P2	Members have different needs	R2	Flexible cooperative arrangements
1998-3	S2	P3	Prevent motivation problems & inequality	R3	Leader rotation
	M1	A2	Set up organizational form		
	L1	O	Set specific objectives		
	M1	P2	Difficult to meet different needs	R2	Consensus decision making
	M2	P6	Prevent members from being uninformed	R6	Records to inform members of progress
	L2	A3	First identification of potential projects		
	L2	P8	Not all products can be bundled easily	R8	Start with a quick win
	L2	P9	Some members already have long contracts	R9	Not all members participate
1998-4	L2	P7	Difficult to acquire sufficient data for project	R7	Use questionnaires
	L2	A4	Kick-off of the first simple project		
1999-1	M1	P15	Prevent duplication of efforts & activities	R15	Clearly divide tasks
1999-2	M3	P2	Contract needs differ	R2	Flexible agreement with supplier
	M2	P16	Difficult to compare single & joint lots		
	M2	P16	Difficult to calculate savings		
	S2	P17	Difficult to allocate costs equitably		
2000-3	L2	P2	Fewer savings due to different contract terms	R2	Next time, synchronize contract terms
	L2	A4	Kick-off of the second simple project		
2002-2	L2	P2	All members want to settle different contracts	R2	Try to standardize contracts
	L2	P19	Losing flexibility to respond to market changes	R19	Longer contract periods
	L2	A4	Kick-off of the third simple project		
2003-1	L2	P20	Transparency issues of new cooperative tender	R20	Next time, consult barrister on forehand
	L2	P20	Juridical & anti-trust issues	R20	Cancel new joint tender, make it individual
	M3	P23	Supplier problems applicable to several members	R23	Handle these on behalf of the group
		A7	End		

[a] In this table, years are divided into four periods

[b] A = Achievement; D = Drivers and conditions; L = Linked process dimension; M = Management component dimension; O = Objectives; P = (Potential) problem; R = Reaction; S = Structure dimension; these abbreviations have not been incorporated in the abbreviation section

PART III

QUANTITATIVE EMPIRICAL APPROACH

In the first chapter of this part, we test some of the propositions developed in Part I while using a quantitative empirical approach. We do this by taking into account the knowledge obtained about the different purchasing group types in Part II. In the second chapter of this part, our main objective is to test how well a certain quantity discount function represents different types of quantity discount schedules found in practice. This function is an important element in the next two parts of the thesis.

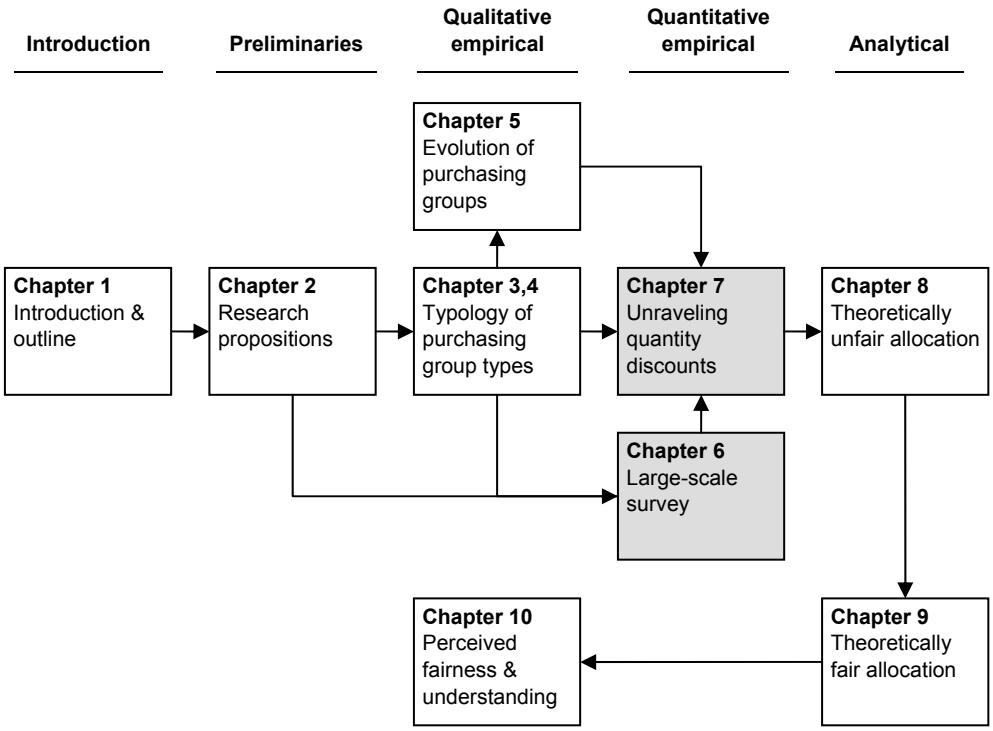

Fig. III.1 Research outline

Chapter 6

A large-scale survey

In Chapter 2, we have stated that further research is necessary for justifying our propositions. In this chapter, we test (parts) of these propositions. The chapter is summarized as follows.

In a large-scale survey among 224 organizations, we identified so-called positive and negative motives for lead buying and program purchasing groups. In addition, we identified critical success factors for managing purchasing groups. In the chapter, we also discuss some related topics, such as the fair allocation of gains and costs.

It turns out that the main motives why organizations are not involved in a purchasing group are ‘a lack of cooperation opportunities’, ‘disclosure of sensitive information’, ‘supplier resistance’, ‘fear of free-riding organizations’, and ‘a lack of cooperation priority’. The ‘lack of cooperation opportunities’ implies that more efforts concerning the encouragement of cooperative purchasing might be worthwhile in both the private and public sector.

The main critical success factors are ‘voluntary participation’, ‘sufficient total contribution of efforts’, ‘all members contribute unique knowledge’, ‘all members rarely change representatives’, ‘fair allocation of gains and costs’, and ‘communication’. In the analytical part of this thesis, we discuss the ‘fair allocation of gains and costs’ in more detail.

6.1. Introduction

As mentioned in the summary above, this chapter tests (parts) of the propositions developed in Chapter 2. The main objectives in this chapter are to identify differences between organizations involved and not involved in a purchasing group regarding motives for cooperative purchasing and to identify critical success factors for managing purchasing groups. In addition, we study properties of suitable products and services, the use of allocation methods, some differences between small and large organizations, and some differences between different purchasing group types.

The chapter has been organized in the following way. First, we discuss the research objectives and their relevance in more detail. Subsequently, we describe the data collection, research procedure, response, data analysis, and the data source. In the findings section, we discuss motives for cooperative purchasing, some differences between small and large organizations, critical success factors, allocation methods, and properties of suitable products and services. Next, we illustrate some differences between different purchasing group types. In the final sections, we discuss some limitations and draw our main conclusions.

6.2. Specific research objectives

As mentioned in the previous section, our research objectives cover several topics. In this section, we discuss the relevance and background of the objectives in more detail.

6.2.1. Positive and negative motives

As noted in Table 2.1 in Section 2.2, previous studies have already contributed to the knowledge on motives for cooperative purchasing. These studies have been carried out by, among others, Huber et al. (2004), Johnson (1999), Nollet and Beaulieu (2005), and Tella and Virolainen (2005). Still, to our knowledge, previous research does not identify motives that play a crucial role in why organizations choose to join or not to join a purchasing group. This is unfortunate as an improved understanding of this issue can help organizations in decisions related to whether or not to cooperate.

Among other things, we study positive and negative motives in this chapter. Positive (negative) motives are organizational motives (not) to purchase cooperatively. The positive and negative motives studied are based on the literature, the motives found in Chapter 2 and Chapter 5, and the dimensions discussed in Chapter 3 and Chapter 4. In this chapter, we only study the most interesting motives that have been identified in Chapter 2. Compared to Chapter 2, we have also added some motives, such as 'reduced tender process throughput time' (see also Section 2.5.4). We have removed some less interesting motives, such as 'budget cuts' and 'extending the cooperation' (see also Section 2.5.4). The positive motives and the related references are:

- **Bundle purchasing volumes** (Ball and Pye, 2000; Hendrick, 1997; Johnson, 1999; Nollet and Beaulieu, 2003, 2005; Polychronakis and Syntetos, 2007; Tella and Virolainen, 2005)
  1. Better quality of purchased products and/or services;
  2. Financial gains (e.g., lower purchase prices);
- **Information sharing** (Nollet and Beaulieu, 2005; Tella and Virolainen, 2005)
  3. Learn from other organizations (e.g., share (price) information);
- **Share resources or processes** (Johnson, 1999; Nollet and Beaulieu, 2005; Tella and Virolainen, 2005)
  4. Better quality of the purchasing process (e.g., share expertise);
  5. Reduced tender process throughput time (e.g., by piggy-backing);
  6. Reduced transaction costs (e.g., reduced duplication of efforts and activities).

The negative motives and the related references are:

- **Expect no improvements** (Dyer, 1997; Gulati and Singh, 1998; Hendrick, 1997; Johnson, 1999; Jost et al., 2005; Nollet and Beaulieu, 2005; Polychronakis and Syntetos, 2007)
  1. Expecting high coordination costs;
  2. Increased chance of supplier resistance;
  3. Increased tender process throughput time (e.g., due to reaching consensus);
  4. Lose control;
- **Lack of trust or support of other organizations** (Hendrick, 1997; Johnson, 1999; Nollet and Beaulieu, 2005; Polychronakis and Syntetos, 2007)
  5. Increased chance of disclosure of sensitive information;

6. Increased chance of free-riding organizations;

- **Lack of priority or cooperation opportunities**
  7. Lack of cooperation opportunity;
  8. Lack of cooperation priority.

Note that most of the literature discusses only the positive motives for cooperative purchasing. As discussed in Section 2.3, we mainly focus on negative motives.

6.2.2. Success

To be able to identify critical success factors for managing purchasing groups, we need to define success. Hoffmann and Schlosser (2001) note that previous studies faced difficulties with evaluating the success of alliances. As a benchmark for success, some studies consider an alliance's longevity (Kogut, 1988) or an alliance's contribution to improving the strategic position or competitiveness of the cooperating organizations (Hagedoorn and Schakenraad, 1994; Mitchell and Singh, 1996). Sarkar et al. (2001) note that as a benchmark for cooperative success, some studies consider financial, survival (Killing, 1983), and ownership stability (Gomes-Casseres, 1987).

Similar to Geringer and Hebert (1989), we note that there is a lack of consensus regarding an appropriate definition and measure of the success of partnerships and alliances. We also note that some alliance measures seem less appropriate for purchasing groups. For instance, longevity, survival, and ownership stability do not apply to project purchasing groups and young program purchasing groups. Additionally, the contribution to improving the strategic position or competitiveness of the cooperating organizations will be difficult to measure.

We determine success in a similar way as Hoffmann and Schlosser (2001) did in their study. In our study, the perceived success of the purchasing group was determined by the organizations themselves, taking into account positive and negative motives for cooperative purchasing.

6.2.3. Critical success factors

Previous studies on critical success factors of partnership and alliance success and failure in general are carried out by, among others, Harbison and Pekar (1998), Hendrick (1997), Hoffmann and Schlosser (2001), Kogut (1998), and Park and Ungson (1997). So far, however, there has been little discussion about critical factors of purchasing group success in specific. To our knowledge, the only previous empirical quantitative study that explicitly deals with several success factors for managing purchasing groups is a study carried out by Hendrick (1997). However, Hendrick studied the perceived importance of critical success factors. We determined the critical success factors by studying differences between successful and unsuccessful purchasing groups. In Section 6.4, we discuss that this leads to some different results.

As mentioned in Chapter 2, there exists a gap between an understanding of (alliance) partnership formation and the practice of partnership management. So, it seems to be important to study the practice of purchasing group management. This is one of the reasons why we focus on success factors for managing purchasing groups. Additionally, insight into critical success factors may help to improve our understanding of how purchasing groups (can) perform efficiently and effectively.

We based the critical success factors for cooperative purchasing on interorganizational problems discussed in the literature, the factors found in Chapter 2, the dimensions distinguished in Chapter 3 and Chapter 4, the problems discussed in Chapter 5, and on the success factors that previous studies have identified as important. The critical success factors studied including the related literature are:

- **Commitment and internal support** (Bakker et al., 2006b; D'Aunno and Zuckerman, 1987; Doucette, 1997; Hoffmann and Schlosser, 2001; Kanter, 1994; Niederkofler, 1991)
  1. All members contribute comparable resources and efforts;
  2. All members have internal support;
  3. All members rarely change representatives;
  4. At least one member acts as a champion;
  5. In total, sufficient efforts and activities are contributed to be able to run the group successfully;
- **Communication** (Anderson and Narus, 1990; Laing and Cotton, 1997; Mohr and Spekman, 1994; Niederkofler, 1991)
  6. Communicate and keep each other up-to-date regarding current projects;
  7. Communicate and keep each other up-to-date regarding new potential projects;
- **Allocation of gains and costs (based on Heijboer, 2003)**
  8. Fair allocation of gains and costs;
- **Formality of the group** (Bakker et al., 2006b; Corsten and Zagler, 2001; Das and Teng, 2002; D'Aunno and Zuckerman, 1987; Hoffmann and Schlosser, 2001; Johnson, 1999; Niederkofler, 1991)
  9. Make engagements regarding important decision moments;
  10. Report important performances of the group periodically;
- **Interorganizational trust** (Aulakh et al., 1996; Bakker et al., 2006b; Browning et al., 1995; Das and Teng, 2001b; Hoffmann and Schlosser, 2001; Gulati, 1995; Klein Woolthuis, 1999; McAllister, 1995; Nollet and Beaulieu, 2005; Polychronakis and Syntetos, 2007; Quayle, 2002a; Robertson, 1998; Sydow, 1998; Vangen and Huxham, 2003; Waddock, 1989)
  11. All members are honest and loyal;
  12. All members like each other personally;
  13. All members meet one's commitments;
- **Knowledge on how to cooperate** (Hoffmann and Schlosser, 2001; Johnson et al., 1996)
  14. All members contribute unique knowledge;
- **Organization** (Enthoven, 1994)
  15. All members have a similar influence on the group activities and decisions;
  16. Voluntary participation;
- **Uniformity of the members** (Klein Woolthuis, 1999; Laing and Cotton, 1997; Polychronakis and Syntetos, 2007)
  17. All members have similar objectives to participate in the group;
  18. All members have similar organizational cultures;
  19. All members have similar procedures.

Note that there are some links between the motives and the success factors. This applies, for instance, to interorganizational trust. We discuss this link in more detail in Section 6.4.3.

6.3. Method

In this section, we discuss the methodology used in carrying out the study. First, we discuss the data collection and research procedure. Next, we discuss the response, describe the data set, and discuss the data analysis procedure.

6.3.1. Data collection and procedure

To triangulate some of the findings of Chapter 2 to Chapter 5, we built a draft questionnaire that used a mix of question types. The questionnaire was first sent to a focus group to test the questions. After the focus group session, the wording of some questions was changed and some questions were added to the questionnaire. The final questionnaire consisted of four parts:

Part (1): The first part consisted of general questions about the respondent and the respondent's (purchasing) organization. We also asked some questions about general motives for cooperative purchasing;

Part (2): The second part consisted of questions about the purchasing group, such as the name, the number of members, the life span of the group, the number of contracts, and the number of meetings. The respondents were asked to choose a purchasing group in which they had been playing an active role for at least the past two years. Organizations engaged in more than one purchasing group were asked to choose the least successful purchasing group. We asked for the least successful purchasing group as it is usually more difficult to find unsuccessful groups than successful groups;

Part (3): The third part consisted of questions about critical success factors for managing purchasing groups. The success factors were grouped according to the categories described in Section 6.2.3. We asked the respondents to what extent the success factors apply to the purchasing group in which the respondent was/is involved;

Part (4): The final part consisted of questions about positive motives, negative motives, and the perceived success of the purchasing group for the respondent's organizations. The motives were grouped according to the categories described in Section 6.2.1. The questions specifically referred to the purchasing group in which the respondent was/is involved. Organizations that were not involved in a purchasing group were asked to answer the questions while taking in mind a program group-like purchasing group (see Chapter 3 for definitions of purchasing group types).

Some issues that specifically apply to our study are the following. First, some individual organizations returned multiple questionnaires about the same purchasing group. Sometimes, these answers differed slightly. In such cases, we averaged the answers. Second, for some purchasing groups, we received multiple questionnaires filled in by different organizations. Sometimes, the answers to the questions that applied specifically to the purchasing group differed slightly. In such cases, we also averaged these answers. Finally, if a respondent did not answer a question, then the respondent was removed from the analysis of that particular question. Thus, missing values were excluded listwise.

6.3.2. Response

The questionnaire was made available online and an invitation to respond was sent by e-mail to all members of NEVI, the Dutch purchasing association. Most of these organizations are private organizations. The total NEVI sample size, that is, the number of organizations that was reached was 797 (56% of the total sample size). Additionally, an invitation to respond was sent by e-mail to all members of PIANOo, a Dutch organization for purchasing employees of public organizations. The total PIANOo sample size, that is, the number of public organizations that was reached was 620 (44% of the total sample size). The data collection was carried out from June 2006 to October 2006.

Similar to the response problem discussed by Claassen et al. (2007), a low response rate was expected as not all NEVI and PIANOo members are involved in a purchasing group. In addition, there is quite some overlap between the organizations in the NEVI and PIANOo samples. After one reminder, the total response was 274, out of which 50 respondents only filled in the first part of the survey. Thus, the total useful response was 224, representing a 'worst case' response rate of 16%. A total of 142 organizations were involved in a purchasing group and a total of 82 organizations were not. The response covered a total of 115 different purchasing groups.

To compensate for nonresponse bias and possible misinterpretations, we developed an Internet website that contained preliminary results with a final request for feedback on any perceived discrepancies and key issues. The website was only available to respondents that completely filled in the questionnaire. The representativeness of the response was tested in two ways:

1. **Early and late responders**
   We tested potential nonresponse bias by comparing early (n = 118) and late responding organizations (n = 24) that are involved in a purchasing group. Respondents are considered late if their answers were received after sending a reminder. We carried out independent samples 2-tailed t-tests for 53 questions. Between the two groups, we found no significant differences between the means of the normal distributed ratings at $p < .05$.
   We also tested potential nonresponse bias by comparing early (n = 76) and late responding organizations (n = 6) that are not involved in a purchasing group. We carried out independent samples 2-tailed t-tests for 45 questions. Between these two groups, we found for two questions significant differences between the means of the normal distributed ratings at $p < .05$. These differences concerned a question about the 'purchasing competence' of the organizations and a question about the motive 'learning from other organizations'. These two differences could be due to chance. Note that we asked organizations not involved in a purchasing group some different questions than organizations involved in a purchasing group. Therefore, we did not combine these two groups of organizations in one test;
2. **Known purchasing groups**
   Before conducting the survey, we already knew the names of dozens of Dutch purchasing groups by following the news using Google News, search engine searches, our contacts, and the professional literature. Most of the purchasing groups that we knew responded to the survey. Only a few purchasing groups responded to the survey of which we did not know their existence already.

Based on the discussions above, we argue that the data possesses desirable representativeness, which is even more important than the response rate (Yang, 2005).

6.3.3. Data description

The organizations and purchasing groups analyzed can be characterized by the contextual factors as shown in Table 6.1 to Table 6.3. Table 6.1 shows that most responding organizations are medium sized. It also shows that about half of the private organizations and most of the public organizations in the sample have been involved in a purchasing group in the past two years. Note that we categorized the organizations in a similar way as we categorized the UN agencies in Chapter 2.

Table 6.1 Contextual factors of organizations analyzed

Size	Annual purchasing in million US dollars	% Total	% Involved in a purchasing group
Public sector			
Large	200 ≤ 2,000	6	83
Medium	20 ≤ 200	33	85
Small	≤ 20	6	100
Private sector			
Large	200 ≤ 2,000	13	36
Medium	20 ≤ 200	24	51
Small	≤ 20	13	36

Note: $n = 224$

Table 6.2 shows some significant differences between public organizations (*Pu*), private organizations (*Pr*), organizations involved in a purchasing group (*I*), and organizations not involved in a purchasing group (*N*). We found the differences between the means of the normal distributed ratings in independent samples 1-tailed t-tests. The table suggests that organizations in group *I* expect to a higher extent than organizations in group *N* that cooperative purchasing will become more prevalent in their sector in the next two years. A similar conclusion concerns the willingness to help others by means of cooperative purchasing. Finally, the table suggests that responding organizations expect that cooperative purchasing will become more prevalent in the public than in the private sector. Again, a similar conclusion concerns the willingness to help others without engagement.

Table 6.2 Cooperative purchasing trends and helping others without engagement

Description	Public sector		Private sector	
	Involved	Not involved	Involved	Not involved
Expected trend	4.0	3.6 ($I^{*} > N$)	3.2 ($Pu^{**} > Pr$)	2.2 ($I^{**} > N$) ($Pu^{**} > Pr$)
Helping others	3.6	3.1 ($I^{*} > N$)	3.3 ($Pu^{**} > Pr$)	2.6 ($I^{**} > N$) ($Pu^{*} > Pr$)

$^{*}p < .05$; $^{**}p < .005$

Note: $n = 224$; measured on a 5 point Likert scale from 1 (very low) to 5 (very high)

Table 6.3 positions the purchasing groups analyzed by the typology from Chapter 3 and Chapter 4. For three reasons, lead buying and program groups are combined in this chapter. First, as indicated in the typology (see Fig 4.1 in Section 4.6), lead buying and program groups are organized quite similarly. Thus, there are not many differences between these two group types. Second, the purchasing groups analyzed are often hybrid groups between lead buying and program groups. Third, the motives and success factors studied in this

chapter do not specifically deal with the differences between lead buying and program groups. Table 6.3 shows that most groups in the data set are lead buying / program-like groups. For this reason, our further analyses mainly focus on this purchasing group type.

Table 6.3 Contextual factors of purchasing groups analyzed

Group	% Total	% Successful
Low intensiveness for the members		
Piggy-backing	6	86
Third party	8	100
High intensiveness for the members		
Project	12	79
Lead buying / program	74	81

Note: $n = 115$

A total of 22 responding private organizations are involved in cooperative purchasing between business units of the same organization. Typically, these business units are more or less independent and have to be profitable on their own. Still, the business units ought to have one common goal related to the holding's overall goals. In addition, there are less or no issues regarding confidential information in business unit purchasing groups. These aspects are quite similar to the aspects mentioned in Section 2.1 concerning cooperative purchasing in the public sector. Hence, from now, we assume that business unit purchasing groups are comparable to public purchasing groups for our analyses.

6.3.4. Data analysis

Our data analysis procedure is partly based on the procedure used by Hoffmann and Schlosser (2001). As mentioned earlier, Hoffmann and Schlosser carried out an empirical study on critical success factors for alliances. More specific, their study gave special consideration to the situation of SMEs. In our study, we focus on success factors for the management of purchasing groups. Thus, we have a different research focus than Hoffmann and Schlosser. Nevertheless, we have comparable research objectives and we make a similar distinction between successful and unsuccessful groups.

The specific steps that we carried out are as follows. First, we used independent samples t-tests to identify variables that differ significantly between successful and unsuccessful purchasing groups. Second, we conducted a discriminant analysis to the variables identified in the previous step. We conducted the discriminant analysis to analyze whether the identified independent variables significantly separate successful and unsuccessful purchasing groups. We used a similar procedure for comparing differences between organizations involved and not involved in a purchasing group.

We tested the assumptions for the statistical tests as follows. We used QQ-plots to test each variable for normality assumptions. For small sample sizes ($n \leq 75$), we assume unequal variances when $p \leq .05$ in Levene's (1960) test for equality of variances. For larger sample sizes ($n > 75$), we look at the variance ratio. This is the ratio of the variances between the group with the largest variance and the group with the smallest variance (Field, 2005). We assume unequal variances when this ratio is equal to or larger than 2.5. We tested the equality of covariance matrices by using Box's (1950) test. We assume unequal covariance

matrices when $p \leq .05$. The tested assumptions for the t-tests that are all met are the following (based on Field, 2005):

- The data is measured at least at the interval level;
- The scores are statistically independent;
- The data is from normally distributed populations;
- Variances in the populations are roughly equal.

The tested assumptions for the discriminant analysis that are all met are the following:

- The data is randomly sampled and measured at least at the interval level;
- The scores are statistically independent and there are no extreme outliers;
- The dependent variables are normally distributed within each group;
- The univariate tests of equality of variances between groups is met;
- The variance-covariance matrices of the different groups are equal;
- The sample size of the smallest group exceeds the number of predictor variables.

6.4. Testing propositions

In this chapter, we mainly compare differences between organizations involved and not involved in a purchasing group and between successful and unsuccessful purchasing groups. These analyses are carried out in Section 6.4.1 and Section 6.4.3. In Section 6.4.2, we discuss some differences between small and large organizations. In the final sections, we focus on fair allocation methods and suitable products and services for cooperative purchasing. Note that Section 6.4 only applies to lead buying / program groups.

6.4.1. Positive and negative motives

First of all, we tested whether there are differences between successful and unsuccessful purchasing groups and between organizations involved and not involved in a purchasing group concerning positive and negative motives for cooperative purchasing. We conducted independent samples 1-tailed t-tests for Table 6.4 and 2-tailed tests for Table 6.5. We found several significant differences as shown in the two tables below. Later in this section (below Table 6.7), we discuss the main positive and negative motives in more detail.

Table 6.4 Motives for (un)successful purchasing groups

Motive	Average			Sign.
	Successful groups		Unsuccessful groups	
Positive motives				
1. Financial gains	4.2	>	3.6	.001
2. Improved process quality	3.7	>	3.2	.005
3. Learn from other organizations	4.1	>	3.8	.016
4. Improved item quality	3.5	>	3.1	.049
Negative motives				
5. Lack of cooperation opportunity	2.4	<	3.1	.002
6. Lose control	2.7	<	3.3	.018
7. Fear of free-riding organizations	2.4	<	3.1	.018
8. Disclosure of sensitive information	2.1	<	2.5	.033

Note: Measured on a 5 point Likert scale from 1 (strongly disagree) to 5 (strongly agree); differences are compared using independent samples 1-tailed t-tests

Table 6.5 Motives for organizations (not) involved in a purchasing group

Motive	Average			Sign.
	Organizations involved		Organizations not involved	
Positive motives				
1. Reduced throughput time	3.1	<	3.7	.001
Negative motives				
2. Lack of cooperation opportunity	2.5	<	3.6	.001
3. Disclosure of sensitive information	2.2	<	3.0	.001
4. Fear of free-riding organizations	2.5	<	3.2	.001
5. Lack of cooperation priority	2.6	<	3.2	.001
6. Supplier resistance	2.2	<	2.7	.010

Note: Measured on a 5 point Likert scale from 1 (strongly disagree) to 5 (strongly agree); differences are compared using independent samples 2-tailed t-tests

The analyses of the mean differences between the groups do not allow a direct examination of the total and individual contributions of the set of positive and negative motives. Therefore, we conducted two discriminant analyses. For the motives in Table 6.4, Wilks' lambda, as a test of the discriminant function in the model, was highly significant (lambda = .733, $Chi^2 = 26.202$, df = 5, $p < .001$). In the model, 84.4% of the purchasing groups were correctly classified as successful or unsuccessful. For the motives in Table 6.5, Wilks' lambda was also highly significant (lambda = .599, $Chi^2 = 69.629$, df = 6, $p < .001$). In the model, 85.1% of the organizations were correctly classified as involved or not involved in a purchasing group.

Conducting the discriminant analysis in steps allows a direct examination of each motive's discriminating power (Hoffmann and Schlosser, 2001). At each step, all motives are evaluated to determine the motive that maximizes the Mahalanobis distance between the two closest groups. The next two tables show the motives that contribute most to the discrimination between the groups. Table 6.6 shows the motives that best predict whether a purchasing group is successful or not successful. Table 6.7 shows the motives that best predict whether an organization is involved or not involved in a purchasing group.

Table 6.6 Main motives for (un)successful purchasing groups

Step	Motive entered in discriminant analysis	Minimum *D* squared				
		Statistic	Exact *F*			
			Statistic	df1	df2	Sign.
1.	Financial gains	.754	9.894	1	87	.002
2.	Lack of cooperation opportunity	1.568	10.172	2	86	.000
3.	Fear of free-riding organizations	2.045	8.740	3	85	.000
4.	Lose control	2.297	7.276	4	84	.000
5.	Improved process quality	2.410	6.035	5	83	.000

Note: The analysis has been made between successful and unsuccessful purchasing groups; the max. number of steps is 16; the min. partial *F* to enter is .5 and the max. to remove is .25

Table 6.7 Main motives for organizations (not) involved in a purchasing group

Step	Motive entered in discriminant analysis	Minimum *D* squared				
		Statistic	Exact *F*			
			Statistic	df1	df2	Sign.
1.	Lack of cooperation opportunity	1.437	46.768	1	139	.000
2.	Disclosure of sensitive information	2.051	33.138	2	138	.000
3.	Reduced throughput time	2.411	25.782	3	137	.000
4.	Supplier resistance	2.661	21.189	4	136	.000
5.	Fear of free-riding organizations	2.810	17.766	5	135	.000
6.	Lack of cooperation priority	2.855	14.932	6	134	.000

Note: The analysis has been made between organizations involved and not involved in a purchasing group; the max. number of steps is 12; the min. partial *F* to enter is .5 and the max. to remove is .25

For successful and unsuccessful purchasing groups, Table 6.6 shows that both positive and negative motives can be considered as important discriminating factors. Table 6.4 shows that unsuccessful purchasing groups perceive both reduced positive motives and increased negative motives. Nevertheless, even in unsuccessful groups, some financial gains and learning opportunities tend to be present.

We tested a part of P_{6a}[19], that is, we tested whether 'lacking opportunities for cooperative purchasing' is one of the decisive negative motives for organizations not to become involved in a purchasing group. Table 6.5 and Table 6.7 support the tested part of P_{6a}. Similar to the UN data set in Chapter 2, the current data set supports the proposition that 'lacking opportunities' is an important motive for organizations not to participate in a purchasing group. This implies that more efforts concerning the encouragement of cooperative purchasing might be worthwhile, which applies to, for instance, business parks, third party groups, and public bodies.

Regarding proposition P_{6b}[20], we tested whether organizations involved in a purchasing group rate 'expecting coordination costs to be high' higher than organizations not involved. The tested part of P_{6b} is rejected for the current data set as we found no significant difference for 'expecting coordination costs to be high' between the two groups. This means that the coordination costs are not under- or overestimated by the respondents. For the data set, a possible explanation is that organizations not involved in a purchasing group are already aware of the coordination costs. Another explanation is that in the international and bureaucratic UN context, coordination costs are relatively high.

As the data set in this chapter is larger and broader than the data set of Chapter 2, we can draw more conclusions about the motives in Table 6.7 than we could in Chapter 2. First of all, we note that it is mainly about the negative motives. The negative motives mostly predict whether an organization is involved or not involved in a purchasing group. The positive motives are recognized by organizations involved and not involved in a group.

Interestingly, 'reduced throughput time' is an important discriminating factor and organizations not involved in a purchasing group rate this positive motive higher than

[19] Lack of organizational support and opportunities to cooperate are decisive negative motives for organizations not to become involved in a purchasing group.

[20] Expecting coordination costs to be high and lack of trust in other organizations' competences are more difficult to deal with than expected in cooperative purchasing.

organizations involved. Thus, our results suggest that it is more difficult than expected to deal with this motive. This supports parts of the qualitative results of Laing and Cotton (1997). Laing and Cotton already indicated that cooperative purchasing often leads to complexity, compromise decision making, and communication problems, what may result in increased throughput times. Huxham (1996) and Jost et al. (2005) conceptualized these issues through the concept of cooperative inertia, a situation when the rate of work output from a group is slowed down considerably compared to what might be expected.

Similar to Hendrick (1997), we found that 'supplier resistance' is an important negative motive. Suppliers may insist on keeping the members of a group as separate customers (Hendrick, 1997). In case of supplier resistance, purchasing groups could share some of the transaction cost savings with the supplier. In addition, groups can emphasize the advantages of cooperative purchasing for the supplier. Examples of such advantages are volume of trade and a reduced number of buyer-supplier transactions (Ball and Pye, 2000).

Finally, Table 6.7 indicates that 'disclosure of sensitive information' is an important motive, which was not indicated as important in Chapter 2. This can be explained by the fact that there are private organizations in the current data set. The data set in Chapter 2 only covered public organizations. Indeed, when running an independent samples 1-tailed t-test, we found a significant difference between private and public organizations (including private organizations involved in business unit purchasing groups) that are involved in cooperative purchasing ($p < .05$; $Pr = 2.8 > Pu = 2.0$). Public organizations rate 'disclosure of sensitive information' lower than private organizations, what supports a part of P_3[21], that is, 'disclosure of sensitive information' is a less important negative motive for cooperative purchasing between public organizations than between private organizations. Note that Hendrick (1997) also indicates that 'disclosure of sensitive information' may be problematic for cooperative purchasing between private organizations. Hendrick suggests using an independent third party in case of potential disclosure problems.

6.4.2. Small and large organizations

As indicated in Chapter 2, there are some differences between Small (*S*) and Large (*L*) organizations regarding cooperative purchasing. Three propositions developed in Chapter 2 concern these differences (P_4[22], P_{5a}[23], P_{5b}[24]). In this section, we discuss P_4 in more detail. We tested a part of P_4, that is, we tested whether small organizations not involved in a purchasing group believe to be more vulnerable to losing control in an intensive purchasing group than large organizations not involved in a purchasing group.

The tested part of proposition P_4 is supported by the data set as we found a significant difference for 'losing control' between small and large organizations that are not involved

[21] Lack of trust in loyalty and honesty are less important negative motives for cooperative purchasing between public organizations than between private organizations.
[22] Small organizations give a lower priority to cooperative purchasing than large organizations due to lower organizational support, commitment, resources, and an increased vulnerability to losing control.
[23] The limited number of small organizations with a sufficiently competent purchasing function to manage relatively complex cooperation processes leads to fewer purchasing groups consisting of organizations that are all small.
[24] More usage of third parties to initiate purchasing groups and new (or existing) staff members to manage these groups results in more groups consisting of organizations that are all small.

in a purchasing group ($p < .05$; $S = 3.1 > L = 2.4$). Small organizations not involved in a purchasing group rate this negative motive higher than large organizations not involved in a purchasing group. Small organizations might expect that due to their smaller size, they have less control in purchasing groups in which larger organizations participate. This could be one of the reasons for such organizations to give a lower priority to cooperative purchasing.

Remarkably, we found a different significant difference for 'losing control' between small and large organizations that are involved in a purchasing group ($p < .05$; $S = 2.0 < L = 2.9$). Small organizations involved in a purchasing group rate this negative motive lower than large organizations involved in a purchasing group. Apparently, for small organizations, this motive turns out to be less negative than anticipated.

6.4.3. Critical success factors

In this section, we discuss our analyses of critical success factors for managing purchasing groups. We tested whether there are differences between successful and unsuccessful purchasing groups concerning several factors. We conducted independent samples 1-tailed t-tests and found several significant differences as shown in Table 6.8. Later in this section (below Table 6.9), we discuss the success factors in more detail.

Again, we conducted a stepwise discriminant analysis to examine the total and individual contributions of the set of success factors. For the success factors in Table 6.8, Wilks' lambda, as a test of the discriminant function in the model, was highly significant (lambda = .621, $Chi^2 = 32.429$, df = 6, $p < .001$). In the model, 89.3% of the purchasing groups were correctly classified as successful or unsuccessful. Table 6.9 shows the factors that best predict whether a purchasing group is successful or not successful.

Table 6.8 Critical success factors for managing purchasing groups

Critical success factor	Average			Sign.
	Successful groups		Unsuccessful groups	
Commitment and internal support				
1. All members rarely change representatives	3.4	>	2.7	.003
2. Sufficient total contribution of efforts	3.5	>	2.7	.005
3. All members have internal support	3.5	>	2.9	.019
Communication				
4. Communication (current projects)	4.0	>	3.4	.005
5. Communication (new projects)	3.8	>	3.3	.031
Allocation of gains and costs				
6. Fair allocation of gains and costs	3.6	>	3.0	.016
Knowledge on how to cooperate				
7. All members contribute unique knowledge	3.4	>	2.5	.002
Organization				
8. Voluntary participation	3.8	>	2.7	.001
9. All members have a similar influence	3.9	>	3.2	.005
Uniformity of the members				
10. All members have similar objectives	3.7	>	3.1	.009

Note: Measured on a 5 point Likert scale from 1 (strongly disagree) to 5 (strongly agree); differences are compared using independent samples 1-tailed t-tests

Table 6.9 Main critical success factors for managing purchasing groups

Step	Critical success factor entered in discriminant analysis	Minimum *D* squared				
		Statistic	Exact *F*			
			Statistic	df1	df2	Sign.
1.	Voluntary participation	.937	10.007	1	71	.002
2.	Sufficient total contribution of efforts	2.283	12.026	2	70	.000
3.	All members contribute unique knowledge	3.061	10.593	3	69	.000
4.	All members rarely change representatives	3.587	9.176	4	68	.000
5.	Fair allocation of gains and costs	3.947	7.960	5	67	.000
6.	Communication (new projects)	4.060	6.722	6	66	.000

Note: The analysis has been made between successful and unsuccessful purchasing groups; the max. number of steps is 20; the min. partial *F* to enter is .5 and the max. to remove is .25

The critical success factors cover several categories. Still, some factors do not differ significantly between the groups. In contrast to the findings of Hendrick (1997), we found that factors related to 'interorganizational trust[25]' and 'the formality of the group[26]' are not critical success factors for managing purchasing groups. These factors are important when establishing interorganizational cooperation (Browning et al., 1995; Gulati, 1995; Hoffmann and Schlosser, 2001; McAllister, 1995), but can be considered as prerequisites for the management phase. That is, without some agreements and interorganizational trust, a purchasing group would probably never have existed in the first place. This means that P_7[27] is partly supported by the current data set. In addition, our results regarding 'interorganizational trust' are consistent with the results of Hoffmann and Schlosser (2001). Note that the differences between the study of this chapter and the studies of Hendrick (1997) and Chapter 2 can be explained by the fact that in the studies of Hendrick and Chapter 2, the perceived importance of success factors was determined. In this chapter, we determined the factors by studying differences between successful and unsuccessful groups.

As indicated in Table 6.9, 'voluntary participation' is the most important critical success factor for managing a purchasing group. A well-organized group should be cost-effective for all its members. In an ideal situation, this cost-effectiveness should attract members without enforcing them to cooperate. Enforced cooperation is often linked to a top-down approach (based on Adler and Borys, 1996; Barnard, 1968; Scott, 1992). Based on our data set and articles such as Brockhoff (1992) and Huijboom and Hoogwout (2004), an enforced approach seems inappropriate for cooperative purchasing in many situations. Still, we argue that after a voluntary decision has been taken to cooperate, the members need to show that they are committed, which can be done by, among other things, a formal declaration of intent (see Chapter 5). It is not shown in the tables, but note that enforced cooperation and unequal influence are particularly problematic for business unit groups.

Success factors such as 'sufficient total contribution of efforts' indicate that cooperative purchasing does not occur as a matter of course. In other words, some knowledge and

[25] All members are honest and loyal, all members meet one's commitments, and all members like each other personally.
[26] Make engagements regarding important decision moments and report important performances of the group periodically.
[27] Critical success factors for managing purchasing groups are related to choosing suitable items, commitment and internal support, interorganizational trust, knowledge on how to cooperate, formality, communication, voluntarily participation, uniformity of the members, and fair allocation of gains and costs.

efforts are necessary to coordinate the activities, to communicate with each other, and to synchronize specifications and supplier preferences. This result is consistent with the work of Hoffmann and Schlosser (2001), who found that 'establishing required resources' is a success factor for alliances. As mentioned earlier, our results concerning communication difficulties are consistent with the qualitative results of Laing and Cotton (1997).

Another success factor concerns 'rarely changing representatives'. If members frequently change representatives, then this may hamper the learning curve of the group. In addition, it is not a sign of commitment to group, which has already been indicated as being an important success factor by Doucette (1997).

Finally, Table 6.8 and Table 6.9 indicate that several success factors concerning differences between members are important, what supports P_1[28] and is consistent with several critical success factors identified by other studies (Bennett and McCoshan, 1993; Doz and Hamel, 1998; Gould et al., 1999; Hardy et al., 2005; Hendrick, 1997; Klein Woolthuis, 1999). However, in contrast to some other (qualitative) empirical studies (e.g., Polychronakis and Syntetos, 2007), we did not find a significant difference concerning 'similar organizational cultures'. For the data set, we found that purchasing groups consisting of organizations with similar or dissimilar cultures can be successful and unsuccessful.

6.4.4. Allocation methods used

Even though the risk of allocation problems is relatively low in lead buying and program groups (see Chapter 4), Table 6.9 indicates that the 'fair allocation of gains and costs' is an important critical success factor for the purchasing groups analyzed. In addition, in Chapter 8 and Chapter 9, we discuss that fair allocation methods could reduce, among other things, the 'fear of free-riding group members'. Finally, the fair allocation gains and costs concerns some propositions for further research (P_{2a}[29], P_{2b}[30], and P_8[31]). For these reasons, we further explore allocation methods in this section. Regarding the allocation of gains and costs, we found the following:

- **Allocation of gains**
  A total of 87% of the purchasing groups analyzed uses the Equal Price gain allocation method. The other 13% uses allocation methods that are more beneficial to larger organizations than the Equal Price method (see Chapter 8 for further discussions of the Equal Price method). Typically, these purchasing groups have a lot of members or have large mutual differences between the members;
- **Allocation of costs**
  A total of 30% of the purchasing groups uses no formal cost allocation method, 29% uses a proportional cost allocation method, 29% uses the Equal Amount cost allocation method or a fixed membership fee, and 11% uses another cost allocation method (see Chapter 9 for further discussions of cost allocation methods).

[28] Intensive purchasing group types are less viable when group members differ strongly in terms of partnership and alliance theory.
[29] Reallocating some of the gains of piggy-backing organizations to organizations that allow piggy-backing leads to more organizations involved in piggy-backing.
[30] More usage of the concept of piggy-backing by using a saving allocation method results in more savings for both small and large organizations.
[31] The development and application of fair allocation methods and increased insight into the (perceived) fairness of allocation methods leads to more successful purchasing groups consisting of organizations that strongly differ.

In the next table, the combinations of gain and cost allocation methods used by the respondents are shown. For instance, 27% of the purchasing groups combines the Equal Price gain method with no formal cost method. A total of 76% of these groups are perceived as successful. The fourth and fifth column of the table also suggest that groups with less uniform members more often combine Equal Price with a proportional method.

Table 6.10 Combinations of allocation methods used

Gain allocation method	Cost allocation method	% Total	Uniformity of contributions to the group[a]	Uniformity of purchasing volume[a]	% Successful
Equal Price	No formal method	27	2,7	2,5	76
Equal Price	Equal Amount or fixed membership fee	26	2,7	2,2	90
Equal Price	Proportional	24	2,3	1,9	79
Equal Price	Another method	9	2,9	1,9	86
Another combination		14	2,1	1,6	82
Total / average		100	2,5	2,1	82

[a] Measured on a 5 point Likert scale from 1 (very dissimilar) to 5 (very similar)

The data suggests that certain combinations of gain and cost allocation methods occur more often in successful purchasing groups. But due to limited data, we could not statistically test whether the usage of certain combinations of gain and cost allocation methods occurs more often in successful purchasing groups than in unsuccessful groups while controlling for, among other things, uniformity of purchasing volumes and contributions to a group of the members of a group. This could be an interesting subject for further quantitative empirical research. In further research, other aspects affecting the perceived fairness of the allocation of gains and costs (see Chapter 10) could be taken into account as well.

6.4.5. Products and services

In Chapter 2, choosing suitable items is indicated as important for purchasing groups. Therefore, we discuss this issue in more detail in this section. Table 2.6 gives the indicated properties that make items suitable for cooperative purchasing. The terms routine, leverage, bottleneck, and strategic refer to the stages of purchasing sophistication (Kraljic, 1983).

Table 6.11 Properties that make items suitable for purchasing groups

Successful property	Freq.	Unsuccessful property	Freq.
General items and/or similar needs	17	Very innovative items	1
Bulk and/or standardized items	9	Customized supplier service	2
Routine items	3	Very technical specifications	3
Leverage items	2	Bottleneck items	4
Simple items	2	Preference for local needs and/or suppliers	6
Shared image	1	Strategic items	6
Demand elasticity of price	1	Customized items	23

From the table, we conclude that general, similar, bulk, standardized, routine, and leverage items are often suitable for cooperative purchasing. Customized, strategic, local, and bottleneck items are often less suitable for cooperative purchasing, supporting P_9[32].

[32] The most important properties that make products and services suitable for cooperative purchasing are similar needs of cooperating organizations, standardized items, and/or not customized items.

6.4.6. Propositions and results

Table 6.12 summarizes the discussions above regarding the propositions.

Table 6.12 Overview of the propositions and results

Proposition		Result
Intensive purchasing group types		
P_1	Intensive purchasing group types are less viable when group members differ strongly in terms of partnership and alliance theory.	Supported (concerns similar contributions of knowledge, objectives, influence, commitment, and internal support)
The piggy-backing problem		
P_{2a}	Reallocating some of the gains of piggy-backing organizations to organizations that allow piggy-backing leads to more organizations involved in piggy-backing	Further research
P_{2b}	More usage of the concept of piggy-backing by using a saving allocation method results in more savings for both small and large organizations	Further research
Trust between public organizations		
P_3	Lack of trust in loyalty and honesty are less important negative motives for cooperative purchasing between public organizations than between private organizations	Tested part supported (concerns disclosure of sensitive information)
Organizational size		
P_4	Small organizations give a lower priority to cooperative purchasing than large organizations due to lower organizational support, commitment, resources, and an increased vulnerability to losing control	Tested part supported (concerns losing control)[33]
P_{5a}	The limited number of small organizations with a sufficiently competent purchasing function to manage relatively complex cooperation processes leads to fewer purchasing groups consisting of organizations that are all small	Further research
P_{5b}	More usage of third parties to initiate purchasing groups and new (or existing) staff members to manage these groups results in more groups consisting of organizations that are all small	Further research
Organizations involved or not involved in a purchasing group		
P_{6a}	Lack of organizational support and opportunities to cooperate are decisive negative motives for organizations not to become involved in a purchasing group	Tested part supported (concerns lack of cooperation opportunity)
P_{6b}	Expecting coordination costs to be high and lack of trust in other organizations' competences are more difficult to deal with than expected in cooperative purchasing	Tested part rejected (concerns coordination costs)
Critical success factors for managing purchasing groups		
P_7	Critical success factors for managing purchasing groups are related to choosing suitable items, commitment and internal support, communication, fair allocation of gains	Partly supported (concerns commitment and internal support, communication, cooperation knowledge, fair allocation, member

[33] Note that for small organizations involved in a purchasing group, this negative motive turns out to be less negative than anticipated.

Proposition		Result
	and costs, formality, interorganizational trust, knowledge on how to cooperate, uniformity of the members, and voluntary participation	uniformity, and voluntary participation) and partly rejected (concerns formality and interorganizational trust)
Fair allocation methods		
P_8	The development and application of fair allocation methods and increased insight into the (perceived) fairness of allocation methods leads to more successful purchasing groups consisting of organizations that strongly differ	In Chapter 8 to Chapter 10, we study (un)fair gain and cost allocation methods
Products and services		
P_9	The most important properties that make products and services suitable for cooperative purchasing are similar needs of cooperating organizations, standardized items, and/or not customized items	Supported

6.5. Highway matrix indications

In Chapter 3 and Chapter 4, we already discussed several differences between the different purchasing group types. In this section, for the highway matrix, we graphically present some of these differences based on the current data set. We note that we did not test these differences statistically due to limited data (see also Table 6.3). Thus, the figures only provide some general indications of, among other things, the average perceived success, the longevity of a purchasing group, and the fair allocation of cooperative gains and costs.

The average perceived success per group is indicated in the figure below. Dark areas indicate an on average high perceived success. Light areas indicate an on average low perceived success. For the data set, the figure suggests that the purchasing groups in the left hand side of the figure (e.g., piggy-backing groups) are more difficult to manage.

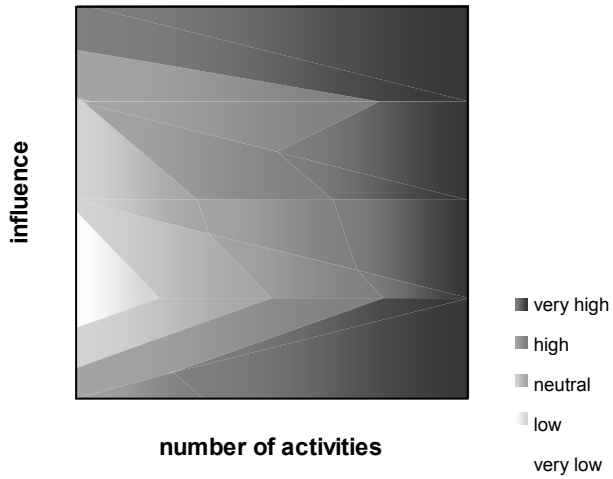

Fig. 6.1 Average perceived success of the purchasing groups

Carrying out similar analyses for several purchasing group properties leads to the following figures. Among other things, the figures suggest that third party purchasing groups typically have large numbers of contracts and members. Project groups typically have a short life span and program groups typically have a relatively high number of meetings for the members.

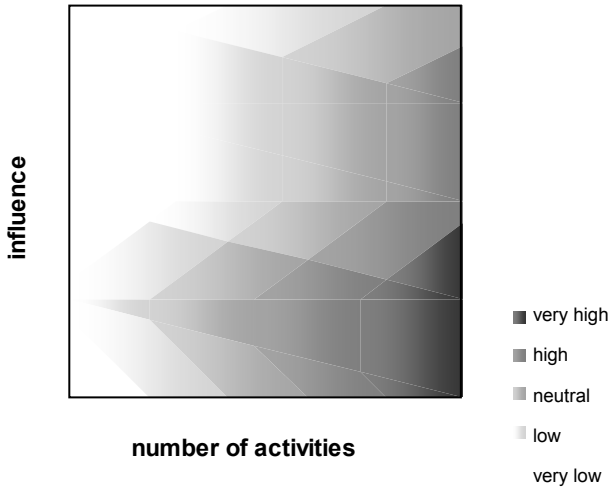

Fig. 6.2 Number of contracts of the purchasing groups

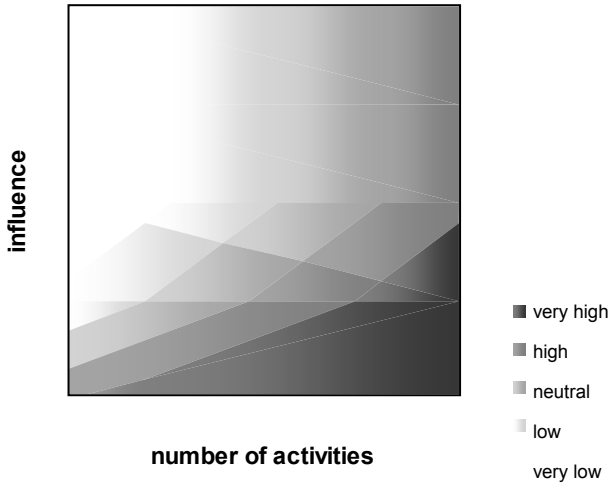

Fig. 6.3 Longevity of the purchasing groups

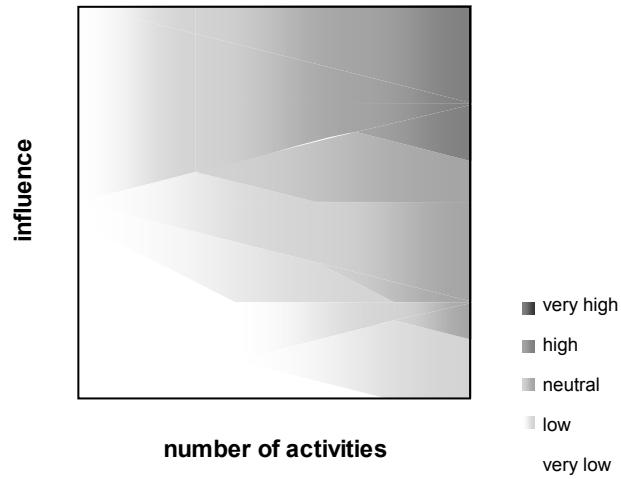

Fig. 6.4 Number of meetings for the members

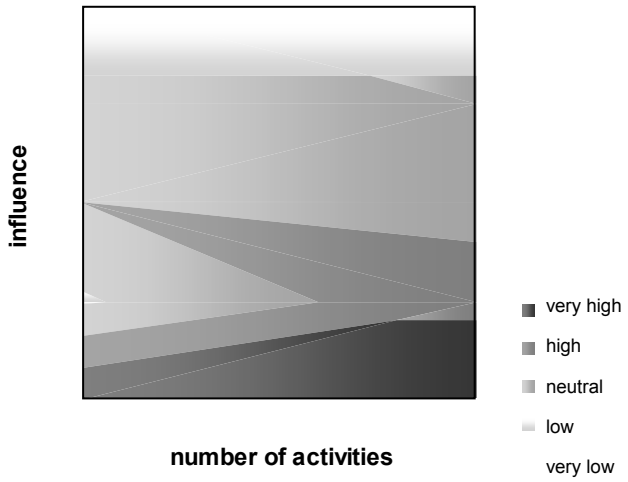

Fig. 6.5 Number of members

The following figures indicate some differences in scores on the success factors studied. For instance, Fig. 6.6 suggests that piggy-backing and networking groups are very informal. Fig. 6.7 suggests that piggy-backing and third party groups are usually very voluntary. Fig. 6.8 suggests that the allocation of gains and costs is mostly problematic in project groups and piggy-backing groups. This is consistent with the results of Chapter 4.

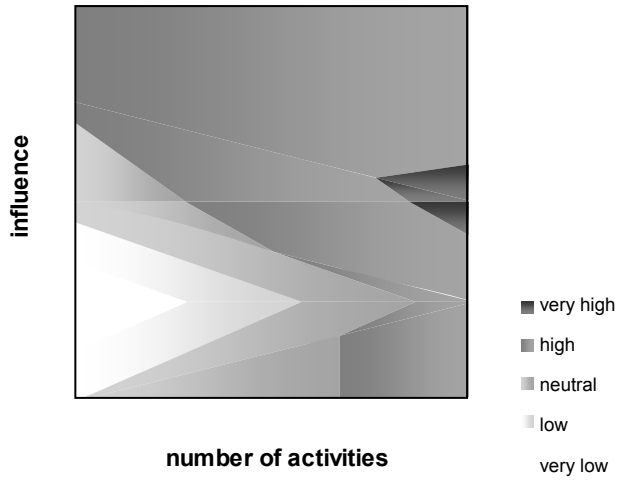

Fig. 6.6 Making engagements

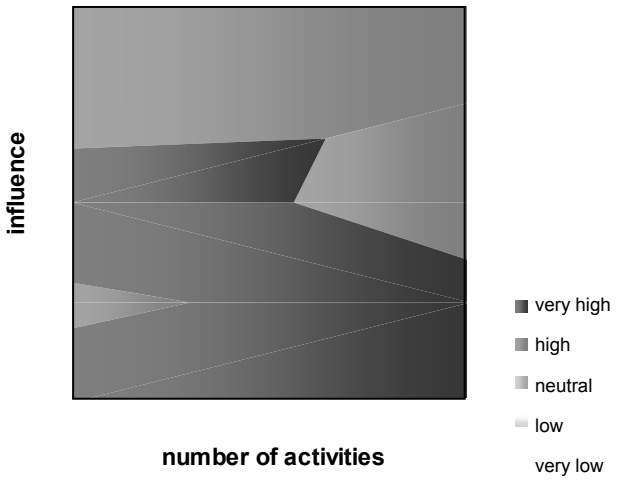

Fig. 6.7 Voluntary participation

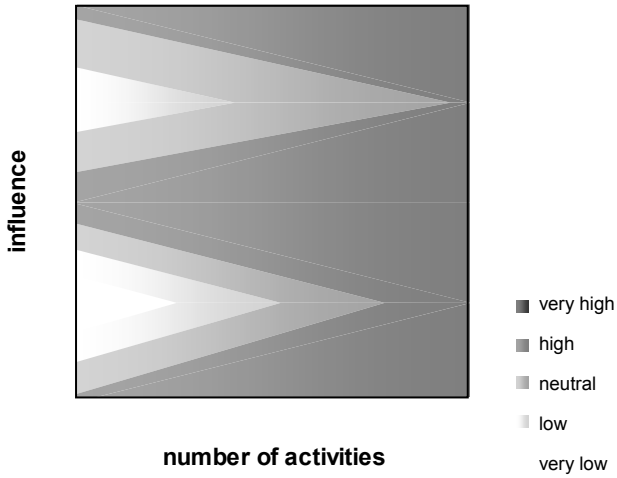

Fig. 6.8 Fair allocation of gains and costs

Finally, the last two figures show a positive and a negative motive. Fig. 6.9 suggests that in one-time purchasing groups, it is difficult to decrease tender process throughput time. This may be due to difficulties caused by cooperating with relatively unknown organizations. Fig. 6.10 suggests that losing control is a typical negative motive of third party purchasing. This negative motive becomes less strong for more intensive purchasing groups.

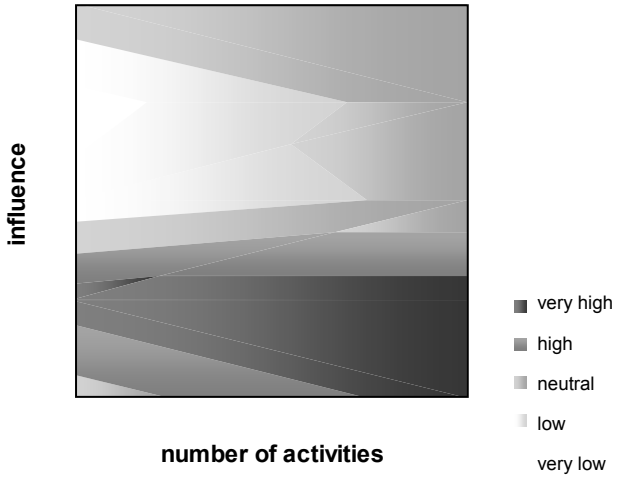

Fig. 6.9 Increased tender process throughput time

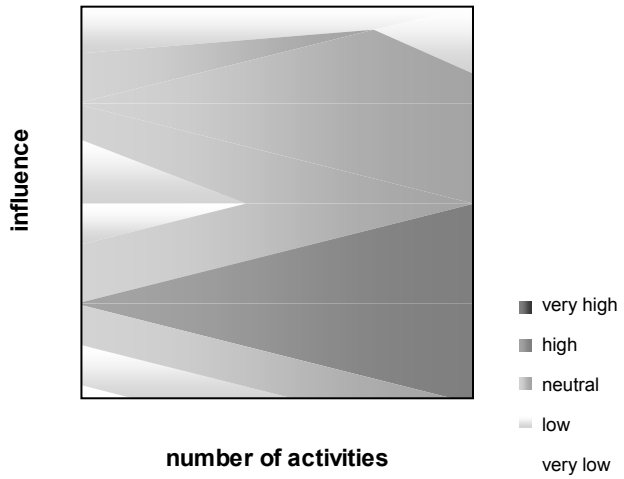

Fig. 6.10 Losing control

6.6. Limitations

Some limitations need to be considered regarding the present study. First, note that we did not statistically test the typology developed in Chapter 3. This chapter focuses on lead buying groups and program groups as we only have sufficient data to statistically test propositions about these groups. Second, as anticipated, there was a low response rate. Despite the low response rate, we already argued that the purchasing group data possesses desirable representativeness. This may not fully apply to the organizations that are not involved in a purchasing group. Therefore, we have to be cautious interpreting and generalizing results on the motives why organizations are not involved in a purchasing group. Nevertheless, our current data set supports most of the tested (parts of the) propositions that are based on the literature, theory, and the UN data set of Chapter 2.

6.7. Conclusions

This chapter set out to identify differences between organizations involved and not involved in a purchasing group regarding motives for cooperative purchasing and to identify critical success factors for managing purchasing groups. In addition, we studied properties of suitable products and services, the usage of allocation methods, differences between small and large organizations, and differences between purchasing group types. For testing several propositions, we used data from lead buying and program groups. The chapter adds to the literature by providing quantitative empirical evidence for (parts of) several propositions. It also builds on earlier studies carried out by, among others, Hendrick (1997), Hoffmann and Schlosser (2001), Laing and Cotton (1997), and Polychronakis and Syntetos (2007).

Our conclusions regarding the motives are as follows. First, we conclude that the most important negative motive is ‘a lack of opportunities for cooperative purchasing’ (supports tested part of P_{6a}). This implies that more efforts concerning encouraging cooperative

purchasing might be worthwhile. Second, our results suggest that it is more difficult than expected to deal with 'reduced throughput times' in a purchasing group. Third, we found no significant difference for 'expecting coordination costs to be high' between organizations involved and not involved in a purchasing group (rejects tested part of P_{6b}). This means that coordination costs for cooperative purchasing are not under- or overestimated by the respondents. Fourth, 'disclosure of sensitive information' is an important negative motive for private organizations (supports tested part of P_3) and 'supplier resistance', 'fear of free-riding organizations', and 'a lack of cooperation priority' are important negative motives for both public and private organizations. Finally, using the main positive and negative motives, we could correctly predict whether an organization is involved or not involved in a purchasing group in 85.1% of the cases.

Regarding differences between small and large organizations, we conclude the following. We found that small organizations not involved in a purchasing group rate 'losing control' higher than large organizations not involved in a purchasing group. Small organizations might expect that due to their smaller size, they have less control in purchasing groups in which larger organizations participate (supports tested part of P_4). Nevertheless, based on an analysis of organizations that are involved in a purchasing group, we conclude that this motive turns out to be less negative than anticipated. Regarding properties that make items suitable for cooperative purchasing, we conclude that suitable items are general, similar, bulk, standardized, routine, and leverage items. Customized, strategic, local, and bottleneck items are less suitable for cooperative purchasing (supports P_9).

Our conclusions regarding critical success factors are as follows. First, we found that the success factors studied that are related to the 'formality of the group' and 'interorganizational trust' are not critical success factors for managing purchasing groups (rejects parts of P_7). Second, we conclude that intensive purchasing group types are less viable when group members differ strongly. This is because we found significant differences between successful and unsuccessful purchasing groups concerning similar 'objectives', 'influence', 'contributions of knowledge', 'commitment', and 'internal support' (supports P_1). Note, however, that we did not find a significant difference concerning 'similar organizational cultures'. Third, we conclude that 'voluntary participation', 'sufficient total contribution of efforts', 'all members contribute unique knowledge', 'all members rarely change representatives', 'fair allocation of gains and costs', and 'communication' are the main critical success factors (supports parts of P_7). Using these critical success factors, we could correctly predict whether a purchasing group is perceived as successful or not successful in 89.3% of the cases. In the analytical part of this thesis, we discuss the 'fair allocation of gains and costs' in more detail (concerns P_8).

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Chapter 7

Unraveling quantity discounts

As indicated in previous chapters, lower purchase prices due to quantity discounts are an important positive motive for cooperative purchasing. This chapter studies quantity discounts in more detail and is summarized as follows.

We consider the situation in which a buying organization deals with a discrete quantity discount schedule offered by a supplier. Furthermore, the buying organization can negotiate with the supplier about the lot size and purchase price, but does not know the underlying function that was used by the supplier to determine the discount schedule.

We provide an analytical and empirical basis for one general Quantity Discount Function (QDF) that can be used to describe the underlying function of almost all different quantity discount types. We first develop such a QDF analytically. Among other things, this QDF enables buying organizations to calculate detailed prices for a large number of quantities. We show that the QDF fits very well with 66 discount schedules found in practice.

We discuss that the QDF and related indicators can be a useful tool in supplier selection and negotiation processes. It can also be used for competitive analyses, multiple sourcing decisions, and allocating savings for purchasing groups. Additionally, the QDF can be included in research models incorporating quantity discounts, as we do in the next chapters. We conclude this chapter with an outlook on further QDF research regarding the characterization of commodity markets from a demand elasticity point of view[34].

7.1. Introduction

Quantity discount schedules have been used widely for many centuries (Elmaghraby and Keskinocak, 2003). These days, quantity discount schedules come in all shapes and sizes. A typical example of a discount schedule is shown in Table 7.1 (Dolan, 1987). This discrete schedule provides the price per item for a limited number of quantities and prices. It does not provide the assumed function which the supplier used to calculate the price per item. Therefore, it is difficult for a buying organization to calculate negotiable prices for the many possible quantities for which no specific prices are provided by the supplier. For instance, if a buying organization needs a quantity of 9,500 items, then the question often is what price – in between 40.9 and 45.4 – the buying organization can start negotiating with. Another question is whether the buying organization should start negotiations with supplier A (see Table 7.1) or supplier B (see Table 7.2) for a quantity of 9,500 items.

[34] Parts of this chapter are based on Schotanus, F., 2006. A basic foundation for unraveling quantity discounts: How to gain more insight into supplier cost mechanisms? IPSERA conference proceedings, San Diego (United States).

As a result of this information deficiency, it is difficult for buying organizations to compare quotes of different suppliers and to determine negotiating spaces. In this chapter, one of our aims is to tackle this information deficiency. We do this by deriving the Quantity Discount Function (QDF) that the supplier used to calculate the price per item. With this QDF, a buying organization can calculate prices for all possible quantities. But more importantly, the QDF derived can be used as a basic ingredient in research models incorporating quantity discounts. Among other things, it can be used in research on gains allocation in cooperative purchasing. Before we discuss more applications and the academic and practical relevance of the QDF in more detail (Section 7.1.2 and Section 7.1.3), we shortly introduce some important insights into quantity discounts in Section 7.1.1.

Table 7.1 Example of a quantity discount schedule of supplier A

Quantity	Price per item
1,000 – 4,999	50.0
5,000 – 9,999	45.4
10,000 – 29,999	40.9
30,000 – 49,999	38.1
50,000 – 199,999	37.1
200,000 and more	33.5

Table 7.2 Example of a quantity discount schedule of fictional supplier B

Quantity	Price per item
500 – 999	51.0
1,000 – 1,999	49.0
2,000 – 3,999	47.0
4,000 – 7,999	45.0
8,000 – 15,999	43.0
16,000 and more	41.0

7.1.1. Relevant knowledge base on quantity discounts

First of all, calculating prices for all possible quantities is only a useful practice if the purchase price is negotiable. According to Munson and Rosenblatt (1998), this is true for most situations. They argue in their study that purchase prices and lot sizes are mostly determined through negotiations. Munson and Rosenblatt also note that quantity discount schedules have different characteristics:

- The number of price breaks in a discount schedule may be one, two, multiple or infinite (Dolan, 1987). It is claimed by Munson and Rosenblatt (1998) that an infinite number of price breaks represents a continuous discount schedule. However, we note that this is only true if all price breaks have an interval of one item. In other words, this is only true if all different quantities have a different price per item;
- The form may be all-items or incremental. An all-items form means that all items receive the same discount (Xiaoa and Qi, 2007). An incremental form means that only the items within a price break interval receive that interval's discount (Xiaoa and Qi, 2007);
- Time aggregation may be individual or multiple. This describes whether the discount applies to individual or multiple purchases over a certain time period (Munson and Rosenblatt, 1998);
- Item aggregation may be one or multiple. This describes whether the discount applies to one or multiple items. A business volume discount is an example of multiple item aggregation. It represents item aggregation where the price breaks are based on the total monetary volume across all products purchased (Munson and Rosenblatt, 1998).

The economic rationales of quantity discounts are mainly three-fold:

- Achieving perfect price discrimination against a single customer or a set of homogenous customers or achieving partial price discrimination against heterogeneous customers (Buchanen, 1953; Dolan, 1987; Sirias and Mehra, 2005);

- Influencing the buying organization's ordering pattern to increase the logistics system efficiency and/or to coordinate and lower costs between different levels in a distribution channel (Crowther, 1967; Dolan, 1987; Sirias and Mehra, 2005). It is claimed by Munson and Rosenblatt (1998) that discount schedules influence the quantity per order, but not the total quantity demanded over the long run. However, we claim that if the price elasticity of demand is high, then lower purchase prices could increase the total demand;
- Often, buying organizations are simply expecting a certain quantity discount for purchasing large amounts (Nason and Della Bitta, 1983).

The body of knowledge on different types of quantity discounts is large, both from the seller's perspective and from the buyer's perspective. From the seller's perspective, a great deal has been written about when suppliers should offer quantity discounts, and if so, what type of quantity discount schedule they should offer to maximize profits (e.g., Lee and Rosenblatt, 1986). From the buyer's perspective, a great deal has been written about the application of quantity discounts in economic order quantity models (e.g., Viswanthan and Wang, 2003) and inventory ownership problems (e.g., Boyaci and Gallego, 2002).

Nearly all the previous research on quantity discounts is focused on creating discount schedules or applying schedules in new or existing models. We use a different perspective. Given a discount schedule, we are interested in deriving the supplier's original function that was used to create the schedule. Up to now, very little is known on deriving a QDF from a quantity discount schedule.

A given discount schedule (see Table 7.1 for an example) provides an indication of potential price discounts. For instance, Table 7.1 provides an indication of potential price discounts for five price breakpoints. For buying organizations, this in itself is useful information for supplier comparison and negotiations. A QDF however, can provide more information. In the next subsections, we discuss the academic and practical relevance of a QDF.

7.1.2. Academic relevance

In this section, we discuss the academic relevance of the chapter. First, a QDF is an essential ingredient in many research models incorporating quantity discounts. As discussed earlier, examples of such models are economic order quantity models (e.g., Viswanthan and Wang, 2003), inventory ownership problems (e.g., Boyaci and Gallego, 2002), and Cooperative Purchasing-games (see Chapter 8 and Chapter 9). Surprisingly, very little is available to provide a sound analytical and empirical base for a QDF. In this chapter, we aim at filling that void.

Second, it seems that there is a large research gap between price elasticity and demand elasticity. Price elasticity of demand is a concept that is used throughout economics. The concept is based on people doing less of what they want to do as the price of doing it rises. Price elasticity of demand is defined as $E_d = \frac{\%\ change\ in\ quantity\ demanded}{\%\ change\ in\ price}$ (e.g., Case and Fair, 2003) and has been studied in great detail. Almost all textbooks discussing the principles of economics or marketing include this topic. In addition, several academic papers describe the price elasticity of different commodities (e.g., Babbel, 1985; Loderer et

al., 1991). Demand elasticity of price is rarely discussed in the literature (Ramsay, 1981). Demand elasticity posits that the price of a product or service may drop as the demand for it rises. These price drops can be explained by increased economies of scale and/or decreased transaction costs. A QDF is a measure for the demand elasticity of different commodities. Note that some academic papers do use the term demand elasticity, but they actually mean price elasticity (e.g., Song and Sumner, 1999; Yan et al., 2001).

7.1.3. Practical relevance

Apart from the academic relevance of a QDF, we claim a QDF has some direct practical relevance as well. First, a QDF provides an indication of potential price discounts on a detailed level. For instance, for Table 7.1, it provides indications of potential price discounts for every quantity between 1,000 and 200,000. A potential price per item for a quantity of 3,000 could be 45.7. A potential price per item for a quantity of 125,000 could be 34.6. Thus, a QDF can be used for calculating theoretical discounts for all possible quantities. As discussed earlier, this reduces information deficiencies for buying organizations and enables buying organizations to compare supplier quotes of different suppliers and determine theoretical negotiating spaces.

Second, retrieving information about quantity discounts may also be a useful step in a competitive analysis. One of the steps in a competitive analysis is to compare and analyze products and services from competitors. A QDF enables organizations to easily compare and analyze different quantity discount schedules from competitors.

Third, calculating purchase prices for all possible quantities is also useful in multiple sourcing decisions. In multiple sourcing decisions, one needs to decide how to allocate a certain quantity between different suppliers. For all possible quantities of the feasible allocations, the quantity discounts need to be calculated and weighed up against other important factors, such as spreading risks.

Fourth, as we demonstrate in this chapter, a QDF can be used to calculate theoretical minimum prices. If the theoretical minimum price for a certain supplier is relatively low, then this may indicate a large negotiating space. Thus, a QDF can provide additional information about the prices of a supplier. This additional information about purchase prices is useful for buying organizations, as the purchase price is often an important criterion for purchasing decisions (e.g., Lehmann and O'Shaughnessy, 1974; Quayle, 2002b).

Finally, the accuracy of the estimation of price savings due to the pooling of demand can be improved by a QDF as well. For instance, typical problems of cooperative purchasing are related to the calculation and allocation of prices and price savings (see Chapter 5). It is difficult to calculate these savings, because it is often unknown what the group members would have paid individually if they were not involved in the purchasing group. A QDF can be used to solve such problems.

7.2. Specific research objectives

In this chapter, we focus on the buyer's perspective on quantity discounts and we assume that prices and lot sizes are negotiable in most situations. Our analytical objective is to

describe a general QDF defined by a limited number of parameters. It should be uncomplicated and practical to derive these parameters from different types of quantity discount schedules (see Section 7.3). Our empirical objective is to test how well the QDF represents different types of quantity discount schedules found in practice. In addition, we develop and test related hypotheses (see Sections 7.4 and 7.5). Our conceptual objective is to develop several practical QDF indicators (see Section 7.6 for some examples). Based on the QDF indicators, we aim to build a basis for more research to demand elasticity of price. This research line could explore QDF parameters and indicator values of typical products and services. These values could serve as guidelines in purchasing processes (see Section 7.6 for some examples). As mentioned in Section 7.1.2, a similar line of research already exists in the price elasticity literature.

7.3. A continuous quantity discount model

In this section, we focus on our first objective. We first provide the rationale for using a continuous QDF (Section 7.3.1). Next, we develop a general QDF (Section 7.3.2 to Section 7.3.4). Finally, we discuss some issues related to minimum prices (Section 7.3.5).

7.3.1. Rationale for a continuous function

From an operations management perspective, quantity discount schedules are developed by a supplier to maximize profits. To maximize profits, suppliers commonly adopt discrete stepwise quantity discount schedules. According to Wang (2002), a continuous quantity discount schedule could reduce the supplier's discount benefits.

With a continuous discount schedule, a buying organization obtains more price information, which it can use in negotiations and supplier comparison. In other words, a continuous schedule suits better with the wishes and needs of a buying organization. As such, deriving a continuous quantity discount function based on a discrete quantity discount schedule could be an interesting operation for a buying organization. To achieve our first objective, we therefore choose to develop a continuous QDF (see Fig. 7.1 for an example of a continuous and a discrete schedule).

As we show in Section 7.5, a continuous QDF is capable of fitting all discount schedule types mentioned in Section 7.1.1. Still, it may be a subject for debate whether it is possible to fit discrete stepwise discount schedules with a continuous function. For instance, in a stepwise schedule, a price of 400 could apply to 50–99 items and a price of 390 could apply to 100–199 items. A simple continuous function cannot fit such a stepwise schedule well. However, as most prices are determined through negotiations, such a stepwise schedule usually does not exist in practice (based on Munson and Rosenblatt, 1998). For instance, if a buying organization needs 95 items, then it could order 100 items or it could negotiate a lower price than 400.

In supplier selection and during negotiations, a QDF can help a buying organization by reducing the information deficiency regarding the purchase price of 95 items. First, a QDF enables the buying organization to compare different schedules of different suppliers for 95 items. Next, the buying organization can start negotiations with the most competitive supplier. Finally, during negotiations, the buying organization has more information regarding the purchase price due to a QDF. This reduced price information deficiency is

valuable to buying organizations (Stigler, 1961), as it could lead to lower purchase prices and/or better quality.

An additional disadvantage of stepwise discount schedule functions is that stepwise functions could lead to an anomaly (Arcelus and Rowcroft, 1992; Sethi, 1984). This anomaly concerns the possibility that it can save money by purchasing more items than needed and throwing the surplus away to obtain a certain quantity discount.

For all the reasons above, we use a continuous price function in stead of a discrete stepwise function. We do note that lot sizes are sometimes fixed and nonnegotiable. This may be the case when logistical aspects, such as truck capacities, are a limiting condition. In this chapter, such discount schedules are not our focus of interest.

We also acknowledge that Munson and Rosenblatt (1998) showed some buyers and/or sellers in their study a simple linear schedule. Many of their respondents opposed continuous schedules. Indicated reasons for this are the administrative challenges that such schedules would create. Using the QDF involves some extra operations. Throughout the chapter, we argue that these are well worth the effort.

7.3.2. Defining a QDF

Quantity discount schedules are specific to the item sold and hence, the cost structure of the supplier and the competition from other suppliers. As the competition and cost structures may differ a lot over items, one could argue that a general QDF that can be applied to different items cannot exist. However, even if the discount schedule foundations themselves are quite different, the shape of the schedules might be similar. This would imply that only some parameters vary between quantity discount schedules.

We use a continuous function described by Heijboer (2003) to build a QDF with a limited number of parameters. The function Heijboer used can be rewritten as $p(q) = p_m + S \cdot q^{-0.5}$. Here p_m is the theoretical minimum price and S scales the function $p(q)$ for quantity q. We build on this function for two reasons. First, it is assumed that a strictly decreasing discount is given with more items being purchased. Second, it is assumed that the total price is increasing with the number of items being purchased. These assumptions hold for most practical situations (Dolan, 1987; Heijboer, 2003). Still, the function described by Heijboer has one main disadvantage. The function does not fit well with discount schedules with a high incremental curve or an almost linear-like curve. For instance, the function is not well suited to fit schedules as shown in Fig. 7.1 and Fig. 7.2. Therefore, we weaken the first assumption and introduce an extra parameter η. We allow that a non-decreasing discount is given with more items being purchased within a limited range of the discount schedule (see Fig. 7.2 for an example). The introduced parameter η represents the steepness of a QDF:

$$QDF(q) = \text{fixed amount} \pm \text{variable amount} = p(q) = p_m + S \cdot q^{-\eta}, \quad q \geq 1 \qquad \textbf{(7.1)}$$

The total purchase cost function is then defined as:

$$TQDF(q) = q \cdot p_m + S \cdot q^{-\eta+1}, \quad q \geq 1 \qquad \textbf{(7.2)}$$

We introduce the steepness parameter η to be able to find a better fit with different types of quantity discount schedules as mentioned in Section 7.1.1. The other parameters in the function are p_m and S. Overall, the following restriction applies: $p_m > 0$. The QDF can be scaled and shaped into two categories: positive steepness and negative steepness. In the next two sections, we discuss both categories in more detail.

7.3.3. A QDF with a positive steepness

Fig. 7.1 shows an example of a quantity discount schedule with a positive steepness. If a QDF has a positive steepness η, then the parameter p_m represents the theoretical minimum price of the function (for $q = \infty$). The scaling parameter S represents the price spread of a function with a positive steepness. For instance, if the steepness of a function is positive and the price spread is 100, then the difference between the price per item for purchasing 1 item (maximum price) and the price per item for purchasing an infinite number of items (minimum price) is 100. Thus, $p(1) - p(\infty) = p_m + S \cdot 1^{-\eta} - p_m - S \cdot \infty^{-\eta} = S$. For a QDF with a positive steepness ($\eta > 0$), it implies $S > 0$.

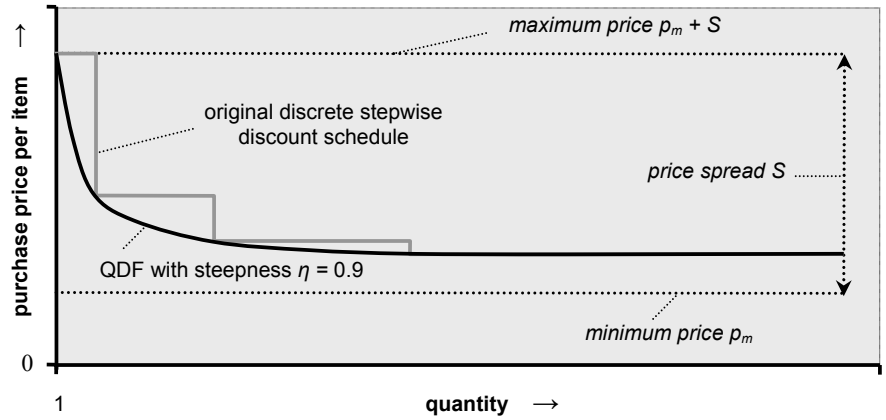

Fig. 7.1 Example of a quantity discount schedule with a positive steepness

7.3.4. A QDF with a negative steepness

Fig. 7.2 shows an example of a quantity discount schedule with a negative steepness. If a QDF has a negative steepness η, then $p(q)' < 0$ implies $S < 0$. Note that while p_m represents a theoretical $p(\infty)$ for a QDF with a positive steepness, it represents a theoretical $p(0)$ for a QDF with a negative steepness. Again, the maximum price (for $q = 1$) is $p(1) = p_m + S \cdot 1^{-\eta} = p_m + S$. For a QDF with a negative steepness, it implies $0 > \eta \geq -1$ and $S < 0$. Note that $\eta < 1$ would lead to an increasingly decreasing price.

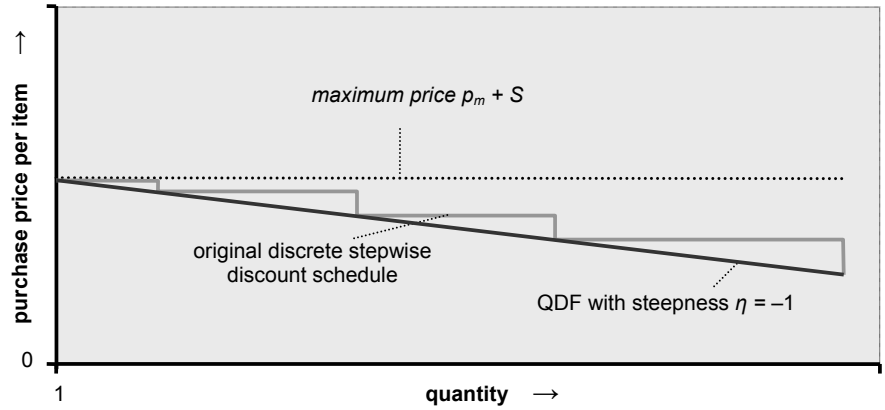

Fig. 7.2 Example of a quantity discount schedule with a negative steepness

Discount schedules with $\eta \geq -1$ are still somewhat peculiar, because extrapolating such functions eventually leads to negative purchase prices. Nevertheless, discount schedules with a negative steepness occur in practice for limited ranges as we show in Section 7.4.2 and discuss in Section 7.5. For instance, we argue that a supplier may use a linear schedule ($\eta = -1$) for a limited range because of marketing reasons or because of the simplicity of such schedules.

7.3.5. Defining the range for a QDF with a negative steepness

A theoretical minimum price for a negative steepness QDF does not follow directly from the QDF, as p_m does not represent the minimum price for negative steepness functions. Still, we can calculate the point where the purchase price becomes zero (see also Fig. 7.3). $QDF(q) = p_m + S \cdot q^{-\eta} = 0$, thus:

$$q^* = \left(-S \cdot p_m^{-1}\right)^{\frac{1}{\eta}} \tag{7.3}$$

The point q^{**} after which the total purchase costs $q \cdot p(q)$ decrease can be calculated by differentiating Eq. 7.2. This gives $TQDF(q)' = -\eta \cdot S \cdot q^{-\eta} + S \cdot q^{-\eta} + p_m = 0$ (see also Fig. 7.3). This can be rewritten as $TQDF(q)' = (1-\eta) \cdot S \cdot q^{-\eta} + p_m = 0$ and as $TQDF(q)' = q^{\eta} + (1-\eta) \cdot S \cdot p_m^{-1} = 0$. This finally gives:

$$q^{**} = \left((-1+\eta) \cdot S \cdot p_m^{-1}\right)^{\frac{1}{\eta}} \tag{7.4}$$

Note that $q^{**} = (1-\eta)^{\frac{1}{\eta}} \cdot q^* < q^*$.

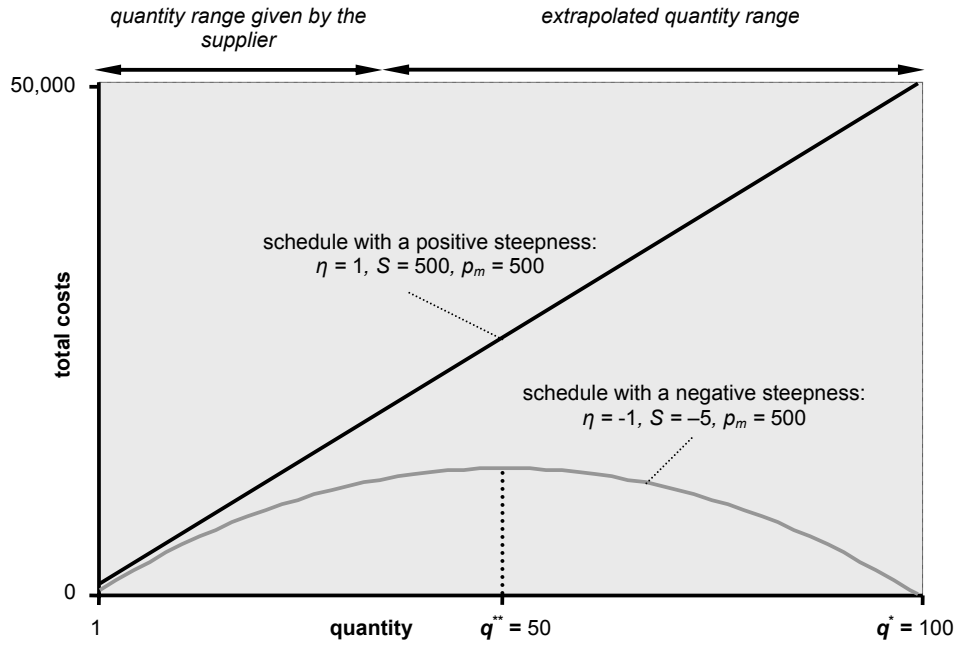

Fig. 7.3 Total purchase cost analysis examples

Eq. 7.4 marks the point until which extrapolation is theoretically possible. We use this equation to calculate a purely theoretical minimum price for a QDF with a negative steepness $p\left(q^{**}\right) = p_m + S \cdot \left(\left(-1+\eta\right) \cdot S \cdot {p_m}^{-1}\right)^{-1}$. This can be rewritten as $p\left(q^{**}\right) = p_m + S \cdot p_m \cdot \left(\left(-1+\eta\right) \cdot S\right)^{-1}$ and as $p\left(q^{**}\right) = p_m + p_m \cdot \left(-1+\eta\right)^{-1}$. This finally gives:

$$p\left(q^{**}\right) = \eta \cdot p_m \cdot \left(-1+\eta\right)^{-1} \quad \textbf{(7.5)}$$

Now we have the basic elements to develop indicators for supplier selection and negotiation processes in Section 7.6. But before we do that, we first test the QDF empirically in the next two sections.

7.4. Method

In this section, we discuss the methodology which we used to achieve the second objective. First, we describe the data collection and the data set itself. Next, we discuss the procedures used to test how well the QDF represents different quantity discount schedule types.

7.4.1. Data collection

We tested the fit of the QDF to quantity discount schedules found in academic papers (Dolan, 1987; Lal and Staelin, 1984), actual offers provided to purchasing groups, and internet stores. We found the internet price schedules by search engine searches on the keyword ‘quantity discounts’. None of the products analyzed had exceptional discounts for marketing or logistical reasons. Some product groups occurred more often in our selection

than others. But as the properties of discount schedules within product groups can differ significantly, we did not correct for product groups.

All the different discount schedule types mentioned in Section 7.1.1 were incorporated in our analysis. After we found all different types mentioned in Section 7.1.1, we stopped collecting and analyzing new discount schedules, leaving a total number of 66 quantity discount schedules. We converted all these discount schedules to the same form as shown in Table 7.1 and Table 7.2. The data collection was carried out at the end of 2004.

7.4.2. Data description

The basic properties of the data set are shown in Table 7.3. The first two columns of the table show properties regarding the number of price breaks. The table shows that there is quite some variety in the number of price breaks. The last two columns of the table show properties regarding the difference between the maximum and minimum price in the discount schedules. The difference in terms of percentage is formulated as the difference between the maximum and minimum price divided by the maximum price. The minimum difference applies to notebook discount schedules. The maximum difference applies to printed matter discount schedules. Both the mean difference and maximum difference are high. Thus, quantity discounts can have a major impact on the total purchase costs.

Table 7.3 Number of price breaks and maximum and minimum prices

Number of price breaks[a,b]	**Value**	**Difference between the maximum and minimum price given by the supplier**	**Value**
Mean number	4.0	Mean difference	31.3%
Median number	4	Median difference	N/A
Minimum number	2	Minimum difference	1.8%
Maximum number	10	Maximum difference	90.1%
Standard deviation	1.7	Standard deviation	21.6%
Skewness of distribution	1.2	Skewness of distribution	0.8

Note: $n = 66$; total number of prices = 327

[a] Here the break measures are corrected by removing two schedules with an infinite number of breaks

[b] We did not take schedules into account with only one price break

The steepness of the discount schedules ranges from –1.00 to 1.60. The schedules with a positive steepness (40% of the total number of observations) have a mean steepness of 0.58. Schedules with a negative steepness (60% of the observations) have a mean steepness of -0.50 . We found five linear schedules (8%) with a steepness of exactly minus one and one schedule (2%) with a steepness of exactly one.

7.4.3. Procedure

We analyzed the discount schedules under the following assumption. We assume that a purchase price for a certain range applies to the lowest quantity in this range. For instance, if a price of 400 applies to 50–99 items and a price of 300 applies to 100–199 items, then we assume that a price of 400 applies to 50 items and a price of 300 applies to 100 items. As mentioned before, the supplier does not quote prices for 51–99 items, but we assume that a lower price than 400 can be obtained through negotiations. We estimated the three parameters of the QDF with an exact algorithm and several nonlinear least squares algorithms, which are commonly used in curve fitting.

7.4.4. Data analysis

We tested the performance of the Gauss-Newton (Dennis and Schnabel, 1983), Levenberg-Marquardt (Levenberg, 1944; Marquardt, 1963; Moré and Sorensen, 1983) or trusted region algorithm (Branch et al., 1999; Byrd et al., 1988; Coleman and Verma, 2001; Steihaug, 1983) in combination with no method, the bisquare (DuMouchel and O'Brien, 1989) or the least absolute residuals robust fitting method (Meyer and Glauber, 1964).

We found very small differences in the accuracy of the algorithms. All algorithms performed very well. As an exact method exceeds an acceptable calculation time, we chose to use the popular Levenberg-Marquardt curve fitting algorithm in combination with the least absolute residuals method. Without going into detail, we found that this combination most frequently gives the best fit of the QDF with the actual schedules.

The Levenberg-Marquardt algorithm found a theoretical minimum price somewhat smaller than zero (for an infinite quantity) in five exceptional schedules. Here we applied the trusted region algorithm with lower bounds for the theoretical minimum price. See Table 7.4 and Fig. 7.4 for an example of how we estimated the QDF parameters of an actual quantity discount schedule with five price breaks (Dolan, 1987).

In Table 7.4, the R^2 used in the quality measurement is calculated based on the breakpoints of the discount schedule. Here we note that the measurement of the quality of approximation is not rigorous for discount schedules with only one breakpoint. For instance, this is the case if a price of 400 applies to 1–99 items and a price of 390 applies to 100 items and more. If we only look at the breakpoints, then using a steepness of, for instance, minus one will lead to a perfect fit. However, a large error might exist everywhere except at the breakpoint. This is a modeling problem that cannot be resolved by using better fitting algorithms. For this reason, we only consider discount schedules with two or more breakpoints.

Table 7.4 Example of a quantity discount analysis

Quantity given by the supplier	**Quantity used for the QDF**	**Price per item given by the supplier (Dolan, 1987)**	**Estimated price per item given the QDF**	**% Diff.[a]**
1,000 – 4,999	1,000	50.0	50.0	0.0
5,000 – 9,999	5,000	45.4	43.9	–0.2
10,000 – 29,999	10,000	40.9	41.6	0.3
30,000 – 49,999	30,000	38.1	38.3	–0.5
50,000 – 199,999	50,000	37.1	36.9	–0.2
200,000 and more	200,000	33.5	33.5	0.0

[a] The R^2 of the estimation is 0.991, the adjusted R^2 is 0.986, and the root mean squared error is 0.718

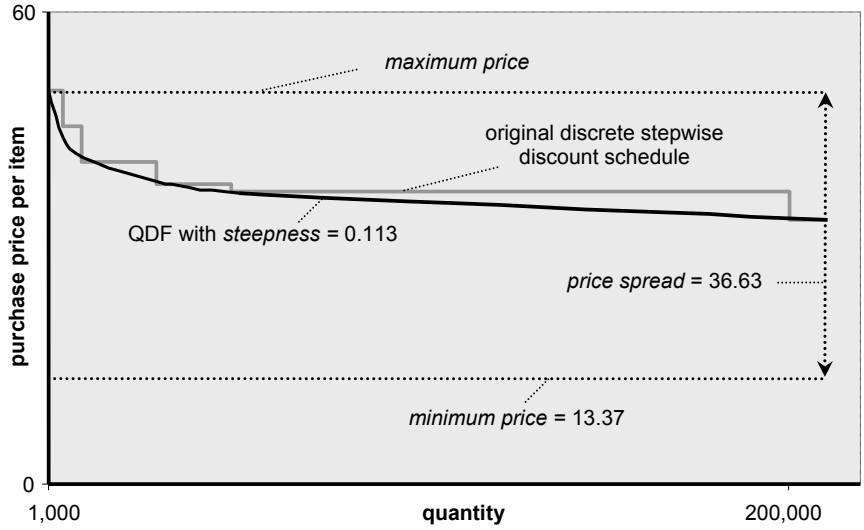

Fig. 7.4 Example of a quantity discount analysis

7.5. Testing the quantity discount function

In this section, we aim to achieve the second objective. We test how well the general QDF represents 66 discount schedules. Hence, we test the following hypothesis:

> **H_1:** The general QDF fits well with all different types of quantity discount schedules as mentioned in Section 7.1.1.

Table 7.5 shows the fit of the QDF with the data set. The second column shows the fit of a 'restricted' QDF in which negative steepness is not allowed. The third column shows the fit of a 'less restricted' QDF in which both positive and negative steepness are allowed. In other words, for the second column, we fitted the data under the additional restrictions $\eta > 0$ and consequently $S > 0$ (in addition to the general restrictions). For the third column, we fitted the data without these additional restrictions.

The table shows that the less restricted QDF fits very well with the different types of discount schedules as discussed in Section 7.1.1. The minimum R^2, the average R^2, and the adjusted R^2 are very high. The adjusted R^2 is not significantly lower than the R^2, which normally means that no explanatory variable(s) are missing. Only three schedules analyzed had relatively large differences between the R^2 and the adjusted R^2. These relatively large differences were caused by outlying points. For the restricted QDF, the minimum R^2 and the minimum adjusted R^2 are relatively low. These minima are observed while fitting an almost linear quantity discount schedule. A restricted QDF (with a positive steepness) does not fit very well with such a schedule.

Table 7.5 Fit of the QDF with the data set

Measure	**Restricted QDF**	**Less restricted QDF**
Average R^2	0.944	0.995
Average adjusted R^2	0.908	0.988
Average root mean squared error	1.602	0.642
Minimum R^2	0.701	0.961
Minimum adjusted R^2	0,403	0.913
Maximum root mean squared error	25.550	4.628

Note: $n = 65$

On first sight, H_1 seems to be supported by the data set. However, we have some marginal notes. For one discrete stepwise schedule, we found a QDF with a q^{**} smaller than the maximum quantity given by the supplier. This would mean that the total purchase costs decrease after a certain point within the quantity range given by the supplier. So, the QDF is not a reliable approximate for this schedule. We explain this issue as follows. The discrete stepwise schedule with a small q^{**} had a clear twist after a certain point. After this point, the stepwise schedule changed form. In other words, the supplier apparently used two different quantity discount functions: one function for the first part of the schedule and another function for the other part of the schedule. Although we did find a high R^2 for the schedule, we removed this exceptional schedule from the analysis.

We also have some notes concerning the extrapolated quantity range (see Fig. 7.3 for an example of an extrapolated range). While not using lower bounds for the theoretical minimum price, we found five positive steepness schedules in which the theoretical minimum price was somewhat smaller than zero. Calculating all possible quantities within the quantity range given by the supplier is possible for such schedules. However, extrapolating prices for much higher quantities should not be done.

Note that the remarkably high values of R^2 can partly be explained because there were several discount schedules with only two price breaks (i.e., three data points). Nevertheless, for three or more price breaks, we found a very good fit as well. Indeed, the minimum R^2 is very high for the less restricted QDF (see Table 7.5). Our explanation for the goodness of fit is that most of the discount schedules seem to have a fairly simple underlying basis. In other words, the goodness of fit can be explained by the fact that most quantity discount schedules show a similar decreasing behavior. In addition, the discount schedules usually have no outliers, but follow a more or less logical line.

As discussed in Section 7.3, discount schedules with a negative steepness are somewhat peculiar. To explain negative steepness, one could argue that there is a relationship between steepness and the difference between the minimum and maximum price of discount schedules provided by the supplier. It could be that negative steepness only exists in discount schedules with a small range regarding the minimum and maximum price. This is because if the range would be larger, then eventually negative prices would occur. So, for large ranges concerning the minimum and maximum price, a positive steepness would normally be found. Thus, we hypothesize:

> **H_2:** Quantity discount schedules with a positive steepness have a higher difference between minimum and maximum prices given by the supplier than schedules with a negative steepness.

With an independent samples t-test, we tested the correlation between the difference between minimum and maximum prices and negative or positive steepness. We assumed the variances of both groups being unequal (Levene's (1960) test $p = 0.002$) and found a significant correlation ($t = –2.173$, $df = 37.060$, $p = 0.036$, 2-tailed), supporting H_2. Price schedules with a positive steepness have a significantly higher difference between minimum and maximum prices (mean difference is 38.0%) than schedules with a negative steepness (mean difference is 25.8%). Therefore, we assume that discount schedules with a negative steepness only provide prices for relatively small quantities. So, discount schedules with a negative steepness should not be used for extrapolating and calculating prices for much larger quantities than given by the supplier.

We also tested the assumption above[35] by removing one or more price breaks from discount schedules with a positive steepness. More specifically, we changed the positive discount schedules that provide prices for relatively large quantities to schedules that provide prices for relatively small quantities. This way, we tested whether the steepness would become negative. This happened in a few cases (20%), but most price breaks in a schedule with a positive steepness are based on the whole range of the schedule. Removing price breaks from such schedules does not change positive steepness to negative steepness.

Finally, we tested the assumption above[35] by adding one price break to discount schedules with a negative steepness. More specifically, we added a price break with a very large quantity and a relatively low purchase price to the negative discount schedules, thereby changing the schedules that provide prices for relatively small quantities to schedules that provide prices for relatively large quantities. This way, we tested whether the steepness of these schedules would become positive. Indeed, even for the discount schedules with an original negative steepness of exactly minus one, we found that the steepness changed from negative to positive.

7.6. Discussion and implications

In this section, we discuss several implications of the QDF. By doing so, we aim to achieve the final objective. Here our main assumption is that if the QDF fits very well with a quantity discount schedule, then related indicators provide useful insights in the schedule. We describe several QDF indicators and parameters in Table 7.6. As shown in the final column of the table, the indicators and parameters have several applications (see Section 7.1.2 and Section 7.1.3 for more discussions of the academic and practical relevance of the QDF and its indicators and parameters).

[35] Discount schedules with a negative steepness only provide prices for relatively small quantities.

Table 7.6 Descriptions and applications of the QDF

QDF indicator / parameter description	Measure	Estimated QDF value	Value given by supplier A[a]	QDF application
1) Price for a all possible quantities	$p(q) = p_m + \frac{S}{q^{\eta}}$ (e.g., q = 4,000)	44.72	50.00	Calculate prices for decisions related to comparing suppliers and indicating negotiating spaces
2) For instance, a purchasing group needs to calculate price savings. The group has two members. Member A needs 200 items. Member B needs 800 items. They pay a price of 50.00 per item to one supplier for 1,000 items:				Calculate and allocate price savings for all possible quantities in multiple sourcing and purchasing group decisions
• Savings of member A: 200 · (p(200) – 50.00)		1,460	N/A	
• Savings of member B: 800 · (p(800) – 50.00)		748	N/A	
3) Steepness of the QDF	η	0.113	N/A	Characterization of quantity discounts
4a) Maximum price given the minimum order quantity $q_{\min}$	$p_{\max} = p(q_{\min})$ (e.g., q = 1,000)	50.00	50.00	Compare suppliers and indicate negotiating spaces; in this example (q = 1,000), there is a theoretical negotiable discount range for the price per item between 13.37 and 50.00
4b) Minimum price	$p_{\min} = \begin{cases} p_m = p(\infty), & \eta > 0 \\ p(q^{**}), & \eta < 0 \end{cases}$	13.37	33.50	
5a) Maximum quantity discount percent	$\frac{p_{\max} - p_{\min}}{p_{\max}}$	73%	33%	Compare suppliers and indicate negotiating spaces; in this example (q = 4,000), there is a theoretical negotiable discount range between 11% and 73% for 4,000 items
5b) Minimum quantity discount percent for a certain quantity	$\frac{p_{\max} - p(q)}{p_{\max}}$ (e.g., q = 4,000)	11%	0%	

[a] The values given by supplier A are also shown in Table 7.1; the original discount schedule in Table 7.1 does not provide information as shown here in this table

Regardless of the simple form of quantity discount schedules, there are many differences between QDF parameters and indicators for different supplier offers. A further extension of the possible use of the QDF is related to cooperative purchasing. The concept of cooperative purchasing becomes more interesting if items have a large difference between maximum (4a) and minimum prices (4b). Cooperative purchasing could have a large impact on the purchase prices of these items. Of course, before purchasing such items in a group, factors such as mutual trust, similar purchasing needs, and commitment have to be taken into account as well. Still, knowing which items have large differences between maximum and minimum prices could be useful for purchasing groups.

Another possible application is related to supplier selection and negotiation processes. In some markets, suppliers could have similar methods to create discount schedules. In these markets, most of the schedules of different suppliers are alike, that is, p_m, η, and S are alike. Other markets could show a different behavior. Here suppliers differentiate by offering schedules different from their competitors. In markets with a large price spread between suppliers, it has been shown that it is interesting for buying organizations to consider a large number of suppliers in the selection process (Boer et al., 2000). There might be more negotiating space as well in such markets. For these reasons, it would be interesting for buying organizations to know which markets have a large price spread between suppliers.

7.7. Limitations

Due to the general character of this chapter, there are some assumptions and limitations regarding the interpretation of our empirical results. Our main preference is to use a continuous QDF in stead of a discrete stepwise QDF. Further case study research among suppliers and buying organizations could be carried out to empirically test this preference.

Although the QDF fits very well with almost all quantity discount schedule types that we found, analytical limitations concern the fact that we only applied a limited number of fitting algorithms. We did this as the focus of this chapter is not on finding the best algorithm to fit discount schedules. In further research, even better fitting results could be obtained by using other estimation methods, such as semi-parametric or nonparametric methods. Another limitation concerns the fact that we only considered one QDF type. Other types could be formulated as exponential functions (e.g., $p(q) = p_m + S \cdot \exp(-\eta \cdot q)$), functions with more parameters (e.g., $p(q) = p_m \cdot q^{-\gamma} + S \cdot q^{-\eta}$) or spline functions.

7.8. Conclusions

Previous research on quantity discounts has focused on creating discount schedules and on applying discount schedules in new or existing models. We propose a different perspective. We consider the situation in which a buying organization has to deal with a negotiable discrete quantity discount schedule, but does not know the underlying function that was used by the supplier to determine the schedule. In this chapter, we provide an analytical and empirical basis for one continuous Quantity Discount Function (QDF) that can be used to describe this underlying function. The QDF consists of only three parameters, which can be derived easily from almost all kinds of different types of quantity discounts as mentioned in Section 7.1.1.

In this chapter, we show that the QDF fits very well with almost all quantity discount schedule types that we found. The QDF information can be used in supplier selection and negotiation processes. Specific QDF applications range from justifying multiple sourcing decisions to calculating savings for purchasing groups. The latter was indicated as being a difficult issue for purchasing groups in Chapter 5. In addition, the QDF can be used in research models incorporating quantity discounts (see also Chapter 8 and Chapter 9). To summarize, we argue that the QDF reduces the price information deficiency for organizations regarding quantity discount schedules provided by suppliers. This reduced

information deficiency could lead to lower purchase prices and/or better quality for buying organizations.

Still, using the QDF involves some extra operations. Throughout the chapter, we argue that these are well worth the effort. For instance, according to Wang (2002), a continuous quantity discount schedule could reduce the supplier's discount benefits. In addition, extra information about purchase prices is useful for buying organizations, as the purchase price is often an important criterion for purchasing decisions (e.g., Lehmann and O'Shaughnessy, 1974; Quayle, 2002b). Finally, our data set shows that quantity discounts can have a major impact on the total purchase costs. We found a maximum discount 90.1% and a mean discount of 31.3%.

The discount schedule behavior of suppliers may differ per market and may also develop during time, following the product life cycle. Further research to QDF indicators and parameters could characterize commodity markets and provide several applications. For instance, for some commodity markets, it could be worthwhile for buying organizations to purchase in groups or to consider a large number of suppliers in selection processes. Also, there could be more space in negotiations in such markets. To be able to utilize such QDF applications, a promising market research line to demand elasticity of price could be set up, following the research line to price elasticity of demand.

Acknowledgements

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PART IV

ANALYTICAL APPROACH

In Part I of this thesis, we have proposed that reallocating some of the gains of piggy-backing organizations to organizations that allow piggy-backing leads to more organizations involved in piggy-backing. We have also proposed that the development and application of fair allocation methods and increased insight into the (perceived) fairness of allocation methods leads to more successful purchasing groups consisting of organizations that strongly differ. In Part III, we have showed that an important critical success factor is the fair allocation of gains and costs. In this part, we study gain and cost allocation methods from an analytical point of view. In particular, we are interested in the theoretical fairness and unfairness of several allocation methods. In Part V of this thesis, we study the perceived fairness of allocation methods as well.

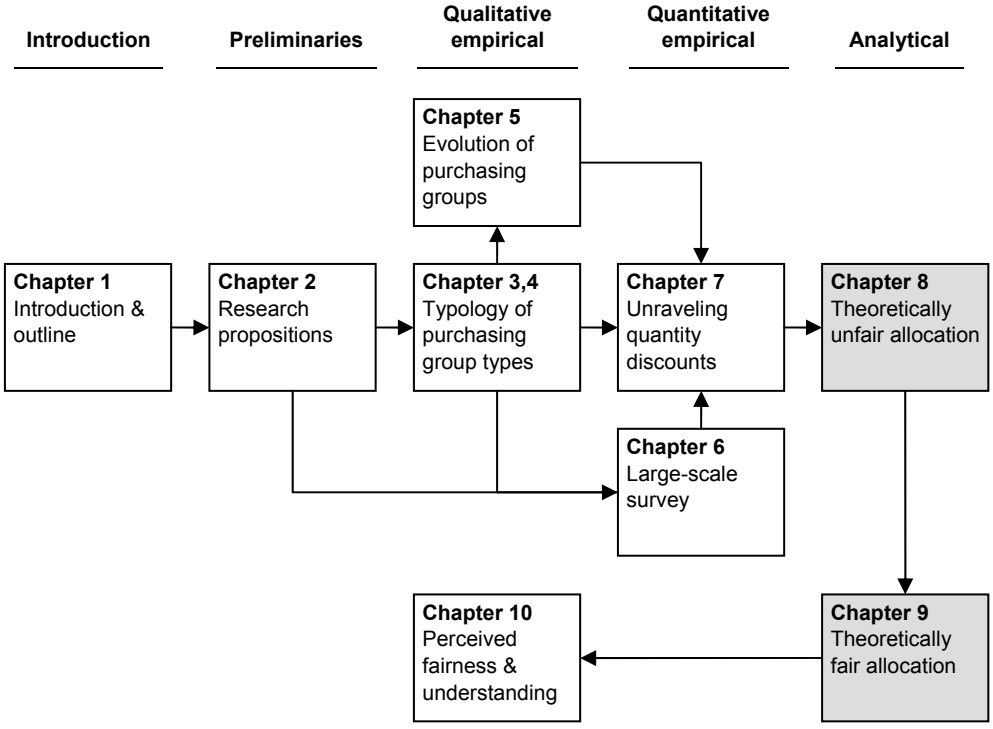

Fig. IV.1 Research outline

Chapter 8

Theoretically unfair allocation of gains

Some purchasing groups do not flourish. As indicated in previous chapters, a possible reason for this is a creeping dissatisfaction among various members of a group with the allocation of the cooperative gains and costs. In this chapter, we analyze theoretical unfairness resulting from using the commonly used Equal Price method for allocating gains under the assumption of continuous quantity discounts. We do this by using the quantity discount function from the previous chapter. The results of this chapter are summarized as follows.

We demonstrate that unfairness is caused by neglecting a particular component of the added value of individual group members. Next, we develop two fairness ratios and tie these to fairness properties from cooperative game theory. Among other things, the ratios show that being too-big a player in a purchasing group can lead to decreasing gains. The ratios can be used to assess whether Equal Price is an unfair method in specific situations.

We discuss measures a purchasing group could consider in order to attenuate perceived unfairness and improve its stability and prosperity. Suggested measures are using another gain allocation method than Equal Price and/or compensating the unfair effects of Equal Price by a cost allocation method that favors larger organizations in a purchasing group. We discuss these measures in more detail in the next chapter[36].

8.1. Introduction

Cooperative purchasing research has focused primarily on inductive explanations of practice and qualitative deductive reasoning (Heijboer, 2003). One specific issue receiving particularly little research attention is the allocation of financial gains resulting from purchase price savings obtained by cooperative purchasing while using the so-called Equal Price (EP) allocation method. This commonly used EP method[37] is defined as all organizations paying an equal price per item independent of their individual purchasing volumes (based on Heijboer, 2003). The price to be paid is determined by the joint purchasing volume only.

It is unfortunate that the EP method is not well-studied in the literature as financial gains are often an important reason for individual organizations to join a purchasing group (Nollet and Beaulieu, 2003). Therefore, this chapter focuses specifically on the EP method. For an overview and treatment of other gain (and cost) allocation methods, see Heijboer (2003) and Chapter 9.

[36] This chapter is largely based on Schotanus, F., Telgen, J., Boer, L., de, 2007. Unfair allocation of gains under the equal price allocation method in purchasing groups. European Journal of Operational Research, 2007.

[37] In Chapter 6, we found that a total of 87% of the purchasing groups uses the EP gain allocation method.

While practically and intuitively appealing, EP may lead to unfair outcomes under certain circumstances. This has been reported previously by Heijboer (2003), but a systematic analysis of this problem is lacking. Still, reasons reported for failure or stagnation of purchasing groups, such as disagreements caused by large differences in organization size (see Chapter 2), group instability (Heijboer, 2003), lack of commitment (Doucette, 1997), and fear of free-riding group members (Hendrick, 1997) are often related to the way the purchasing group's gains are allocated (Heijboer, 2003). To prevent these kinds of allocation problems, each of the organizations in a purchasing group should therefore receive a fair part of the total gains (based on Dyer, 2000). However, this may be difficult when organizations purchase different volumes through a purchasing group and use EP for allocating gains.

An example of one of the problems of EP is illustrated by the so-called piggy-backing problem (see also Chapter 2). This problem occurs when a small buying organization uses a contract negotiated by a large buying organization. For large organizations, there may be no incentive to allow piggy-backing while using EP. For small organizations, it can be very interesting to piggy-back though, as they lack economies of scale and can obtain a substantially lower purchase price by piggy-backing.

Granot and Sošic (2005) discuss a similar problem in which a relatively small organization would benefit from joining a specific purchasing group, but the inclusion of such an organization could possibly decrease the profits of the bigger organizations in this exchange. Furthermore, Eßig (2000) notes that it is important to avoid an imbalance of incentives and contributions of organizations in a purchasing group, which can be caused by EP. Spekman et al. (2000) also note that a typical problem in cooperation between organizations is that one of the organizations is dissatisfied, particularly if one of the cooperating organizations is consistently extracting more value than the other organizations.

Finally, reasoning from an equity theory perspective (Adams, 1963; Adams, 1965), it can be explained how perceptions of equity are developed. Equity theory states that individuals who feel under-rewarded will try to restore equity. Similarly to purchasing groups, EP may lead to under-rewarded organizations in a group. This may lead to lower commitment of these organizations or them leaving the group (Das and Teng, 2001a).

8.2. Specific research objectives

Despite the relevance of the studies mentioned above, these studies do not formally analyze how and under which conditions unfairness arises while using EP. These two issues are important to all types of purchasing groups as all of them have to make a decision on how to allocate its gains. Therefore, this chapter provides an analytical analysis of unfair outcomes of EP, provides recommendations for purchasing groups as how to deal with it, and contributes to more awareness and understanding of EP related problems. Hence, the main research question in this chapter is: how and under which conditions does the Equal Price allocation method lead to unfair outcomes?

The organization of the chapter is as follows. First, we develop a formal model of cooperative purchasing that enables us to analyze and illustrate unfairness effects while

using EP. Next, we use the formal model of cooperative purchasing to analytically investigate what makes EP result in unfair outcomes. We do this by decomposing the added value of a purchasing group into three components and study how applying EP affects each component separately. This will answer the first part of our research question: how does EP lead to unfair outcomes? Next, we study how the degree of unfairness is affected by the relative stake of each organization in a purchasing group and develop several practical guidelines. This will answer the second part of our research question: under which conditions does EP lead to unfair outcomes? In the final sections, we discuss the limitations of the research, draw conclusions, and provide recommendations for purchasing groups and scholars in the field.

8.3. CP-games without costs

As mentioned in the introduction, several issues play a role in the success of establishing and managing purchasing groups. In this chapter, we focus on the actual financial gains issue, as this is indicated in the previous section as an important reason for purchasing cooperatively. Hence, we do not consider situations where quantity discounts are dependent on individual transportation costs, decreasing the direct financial gains.

We model a purchasing group by assuming purchase price savings due to economies of scale when buying from suppliers (Heijboer, 2003). In our model, we make the following three basic assumptions about quantity discounts, which hold for many practical situations as discussed in the previous chapter and by Arnold (1996c), Dolan (1987), and Heijboer (2003).

Assumption 1. *For the purchase price per item p(q), we assume that a non-increasing volume discount is given with more items being purchased. In addition, we assume the total purchasing spend* $q \cdot p(q)$ *to be increasing with the number of items being bought (Heijboer, 2003).*

Assumption 2. *Based on Assumption* 1*, we assume that* $p(q) = p_0 \cdot \left(c_1 + c_2 \cdot q^{-\eta}\right)$ *for* $q > 0$*. This function corresponds with almost all kinds of different types of quantity discounts* (*see the previous chapter*)*. The parameter η represents the steepness of the price function for* $\eta \geq -1$ *and* $\eta \neq 0$*. For* $p_0 > 0$ *and* $c_1 > 0$, $p_0 \cdot c_1$ *represents the minimum* (*maximum*) *price* p_m of a function with a positive (negative) *η*. *Furthermore,* $p_0 \cdot c_2$ *represents the spread S of the function. Thus,* $p(q) = p_0 \cdot \left(c_1 + c_2 \cdot q^{-\eta}\right) = p_m + S \cdot q^{-\eta}$*, what corresponds to the quantity discount function in the previous chapter. If η is negative* (*positive*)*, then* c_2 *is negative* (*positive*) *as well.*

Note that in practice, discount schedules with a negative η are only observed for quite limited purchasing volumes (see the previous chapter). Such limited volumes may apply to cooperative purchasing situations, but this is usually not the case. As purchasing groups usually purchase relatively large amounts of items, discount schedules for limited purchasing volumes do not typically represent the practical case investigated.

Assumption 3. *For purchasing groups, it may be difficult to determine an accurate estimate for the steepness η. We assume an average value of* 0.50 *for a positive η.*

Assumption 3 is based on two studies. According to Arnold (1996c), doubling the output by concentrating demand as a result of cooperative purchasing can provide on average 25% reduction of the purchase price. This corresponds to an average positive η of 0.42. According to the study in the previous chapter, positive η may vary between at least 0.04 and 1.60. In the study, an average positive η of 0.58 is found. Therefore, we assume 0.5 to be a reasonable compromise for the average value of η.

Note that the value of 0.5 for a positive average η in Assumption 3 may still be questioned. Therefore, we also study the effects of a whole range of values of η in Sections 8.7.2 and 8.7.3. If it is possible to determine an accurate estimate for η for the specific purchasing situations of a purchasing group, then a group can consult these results in Sections 8.7.2 and 8.7.3.

We refer to our model as a Cooperative Purchasing game or CP-game(N,q_i,p) (Heijboer, 2003). N is the total number of organizations in a purchasing group (i.e., the grand group), q is the number of items each organization i in a group S wants to purchase, and p is the price per item. The total gains function $v(S)$ is defined as the total gains the group generates by buying items together compared to the situation where each of the organizations in a purchasing group would buy these items on its own:

$$v(S) = \sum_{i \in S} \left(q_i \cdot p\left(q_i\right) \right) - \sum_{i \in S} q_i \cdot p\left(\sum_{i \in S} q_i \right) \qquad \textbf{(8.1)}$$

In the following two sections, we illustrate unfairness by means of a numerical example as a further introduction to our research problem and we define the measures of fairness that we shall evaluate in this chapter. In the next chapter, we analyze CP-games with costs.

8.3.1. Unfairness of Equal Price illustrated

In the following example, we illustrate the gain allocation effects of current practices in cooperative purchasing. Consider three organizations purchasing 60 items cooperatively and using EP. The price for the items as a function of the quantity that will be ordered is $p\left(q\right) = p_0 \cdot \left(c_1 + c_2 \cdot q^{-0,5}\right) = 959 \cdot \left(1 + q^{-0,5}\right)$ for $q > 0$. This can be modeled into a CP-game as shown in Table 8.1.

Table 8.1 Allocations of the case savings

Purchasing group S	Total quantity of group S	Price per item	Total purchasing volume of group S	Total gains of group S
{1}	35	1,121	39,246	0
{2}	10	1,262	12,625	0
{3}	15	1,207	18,102	0
{1,2}	45	1,102	49,597	2,273
{1,3}	50	1,095	54,741	2,607
{2,3}	25	1,151	28,775	1,952
{1,2,3} = N	60	1,083	64,980	4,992

Given this table, the gains can be calculated, which each individual organization receives when the grand purchasing group uses EP:

Organization i gains $EP_i(v) = q_i \cdot \left(p(q_i) - p\left(\sum_{j \in N} q_j \right) \right)$

Organization 1 gains 35 · (1,121 – 1,083) = **1,340** (largest organization)
Organization 2 gains 10 · (1,262 – 1,083) = **1,795** (smallest organization)
Organization 3 gains 15 · (1,207 – 1,083) = **1,857**

The total gains are 1,340 + 1,795 + 1,857 = **4,992**

The outcome of this example shows that EP may lead to a situation where the largest organization (number 1) receives the smallest part of the total gains (1,340). The largest organization could object to this allocation as it adds the most value to the purchasing group in our model. This situation could lead to instability in the group, because the largest organization could leave or reduce its commitment.

8.4. Properties of fairness

The unfairness illustrated in the example in the previous section concerns one specific situation. To assess the unfairness of EP in general, we analyze several common properties of fairness from cooperative game theory (Friedman, 2003; Heijboer, 2003; Moulin, 2001; Shapley, 1953). Game theory is a mathematical research field that deals with multilateral decision making. Each decision maker (player) has his own interests and has a number of possible actions open to him. By his actions, each player affects the outcomes for the other players. In cooperative game theory, it is assumed that gains can be made when all players cooperate. One of the problems that are addressed in this theory is how to divide these gains in a fair way among all players (Heijboer, 2003). The common properties of fairness we use in this chapter are:

- **EFF: Efficiency**
  All pay-offs are allocated back to the organizations in a group: $\sum_{i \in N} f_i(v) = v(N)$. Here $f(v)$ is the allocation vector for each game;
- **SYM: Symmetry**
  If two organizations i and j in a group can be interchanged without changing any $v(S)$, then $f_i(v) = f_j(v)$. It means that equal organizations in a group should get equal pay-offs;
- **DUM: Dummy**
  If $v(S \cup \{i\}) - v(S) = v(\{i\})$ for all $S \subset N \setminus \{i\}$, then $f_i(v) = v(\{i\})$. It means that an organization in a group that does not contribute anything, should not receive anything;
- **STA: Stability**
  For all groups S, it holds that $\sum_{i \in S} f_i(v) \geq v(S)$. It means that for each organization the pay-off of cooperation in the group is equal to or higher than the pay-off of working alone or in any other subgroup;

- **MON: Monotonicity**
  If for one organization i $q_i' \geq q_i$, then $f_i(v') \geq f_i(v)$. Satisfying this property means that if the quantity of items to be purchased by one organization in a purchasing group stays equal to or becomes larger than in a former situation, then this organization should receive an equal or larger amount of the pay-offs.

In addition, we introduce one new property of fairness:

- **FRAV: Fair Ranking Added Value**
  If for two organizations i and j in a group $M_i(v) > M_j(v)$, then $f_i(v) > f_j(v)$. Here $M_i(v) = v(N) - v(N \setminus \{i\})$ (Borm et al., 1992), as we discuss in Section 8.6.1. Satisfying the FRAV property means that an organization with a larger added value should receive a larger share of the pay-offs.

Note that FRAV is based on the Compromise Value method. The Compromise Value $CV_i(v)$ is based on the maximum $M_i(v)$ and minimum $m_i(v)$ amount of the total pay-offs that each organization i can reasonably claim: $CV_i(v) = \beta M_i(v) + (1-\beta)\, mc_i(v)$ with $\beta \in [0,1]$ unique such that $\sum_{i \in N} CV_i(v) = v(N)$ (Borm et al., 1992; Driessen, 1985). Heijboer (2003) notes that $mc_i(v)$ can be determined by looking at each subgroup that organization i could belong to. In each of these subgroups, organization i will give the other organizations their maximum claims and see what is left for organization i. The maximum leftover is the minimum claim $mc_i(v) = \max_{S: i \in S} \left\{ v(S) - \sum_{j \in S, i \neq j} M_j(v) \right\}$.

8.5. Properties of Equal Price for CP-games without costs

Table 8.2 shows that the allocations of EP have the core property, that is, in general, the allocation method satisfies EFF and STA. The table also shows that EP can lead to situations where an organization adds more value to a group than another organization, but receives fewer gains (i.e., the FRAV property is not satisfied). In addition, the situation could occur in which an organization increases its purchases through the group, but in return receives a smaller amount of the gains (i.e., the MON property is not satisfied). This could slow down further growth of the purchasing group or harm its stability.

Table 8.2 Properties for CP-games without costs

Properties of fairness	**Equal Price**
Efficiency (EFF)	✓
Symmetry (SYM)	✓
Dummy (DUM)	✓
Stability (STA)	✓
Monotonicity (MON)	×
Fair Ranking Added Value (FRAV)	×

Note: ✓ = satisfied in general, × = not satisfied in general, and $\eta = 0.5$

Although useful, Table 8.2 only gives a general overview of fairness properties. The table does not provide information on how and under which specific conditions EP leads to unfair outcomes.

8.6. How does Equal Price lead to unfair outcomes?

In this section, we extend the model developed in the previous section in order to answer the first part of our research question: how does EP lead to unfair outcomes? We answer this question by formally defining the added value of an organization to a purchasing group in Section 8.6.1, breaking it down into three components in Section 8.6.2, and proving that EP neglects one component of the added value in Section 8.6.3.

8.6.1. Added value

Organizations can add value to a group in several ways. In this chapter, the added value of each organization *i* for the other organizations of a group is defined as the total gains of the group minus the gains the other organizations in the group can establish without organization *i*: $M_i(v) = v(N) - v(N \setminus \{i\})$. Given $M_i(v)$, we can calculate the added value of the organizations 1, 2, and 3 from Section 8.3.1:

The added value of organization 1 is 4,992 – 1,952 = **3,040** (largest organization)
The added value of organization 2 is 4,992 – 2,607 = **2,385** (smallest organization)
The added value of organization 3 is 4,992 – 2,273 = **2,719**

8.6.2. Decomposing added value

To obtain more insight into the value that organizations add to a purchasing group, we split the added value of an organization into three different components, as we also show in Theorem 1: (1) gains for and by organization *i* created by joining a group (m_i), (2) gains created by organization *i* for the other organizations in a group (n_i), and (3) gains for organization *i* created by the other organizations in a group (o_i). For instance, as shown in Table 8.3, the added value of the organizations from Section 8.3.1 can be divided into these components. Fig. 8.1 and Fig. 8.2 illustrate how the components work together in creating and limiting value.

In Fig. 8.1, a price per item of 1,207 applies to a quantity of 15 (q_3). A price of 1,102 applies to a quantity of 45 ($q_1 + q_2$) and a price of 1,083 applies to a total quantity of 60. In Fig. 8.2, a price of 1,121 applies to a quantity of 35 (q_1), a price of 1,141 applies to a quantity of 25 ($q_1 + q_2$) and a price of 1,083 applies to a total quantity of 60. The corresponding values of n_i, m_i, and o_i are shown in Table 8.3.

Table 8.3 Decomposition of added value into three types of gains

Component	**Description**	***i* = 3**	***i* = 1**
m_i = gains for and by i	$= \begin{cases} q_i \cdot \left(p\left(\sum_{j\in N\setminus i} q_j\right) - p\left(\sum_{j\in N} q_j\right)\right), & p\left(\sum_{j\in N\setminus i} q_j\right) \le p(q_i) \\ q_i \cdot \left(p(q_i) - p\left(\sum_{j\in N} q_j\right)\right), & p\left(\sum_{j\in N\setminus i} q_j\right) > p(q_i) \end{cases}$ $= q_i \cdot \left(\min\left\{ p\left(\sum_{j\in N\setminus i} q_j\right), p(q_i)\right\} - p\left(\sum_{j\in N} q_j\right)\right)$	= 15 · (1,102– 1,083) = 287	= 35 · (1,121– 1,083) = 1,340
n_i = gains by i for $N \setminus \{i\}$	$= \sum_{j\in N\setminus i} q_j \cdot \left(p\left(\sum_{j\in N\setminus i} q_j\right) - p\left(\sum_{j\in N} q_j\right)\right)$	= 45 · (1,102– 1,083) = 862	= 25 · (1,151– 1,083) = 1,700
o_i = gains for i by $N \setminus \{i\}$	$= \begin{cases} q_i \cdot \left(p(q_i) - p\left(\sum_{j\in N\setminus i} q_j\right)\right), & p\left(\sum_{j\in N\setminus i} q_j\right) \le p(q_i) \\ q_i \cdot (p(q_i) - p(q_i)) = 0, & p\left(\sum_{j\in N\setminus i} q_j\right) > p(q_i) \end{cases}$ $= \max\left\{ q_i \cdot \left(p(q_i) - p\left(\sum_{j\in N\setminus i} q_j\right)\right), 0\right\}$	= 15 · (1,207– 1,102) = 1,570	= 35 · (1,121– 1,121) = 0
Total	$= M_i$	= 2,719	= 3,040

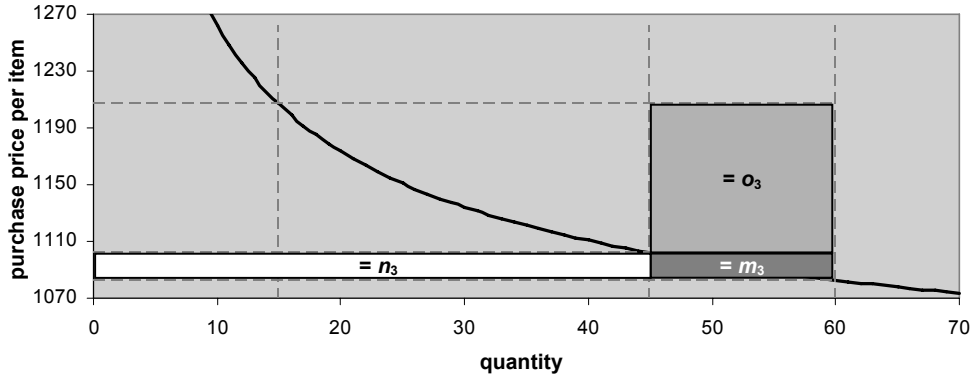

Fig. 8.1 Added value and three gain types for organization 3

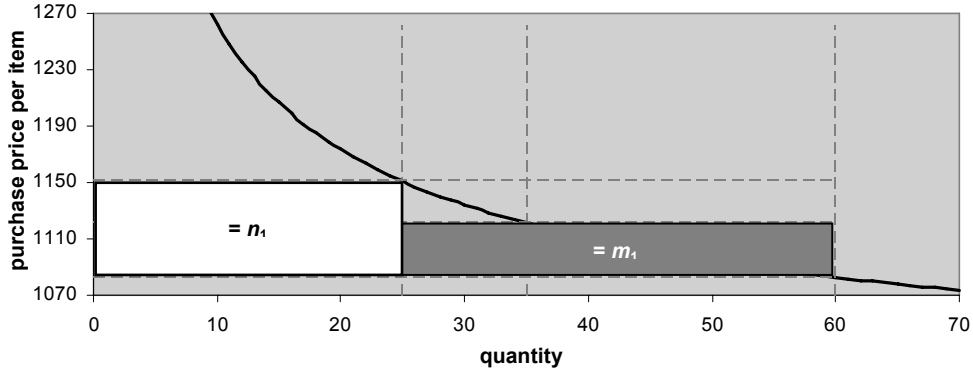

Fig. 8.2 Added value and two gain types for organization 1

Theorem 1. *The added value* $M_i(v) = v(N) - v(N \setminus \{i\})$ *of organization i in a purchasing group can be split in three different components* $M_i(v) = m_i + n_i + o_i$ *as defined in Table 8.3.*

Proof. If the value of a purchasing group $v(N) = \sum_{j \in N}(q_j \cdot p(q_j)) - \sum_{j \in N} q_j \cdot p\left(\sum_{j \in N} q_j\right)$, then the added value of an organization *i* for a purchasing group is $M_i(v) = v(N) - v(N \setminus \{i\})$ $= \sum_{j \in N}(q_j \cdot p(q_j)) - \sum_{j \in N} q_j \cdot p\left(\sum_{j \in N} q_j\right) - \sum_{j \in N \setminus i}(q_j \cdot p(q_j)) + \sum_{j \in N \setminus i} q_j \cdot p\left(\sum_{j \in N \setminus i} q_j\right)$. We can rewrite this as $M_i(v) = q_i \cdot p(q_i) - \sum_{j \in N} q_j \cdot p\left(\sum_{j \in N} q_j\right) + \sum_{j \in N \setminus i} q_j \cdot p\left(\sum_{j \in N \setminus i} q_j\right)$, as $M_i(v) =$ $q_i \cdot \left(p(q_i) - p\left(\sum_{j \in N} q_j\right)\right) + \sum_{j \in N \setminus i} q_j \cdot \left(p\left(\sum_{j \in N \setminus i} q_j\right) - p\left(\sum_{j \in N} q_j\right)\right)$, and as $M_i(v) =$ $q_i \cdot \left(\min\left\{p\left(\sum_{j \in N \setminus i} q_j\right), p(q_i)\right\} - p\left(\sum_{j \in N} q_j\right)\right) + \sum_{j \in N \setminus i} q_j \cdot \left(p\left(\sum_{j \in N \setminus i} q_j\right) - p\left(\sum_{j \in N} q_j\right)\right)$ $+ \max\left\{q_i \cdot \left(p(q_i) - p\left(\sum_{j \in N \setminus i} q_j\right)\right), 0\right\}$. So, given the definitions of m_i, n_i, and o_i in Table 8.3, the added value of an organization *i* for a purchasing group is $M_i(v) = m_i + n_i + o_i$. □

8.6.3. Equal Price neglects one component of added value

We illustrated in Sections 8.3.1 and 8.4 that EP can be unfair in situations where organizations differ in size. Now, given the three components of the added value, we can prove that this unfairness is caused by the fact that EP neglects component n_i of the added value of an organization for a group, as shown in Theorem 2:

Theorem 2. *Equal Price neglects the component* n_i *of the added value of organization i for a purchasing group, as the added value of organization i for a purchasing group is* $M_i(v) = m_i + n_i + o_i$ *and the Equal Price allocation for organization i is* $EP_i(v) = m_i + o_i$.

Proof. In Theorem 1, we have already proven that the added value of an organization *i* for a group is $M_i(v) = m_i + n_i + o_i$. So, we only have to prove that $EP_i(v) = m_i + o_i$. We do this by rewriting the definition of $EP_i(v) = q_i \cdot \left(p(q_i) - p\left(\sum_{j \in N} q_j\right)\right)$. We can rewrite this

$$\text{as } EP_i(v) = \begin{cases} q_i \cdot \left(p(q_i) - p\left(\sum_{j \in N} q_j \right) \right), & p\left(\sum_{j \in N \setminus i} q_j \right) \le p(q_i) \\ q_i \cdot \left(p(q_i) - p\left(\sum_{j \in N} q_j \right) \right), & p\left(\sum_{j \in N \setminus i} q_j \right) > p(q_i) \end{cases} \text{ and as}$$

$$EP_i(v) = \begin{cases} q_i \cdot \left(p(q_i) + p\left(\sum_{j \in N \setminus i} q_j \right) - p\left(\sum_{j \in N \setminus i} q_j \right) - p\left(\sum_{j \in N} q_j \right) \right), & p\left(\sum_{j \in N \setminus i} q_j \right) \le p(q_i) \\ q_i \cdot \left(p(q_i) - p\left(\sum_{j \in N} q_j \right) \right) + 0, & p\left(\sum_{j \in N \setminus i} q_j \right) > p(q_i) \end{cases}$$

Now it follows from Table 8.3 that $EP_i(v) = q_i \cdot \left(\min\left\{ p\left(\sum_{j \in N \setminus i} q_j \right), p(q_i) \right\} - p\left(\sum_{j \in N} q_j \right) \right)$

$+ \max\left\{ q_i \cdot \left(p(q_i) - p\left(\sum_{j \in N \setminus i} q_j \right) \right), 0 \right\}$. So, $EP_i(v) = m_i + o_i$. □

We have shown in our example in Section 8.3.1 that the largest organization may receive the smallest part of the total gains despite adding the most value. Using Theorem 2, we demonstrate that this is caused by ignoring n_i:

Organization i gains $EP_i(v) = m_i + o_i$	
Organization 1 gains $m_1 + o_1 =$ **1,340**	(largest organization)
Organization 2 gains $m_2 + o_2 =$ **1,795**	(smallest organization)
Organization 3 gains $m_3 + o_3 =$ **1,857**	
The added value of organization i is $M_i(v) = m_i + n_i + o_i$	
The added value of organization 1 is $(m_1 + o_1) + n_1 = 1{,}340 + 1700 =$ **3,040**	
The added value of organization 2 is $(m_2 + o_2) + n_2 = 1{,}795 + 591 =$ **2,385**	
The added value of organization 3 is $(m_3 + o_3) + n_3 = 1{,}857 + 862 =$ **2,719**	

8.7. Under which conditions does Equal Price lead to unfair outcomes?

In this section, we investigate which circumstances determine the extent of unfairness caused by EP. In Section 8.7.1, we analyze the three components of the added value of organizations for a group. Proofs have been omitted in Section 8.7.1; instead, we combine the effects on the three components in two theorems which come with proofs in Sections 8.7.2 and 8.7.3. In these two sections, we also show how we can use our results to develop practical guidelines that purchasing groups can use to enhance their stability and prosperity. This will answer the second part of our research question: under which conditions does EP lead to unfair outcomes?

8.7.1. The impact of organization size on m_i, n_i, and o_i

In our model, there are two main disadvantages to EP, which apply especially to large organizations in a purchasing group. First, as n_i is always increasing with more items being purchased by organization i, it becomes less attractive for larger organizations to use EP.

After all, n_i is not incorporated in EP, and the larger the value of n_i, the more these organizations are put at a disadvantage. The second disadvantage applies to m_i and o_i. These components of added value will become smaller after a certain point. This also puts larger organizations at a disadvantage, because m_i and o_i are the only two components incorporated in EP.

8.7.2. The MON Fairness Ratio (i.e., the 38%-rule)

Fig. 8.3 illustrates the combined effects of changes in q_2 on the three different types of gains for organization 2 while the steepness η is 0.5. The total number of needed items for organizations 1 and 3 is constant in this figure.

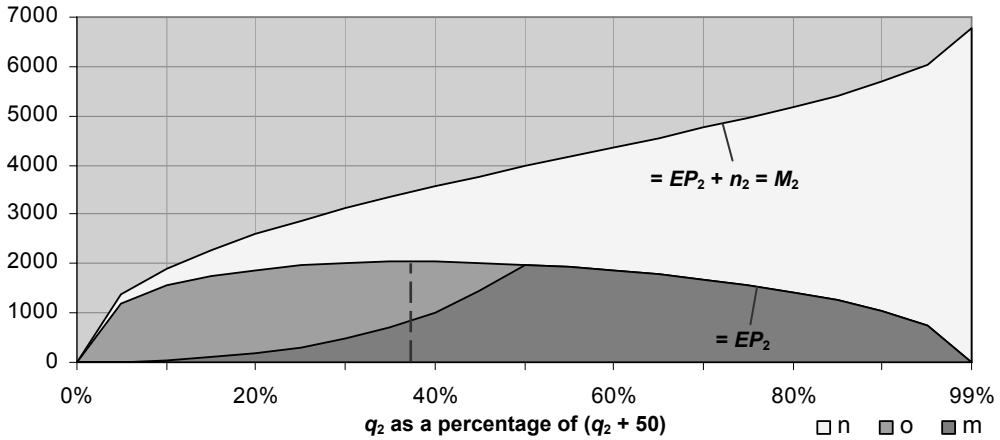

Fig. 8.3 EP effects when a group member increases purchases

In this figure, the value of M_2 increases with an increasing value of q_2. At the point where q_2 is 38% of the total volume, the EP outcome for organization 2 reaches its maximum value. We call 38% the MON Fairness Ratio (MONFR) of EP while η is 0.5 (i.e., the 38%-rule). With Theorem 3, we prove that this is the case in almost any given situation in our model, as this percentage is independent of the values of the parameters p_0, c_1, and c_2 in the price structure, the number of organizations in a purchasing group, and the allocation of the group volume among these organizations.

Theorem 3. *While using Equal Price and given Assumptions* 1 *to* 3*, organizations increasing their purchases through a* purchasing group *to more than* 38% *of the total volume are put at a disadvantage; they will receive fewer gains with an increasing volume. Note that this implies that MON is not satisfied from this point.*

Proof. Again, the definition of $EP_i(v) = q_i \cdot (p(q_i) - p(T_i))$, $\eta = 0.5$, and $T_i = q_i + \sum_{j \in N/i} q_j$, where the volume of the other organizations $\sum_{j \in N/i} q_j$ is constant. We can rewrite $EP_i(v)$ as $q_i \cdot \left(p_0 \cdot \left(c_1 + c_2 \cdot q_i^{-0.5}\right) - p_0 \cdot \left(c_1 + c_2 \cdot T_i^{-0.5}\right)\right)$. The variable c_1 cancels itself out, so, $q_i \cdot \left(p_0 \cdot \left(c_2 \cdot q_i^{-0.5}\right) - p_0 \cdot \left(c_2 \cdot T_i^{-0.5}\right)\right) = p_0 \cdot c_2 \cdot \sqrt{q_i} - p_0 \cdot c_2 \cdot q_i \cdot T_i^{-0.5}$. We

want to find the maximum value of $EP_i(v)$, so, $EP_i(v)' = 0.5 \cdot p_0 \cdot c_2 \cdot q_i^{-0.5} - p_0 \cdot c_2 \cdot T_i^{-0.5} + 0.5 \cdot p_0 \cdot c_2 \cdot q_i \cdot T_i^{-1,5} = 0.5 \cdot q_i^{-0.5} - T_i^{-0.5} + 0.5 \cdot q_i \cdot T_i^{-1,5} = 0$. If $q_i = MONFR \cdot T_i$, then $0.5 \cdot (MONFR \cdot T_i)^{-0.5} - T_i^{-0.5} + 0.5 \cdot MONFR \cdot T_i \cdot T_i^{-1,5} = 0$. We can rewrite this as $MONFR^{-0.5} \cdot T_i^{-0.5} - 2 \cdot T_i^{-0.5} + MONFR \cdot T_i^{-0.5} = 0$, which gives $MONFR + MONFR^{-0.5} - 2 = 0$. So, $MONFR = \frac{3 - \sqrt{5}}{2} \cdot 100\% = 38\%$. □

The only dependent variable in this proof is the steepness parameter η in the price function $p(q_i) = p_0 \cdot (c_1 + c_2 \cdot q_i^{-\eta})$ for $q_i > 0$. Until now, we assumed η always being 0.5. However, 0.5 is an estimated average value as discussed in Assumption 3. In practice, η may vary. For values of η between –1 and 1, the following applies: $\eta \cdot \mathrm{MONFR}^{1+\eta} - \mathrm{MONFR}^{\eta} - \eta + 1 = 0$ (see also Fig. 8.4). Note that η less than 0 implies that c_2 becomes less than 0 and $p_0 \cdot c_1$ becomes the maximum price. For instance, if η is –1, p_0 is 959, c_1 is 1, and c_2 is –1, then the price function is $p(q_i) = 959 \cdot (1 - q_i)$.

If η is another value than the estimated average value of 0.5, then MONFR is not equal to 38%. For instance, if η is 1, then MONFR is 0% and all organizations increasing their volume through the purchasing group will receive fewer gains. In this case, the smallest organization will receive the largest part of the gains. The largest organization will receive the smallest part of the gains. So, MON is not satisfied in any situation for purchasing groups with various members. With η less than 0, MON is satisfied in all situations.

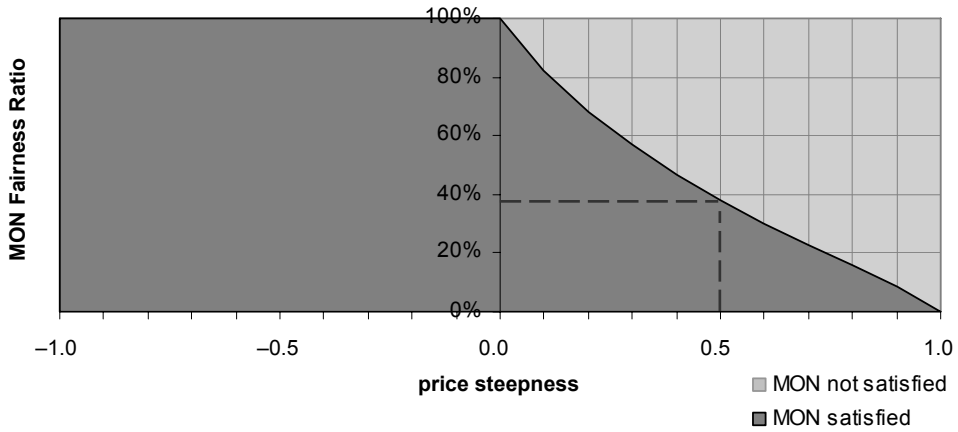

Fig. 8.4 The MON Fairness Ratio as a function of steepness

The main application of Fig. 8.3 and Fig. 8.4 is that they can help in decisions concerning whether or not to use EP in purchasing groups. If organizations in a purchasing group are unequal in size or size differences among previously similar organizations increase steadily, then it can be easily shown whether or not MON is satisfied and whether or not EP is theoretically fair.

Fig. 8.3 and Fig. 8.4 can also be applied in situations as in the following example. Consider several organizations in a purchasing group using EP and purchasing different items cooperatively. One organization in this group has the possibility to increase its purchasing volume for one item. This organization can choose between items A and B, which both have an almost identical price function with η is 0.5. For item A, the organization can increase its purchasing volume from 30% to 35%. For item B, the organization can increase its purchasing volume from 40% to 60%. If this organization wants to optimize its own gains by purchasing through the purchasing group, the organization should choose item A. If this organization wants to optimize the total gains of the purchasing group, the organization should choose item B.

To conclude, when using EP and given Assumptions 1 to 3, organizations that increase their stake in the cooperative volume past the 38% point will receive fewer gains, even though the added value of the organization and the total gains of a purchasing group increase. The more the organizations of a purchasing group will differ in purchasing volumes, the stronger the unfair effects of EP will be. The unfair effects will also be stronger if η becomes larger than the assumed average value of 0.5.

8.7.3. The FRAV Fairness Ratio (i.e., the 25%-rule)

Fig. 8.3, Fig. 8.4, and the MON property of fairness apply to organizations increasing or decreasing their volume and simultaneously increasing or decreasing the total volume of a purchasing group. Thus, Fig. 8.3, Fig. 8.4 and the MON property apply to a dynamic situation. In this section, we study the FRAV property of fairness. This property applies to a static situation; given a certain allocation of the total volume of a group among individual organizations, we provide guidelines to test whether or not FRAV is satisfied. Therefore, we consider the situation where the total volume of a group is constant, but the allocations of the total volume among the individual organizations differ. In other words, we study the EP effects on all possible allocations that may occur in a purchasing group. Fig. 8.5 illustrates this scenario for different quantities of organization 2 while the steepness η is 0.5. Figures of the same kind can be drawn for different values of the total volume.

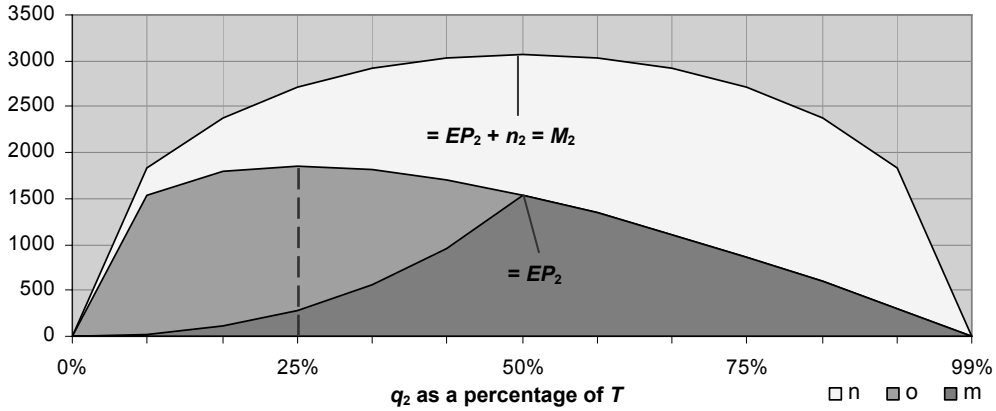

Fig. 8.5 EP effects on all group allocations

At the point where q_2 is 50% of the total volume, M_2 reaches its maximum value. However, already at the point where q_2 is 25% of the total volume, the EP outcome for organization 2

reaches its maximum. In other words, if η is 0.5, then the figure shows that an organization that purchases 15 items (25%) of a total volume of 60 receives the most gains. Other organizations that purchase 35 (58%) and 10 items (17%) receive less gains.

We call 25% the FRAV Fairness Ratio (FRAVFR) of EP while η is 0.5 (i.e., the 25%-rule). With Theorem 4, we prove that this is almost always the case in any given situation in our model. Again, this percentage is independent of the values of the parameters p_0, c_1, and c_2 in the price structure, the number of organizations in a purchasing group, and the allocation of the group volume among these organizations.

Theorem 4. *While using Equal Price and given Assumptions* 1 *to* 3*, organizations purchasing* 25% *of the total volume of a purchasing group receive the maximum allocation of gains. Note that this implies that FRAV is not satisfied from this point.*

Proof. Again, the definition of $EP_i(v) = q_i \cdot \left(p(q_i) - p(T)\right)$, $\eta = 0.5$, and $T = \sum_{j \in N} q_j$ where the total volume of all organizations T is constant. We can rewrite $EP_i(v)$ as $p_0 \cdot c_2 \cdot \sqrt{q_i} - p_0 \cdot c_2 \cdot q_i \cdot T^{-0.5}$. Here $EP_i(v)' = 0.5 \cdot p_0 \cdot c_2 \cdot q_i^{-0.5} - p_0 \cdot c_2 \cdot T^{-0.5}$. Again, we aim to find the maximum value of $EP_i(v)$, so $0.5 \cdot p_0 \cdot c_2 \cdot q_i^{-0.5} - p_0 \cdot c_2 \cdot T^{-0.5} = 0.5 \cdot q_i^{-0.5} - T^{-0.5} = 0$, which gives $q_i = 0.25 \cdot T$. So, if $q \cdot 100\% = FRAVFR \cdot T$, then $FRAVFR = 25\%$. □

Once more, the only dependent variable in this proof is the steepness η. Therefore, organizations in a purchasing group should check the average η of the items purchased through the group and the consequences of that value on MONFR and FRAVFR.

We have already described the function of MONFR. For FRAVFR, the following optimality condition applies: $\text{FRAVFR} = (1-\eta)^{\frac{1}{\eta}} \leq \text{MONFR}$ (see also Fig. 8.6). For instance, if η is -1, then FRAVFR is 50%. This is a fair situation as FRAVFR equals the point where the added value also reaches its maximum. If η is greater than -1, then FRAVFR is less than 50%. This could lead to an unfair situation as FRAVFR reaches its maximum before the added value does.

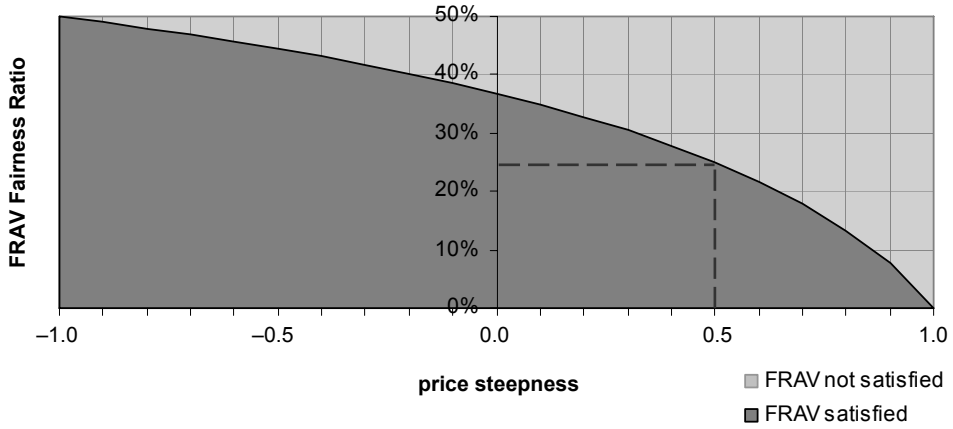

Fig. 8.6 The FRAV Fairness Ratio as a function of steepness

The main application of Fig. 8.5 and Fig. 8.6 is that they can also serve in decisions concerning whether or not to use EP in purchasing groups. If organizations in a purchasing group are unequal in size or size differences among previously similar organizations increase steadily, then it can be easily shown whether or not FRAV is satisfied and EP is theoretically fair. For instance, if the average η is 0.5, then EP is unfair for purchasing groups with organizations larger than 25% of the total volume and especially to organizations larger than 38%, as both MON and FRAV are not satisfied from this point.

Fig. 8.5 and Fig. 8.6 can also be useful for finding ways of limiting unfairness effects when a purchasing group uses EP. Consider for instance that organizations in a purchasing group want to purchase one new item cooperatively. One organization has the decisive vote in what item to purchase cooperatively. This organization can choose between items A and B, which both have an identical total volume, an almost identical average price function, and η is 0.5. For item A, the organization would purchase 25% of the total volume. For item B, the organization would purchase 35% of the total volume. If this organization wants to optimize its own gains by purchasing through the purchasing group, then the organization should choose item A.

To conclude, when using EP and given Assumptions 1 to 3, organizations purchasing 25% of the total volume will receive the maximum allocation of gains. Larger and smaller organizations will receive a smaller amount of gains. Again, the unfair effects of EP will be stronger if η becomes larger than the assumed average value of 0.5.

8.8. The golden mean and some mathematical properties

In this section, we first describe a link between MONFR (i.e., the 38%-rule) and the golden mean. Next, we discuss a link between FRAVFR (i.e., the 25%-rule) and MONFR. These topics may be omitted with no loss of continuity.

8.8.1. The MON Fairness Ratio and the golden mean

In mathematics, two quantities are in the golden ratio (also known as golden mean, golden section, golden proportion, and golden cut) to each other, if the whole is to the larger part as

the larger part is to the smaller part. The whole in this case is the sum of both parts (Jaeger, 2006). The golden mean has been studied for centuries by mathematicians, artists, biologists, physicists, and architects. It has some unique and interesting mathematical properties. It is also believed that the golden ratio proportion is aesthetically pleasing and features some kind of natural symmetry (Dunlap, 1997; Jaeger, 2006). The golden mean can be derived from $\frac{a}{b} = \frac{a+b}{a}$. Accordingly, the golden mean is (e.g., Livio, 2002):

$$\varphi = \frac{a}{b} = \frac{1+\sqrt{5}}{2} = 1.62 \quad \textbf{(8.2)}$$

The MON Fairness Ratio can be rewritten as $\text{MONFR} = \left(\eta \cdot \text{MONFR}^{1+\eta} - \eta + 1\right)^{\frac{1}{\eta}}$. Thus, for $\eta = 0.5$:

$$\text{MONFR}_{\eta=0.5} = \frac{3 - \sqrt{5}}{2} = 0.38 \quad \textbf{(8.3)}$$

It happens so to be that the golden mean in Eq. 8.2 can be linked to MONFR in Eq. 8.3. Note that this link only applies to a steepness of 0.5. We define $b = \text{MONFR}_{\eta=0.5} = 0.38$ as the purchasing volume of an organization that purchases 38% of the total purchasing volume of a purchasing group. We define $a = 1 - \text{MONFR}_{\eta=0.5} = 0.62$ as the purchasing volume of the other organizations of the purchasing group. For $\frac{a}{b} = \frac{a+b}{a}$, this gives $\frac{\text{volume of the others (62\%)}}{\text{volume of 38\% organization (38\%)}} = \frac{\text{total volume (100\%)}}{\text{volume of the others (62\%)}}$. Thus:

$$\varphi = \frac{\text{volume of the others (62\%)}}{\text{volume of 38\% organization (38\%)}} = 1.62 \quad \textbf{(8.4)}$$

8.8.2. The FRAV Fairness Ratio and the MON Fairness Ratio

The equation that describes MONFR is $\text{MONFR} = \left(\eta \cdot \text{MONFR}^{1+\eta} - \eta + 1\right)^{\frac{1}{\eta}}$ and can be rewritten as:

$$\text{MONFR}^{\eta} = \eta \cdot \text{MONFR}^{1+\eta} - \eta + 1 \quad \textbf{(8.5)}$$

The equation that describes FRAVFR is $\text{FRAVFR} = \left(1 - \eta\right)^{\frac{1}{\eta}}$. This can be rewritten in a similar form as Eq. 8.5:

$$\text{FRAVFR}^{\eta} = -\eta + 1 \quad \textbf{(8.6)}$$

Integrating Eq. 8.6 into Eq. 8.5 gives $\text{MONFR}^{\eta} = \eta \cdot \text{MONFR}^{1+\eta} + \text{FRAVFR}^{\eta}$. This can be rewritten as $\text{FRAVFR}^{\eta} = \text{MONFR}^{\eta} - \eta \cdot \text{MONFR}^{1+\eta}$ and as $\text{FRAVFR}^{\eta} = \text{MONFR}^{\eta} - \eta \cdot \text{MONFR} \cdot \text{MONFR}^{\eta}$. This equals $\text{FRAVFR}^{\eta} = \left(1 - \eta \cdot \text{MONFR}\right) \cdot \text{MONFR}^{\eta}$ and $\text{FRAVFR} = \left(\left(1 - \eta \cdot \text{MONFR}\right) \cdot \text{MONFR}^{\eta}\right)^{\frac{1}{\eta}}$. Finally, this can be rewritten as $\text{FRAVFR} = \left(1 - \eta \cdot \text{MONFR}\right)^{\frac{1}{\eta}} \cdot \left(\text{MONFR}^{\eta}\right)^{\frac{1}{\eta}}$, which equals:

$$\text{FRAVFR} = \left(1 - \eta \cdot \text{MONFR}\right)^{\frac{1}{\eta}} \cdot \text{MONFR} \qquad \textbf{(8.7)}$$

Thus, the link between MONFR and FRAVFR can be described by Eq. 8.7. Note that the same solution can also be found by solving $\text{FRAVFR} \cdot x = \text{MONFR}$. Note that MONFR can be rewritten given Eq. 8.7 as $\text{MONFR} = \left(1 - \eta\right)^{\frac{1}{\eta}} \cdot \left(1 - \eta \cdot \text{MONFR}\right)^{-\frac{1}{\eta}}$.

For instance, given a steepness of 0.5, FRAVFR and MONFR link together as follows:

$0.25 = \left(1 - 0.5 \cdot 0.38\right)^{\frac{1}{0.5}} \cdot 0.38$

For instance, given a steepness of 0.1, FRAVFR and MONFR link together as follows:

$0.35 = \left(1 - 0.1 \cdot 0.82\right)^{\frac{1}{0.1}} \cdot 0.82$

Fig. 8.7 shows both FRAVFR (i.e., the 25%-rule) and MONFR (i.e., the 38%-rule). The triangle line in the figure is defined by Eq. 8.7 as $\frac{\text{FRAVFR}}{\text{MONFR}} = \left(1 - \eta \cdot \text{MONFR}\right)^{\frac{1}{\eta}}$.

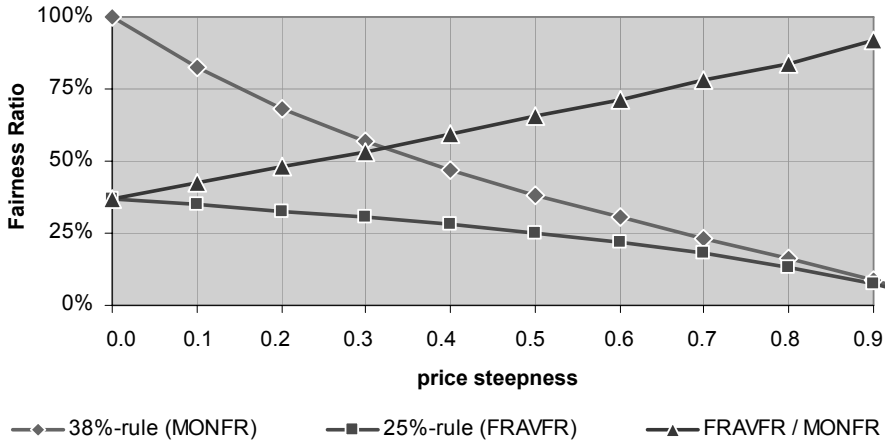

Fig. 8.7 MONFR, FRAVFR, and FRAVFR divided by MONFR

8.9. Limitations

Before we draw conclusions on the basis of our analyses in the previous sections, we point out the main limitations of the research that should be taken into account.

First, purchasing groups often purchase multiple items cooperatively. For instance, organization 1 purchases 10 pieces of item A and 100 pieces of item B. Organization 2 purchases 100 pieces of item A and 10 pieces of item B. This could compensate for unfair effects. Some organizations gain more on item A and others on B, but the total of two unfair allocations might be fair.

Second, we neither take into account the costs of cooperating (see Chapter 9) nor advantages other than financial gains. These other advantages, as political control over other organizations or obtaining knowledge from other organizations, could compensate for unfairness related to EP.

Further research could (1) take into account the costs of setting up a purchasing group, handling, and monitoring its transactions, (2) take more benefits of cooperation into account than only volume discounts, for instance by using multi-attribute utility functions (Keeney and Raiffa, 1976), and (3) find solution methods to unfairness problems that take into account all components of the added value of cooperating organizations.

8.10. Conclusions

In this chapter, we analyze causes of unfairness resulting from using the Equal Price (EP) allocation method. We first demonstrate that EP may result in unfair allocations of gains for large organizations in purchasing groups. We prove that EP results in these kinds of unfair outcomes because it ignores an important part of the added value of each organization for the other organizations of a purchasing group. This answers our first research question: how does EP lead to unfair outcomes? In the next subsections, we answer our second research question: under which conditions does EP lead to unfair outcomes?

We conclude that under Assumptions 1 to 3 and while using EP, organizations increasing their volume past 38% of the total volume of a purchasing group will receive fewer gains, even though their added value for the purchasing group increases and the total gains of the group increase. This means that the MON property of fairness is not satisfied past this point. The 38%-rule applies to an estimated average steepness η of 0.5. We have generalized the 38%-rule for all values of η in the MON Fairness Ratio in Fig. 8.4.

Furthermore, we prove that under Assumptions 1 to 3 and while using EP, an organization in a purchasing group receives its maximum pay-off when its share of the total volume of a group is 25%. Past this point, the FRAV property is not satisfied. As a result, it becomes less attractive for larger organizations to participate in a purchasing group. Again, the 25% guideline only applies to an η of 0.5. We have generalized the 25% guideline for all values of η in the FRAV Fairness Ratio in Fig. 8.6. Fig. 8.3 to Fig. 8.6 show that the unfair effects of EP become stronger if η becomes larger than the assumed average value of 0.5.

To conclude, if organizations in a purchasing group are unequal in size or size differences among previously similar organizations increase steadily and they use EP, then it seems important that they address the possible unfairness of EP and develop solutions for it in order to avoid instability of the group on the longer term. Under Assumptions 1 to 3, this applies to purchasing groups with organizations larger than 25% of the total volume and especially to purchasing groups with organizations larger than 38%, because both MON and FRAV are not satisfied from this point. Again, for other values of η, we refer to Fig. 8.4 and Fig. 8.6. Possible solutions to EP related problems are the following:

- **Group structure**
  Create a group structure in which the side effects of EP are reduced to a minimum. The MON Fairness Ratio and the FRAV Fairness Ratio can be used to find a suitable number of organizations of a suitable size for the purchasing group;
- **Gain allocation method**
  Use another gain allocation method than EP. Cooperative game theory offers several alternative allocation methods. Again, the MON Fairness Ratio and the FRAV Fairness Ratio can be used to find out if EP is a fair allocation method for the purchasing group or if another allocation method should be used. In Chapter 9, we discuss the alternative allocation methods in more detail;
- **Cost allocation method**
  Compensate the unfair effects of EP by a cost allocation method that favors larger organizations in a purchasing group. Again, the MON Fairness Ratio and the FRAV Fairness Ratio can be used to find out if it is necessary to compensate unfair effects of EP (see Chapter 9).

Acknowledgements

We acknowledge the contributions and suggestions for improvement of Aart van Harten, in memoriam, and the referees of the European Journal of Operational Research.

Chapter 9

Theoretically fair allocation of gains and costs

In the previous chapter, we have showed that the common Equal Price method can result in a theoretically unfair allocation of gains. This chapter builds further on existing gain and cost allocation methods and adapts them to purchasing groups, trying to increase theoretical fairness and reduce allocation problems. The chapter is summarized as follows.

We introduce two new allocation methods, the Adapted Compromise Value 1 and 2, and compare these to existing allocation methods. We compare the methods while using the quantity discount function from Chapter 7 and by extending the cooperative purchasing model from Chapter 8.

We also give recommendations concerning which gain and cost methods to use in which situation. We advice against combining the Equal Price gain method with the Proportional by Volume cost method. We recommend using the Equal Price gain method in combination with the Equal Amount cost method in situations with (almost) equally sized organizations in a purchasing group and/or when the necessity for a formal allocation method is low and the financial risks are low. When organizations are unequally sized and the necessity or the financial risks are high, we recommend using the Adapted Compromise Value 2.

We conclude by emphasizing the importance for purchasing groups to make a clear decision about an allocation method. In the next chapter, we describe several practical steps for dealing with allocation problems[38].

9.1. Introduction

As mentioned in Section 8.1, a specific purchasing group issue receiving relatively minor research attention is the gain and cost allocation issue. It is worrying that the main reasons for purchasing group problems indicated from practice - as anti-trust, no commitment and 'fear of free-riding group members' issues - seem related to allocation problems (Heijboer, 2003). For this reason and others, we studied the unfair allocation of gains of the common Equal Price allocation method in Chapter 8. In that chapter, we did not incorporate the costs of cooperative purchasing and studied one allocation method in detail. In this chapter, we do incorporate costs and study several allocation methods.

9.2. Specific research objectives

The purpose of this chapter is (1) to build further on allocation problems concerning the savings (i.e., costs minus gains) of purchasing groups (Heijboer, 2003) and (2) to make a

[38] Parts of this chapter are based on Schotanus, F., 2004. Enhancing trust and stability in purchasing consortia. IPSERA conference proceedings, Catania (Italy), 676–685.

contribution to the quantitative deductive development of cooperative purchasing research regarding saving allocation problems. More specifically, we aim to answer the question which combinations of gain and cost allocation methods lead to fair outcomes for the members of a purchasing group.

This chapter is organized in the following way. First, we extend the cooperative purchasing model developed in Chapter 8. Next, we adapt several allocation methods to purchasing groups and illustrate the application of the methods. To be able to asses the methods in general, we subsequently describe several common properties of fairness from cooperative game theory. Next, we asses which gain and cost allocation methods satisfy which properties of fairness for cooperative purchasing games. We also study the allocation of gains and costs under specific stepwise discount circumstances. Subsequently, we make some remarks on the size of a purchasing group and related group member sizes. In the final sections, we discuss the limitations and draw our conclusions.

9.3. CP-games with costs

In Chapter 8, we considered price reductions while modeling purchasing groups as a Cooperative Purchasing-game (CP-game). In this chapter, we also consider costs for managing a group (Section 9.3.1) and so-called compensation costs (Section 9.3.2).

9.3.1. Costs for managing a purchasing group

For modeling costs, we assume a cost function $C(S)$ with fixed costs C_o and variable costs c depending on the number of organizations in the purchasing group S. The cost function has been developed by Heijboer (2003) and is defined as:

$$C(S) = \begin{cases} C_0 + c \cdot |S|^{\alpha}, & |S| \geq 2 \\ 0, & |S| = 1 \end{cases} \qquad \textbf{(9.1)}$$

Here α determines whether the variable costs are less than proportional ($\alpha < 1$), proportional ($\alpha = 1$) or more than proportional ($\alpha > 1$) to S. Heijboer (2003) states that, in practice, the costs are likely to increase more than proportional with the number of group members. More specifically, we assume that this applies to project groups, lead buying groups, and program groups (see also Chapter 3). Adding organizations to a third party group will usually bring fewer costs than adding organizations to intensive groups such as program groups. The cost function $C(S)$ can be integrated in the expression for $v(S)$, which was introduced in Chapter 8. This gives $v(S) = \sum_{i \in S} (q_i \cdot p(q_i)) - \sum_{i \in S} q_i \cdot p\left(\sum_{i \in S} q_i\right) - C(S)$ and can be rewritten as:

$$v(S) = \sum_{i \in S} (q_i \cdot p(q_i)) - \sum_{i \in S} q_i \cdot \left(p\left(\sum_{i \in S} q_i\right) + \frac{C(S)}{\sum_{i \in S} q_i} \right) \qquad \textbf{(9.2)}$$

It is safe to assume that $v(S)$ will not become negative. If the costs of cooperating would be larger than the benefits for a group S, then cooperation would simply not occur and $v(S)$ would be zero. Still, note that in practice, examples do exist of purchasing group in which $v(S)$ becomes smaller than zero. Possible reasons for this are (1) underestimated costs and/or overestimated gains and/or (2) indirect gains like learning from others that compensate a negative $v(S)$.

9.3.2. Compensation costs

In his study, Heijboer (2003) indicated that further research could include extensions of CP-games. One indicated extension concerns compensation costs that can be introduced into CP-games when one or more organizations in the purchasing group have to make sacrifices in favor of the total group savings. For instance, consider non-homogeneous items: each organization could have different requirements regarding the items to be purchased through the purchasing group. Some organizations would therefore have to change their requirements in order to obtain the volume discount, for which they could receive compensation (Heijboer, 2003).

Notice the difference of character of compensation costs compared to costs for managing a purchasing group. While the latter are related to the group in its entirety, compensation costs are related to one or more organizations in specific. Including the compensation costs cc in the expression for $C(S)$ gives:

$$C(S) = \begin{cases} C_0 + c \cdot S^{\alpha} + \sum_{i \in S} (cc_i), & |S| \geq 2 \\ 0, & |S| = 1 \end{cases} \quad \textbf{(9.3)}$$

9.4. Gain and cost allocation methods

In practice, simple allocation methods are often used when distributing gains and costs among the members of a purchasing group[39]. These simple methods will be considered in the continuation of this chapter and compared to more sophisticated methods from game theory. The game theoretical methods are chosen because they are still relatively easy to explain to practitioners with no mathematical background. The gain and cost allocation methods to be considered are defined in the following subsections.

9.4.1. Equal Amount

All n organizations are considered equal, hence, they obtain the same pay-off (Heijboer, 2003). The Equal Amount (EA) method ignores the level of input of an organization. The EA gains are allocated as follows:

$$GEA_i(v) = \frac{v(N)}{n} \quad \textbf{(9.4)}$$

[39] For instance, in Section 6.4.4, we found that a total of 87% of the analyzed purchasing groups uses the EP gain allocation method. A total of 29% of the purchasing groups uses the PV cost allocation method.

Similarly, the EA costs are allocated as follows:

$$CEA_i(v) = \frac{C(N)}{n} \tag{9.5}$$

9.4.2. Proportional by Volume

The Proportional by Volume (PV) method allocates an amount to an organization which is proportional to the number of items it purchases (Moulin and Watts, 1997; Watts, 1996). As can be easily verified, with PV (i.e., Average Cost Pricing), the gains are allocated on a basis of equal (absolute) gains per item:

$$GPV_i(v) = \frac{q_i \cdot p\left(\sum_{i \in N} q_i\right)}{\sum_{i \in N} q_i \cdot p\left(\sum_{j \in N} q_j\right)} \cdot v(N) = \frac{q_i}{\sum_{j \in N} q_j} \cdot v(N) \tag{9.6}$$

Similarly, the PV costs are allocated as follows:

$$CPV_i(v) = \frac{q_i}{\sum_{j \in N} q_j} \cdot C(N) \tag{9.7}$$

9.4.3. Equal Percentage

PV allocates the gains and costs proportional to the number of items purchased by an organization. The Equal Percentage (EPR) method allocates the gains and costs proportional to the number of items purchased by an organization multiplied by the related purchase price. Thus, the EPR gain method allocates an amount to an organization based on an equal savings percentage per item (Heijboer, 2003):

$$GEPR_i(v) = \frac{q_i \cdot p(q_i)}{\sum_{j \in N}\left(q_j \cdot p(q_j)\right)} \cdot v(N) \tag{9.8}$$

Similarly, the EPR costs are allocated as follows:

$$CEPR_i(v) = \frac{q_i \cdot p(q_i)}{\sum_{j \in N}\left(q_j \cdot p(q_j)\right)} \cdot C(N) \tag{9.9}$$

9.4.4. Equal Price

As mentioned in the previous chapter, the Equal Price (EP) gain method is defined as:

$$GEP_i(v) = q_i \cdot \left(p(q_i) - p\left(\sum_{j \in N} q_j\right)\right) \tag{9.10}$$

The EP cost allocation method can be determined by using Eq. 9.2 in $CEP_i(v) = CEP_i(v) = q_i \cdot \left(p(q_i) - p\left(\sum_{j \in N} q_j \right) \right) - q_i \cdot \left(p(q_i) - p\left(\sum_{j \in N} q_j \right) - \frac{C(N)}{\sum_{j \in N} q_j} \right)$, which equals:

$$CEP_i(v) = CPV_i(v) = \frac{q_i}{\sum_{j \in N} q_j} \cdot C(N) \qquad \textbf{(9.11)}$$

9.4.5. Serial Cost Sharing (increasing rule)

Serial Cost Sharing (increasing rule) (SERI) allocates an amount to each organization in order of increasing demand (Moulin and Shenker, 1992). Given a list of demands $q_1,...,q_n$, order them first in increasing order: $q_1 \le q_2 \le ... \le q_n$. Now organization 1 (with the smallest demand) receives precisely the gain share $GSERI_1 = \frac{v(N_1)}{n}$ and $v(N_1) = n \cdot q_1 \cdot p(q_1) - n \cdot q_1 \cdot p(n \cdot q_1)$. The agents $2,...,n$ then receive $\frac{v(N_1)}{n}$ to cover their demand up to the level q_1 and divide the gains of their incremental demands $q_i^* = q_i - q_1$, $i \ge 2$. To calculate $GSERI_1$ to $GSERI_n$, we use the following demands: N_1: $\{n \cdot q_1\}$, N_2: $\{(n-1) \cdot q_2, q_1\}$, N_i: $\{(n-i+1) \cdot q_i, q_{i-1},...,q_1\}$, and N_n: $\{q_n,...,q_1\}$. Thus, $GSERI_2 = \frac{v(N_2)}{n-1} - \frac{v(N_1)}{n(n-1)}$ and $GSERI_i(v) = \frac{v(N_i)}{n-i+1} - \frac{v(N_{i-1})}{(n-i+2)(n-i+1)} - ... - \frac{v(N_1)}{n(n-1)}$. This equals:

$$GSERI_i(v) = \frac{v(N_i) - \sum_{j=0}^{i-1} GSERI_j}{n-i+1} \qquad \textbf{(9.12)}$$

Given the definition of $C(S)$ for CP-games, it can be verified that the costs will be allocated equally while using SERI: $C(N)=C(N_1) = C(N_2) = C(N_i) = C(N_n)$, thus: $CSERI_i = \frac{C(N)}{n-i+1} - \frac{C(N)}{(n-i+2)(n-i+1)} - ... - \frac{C(N)}{n(n-1)} = \frac{C(N) - (i-1) \cdot \left(\frac{C(N)}{n} \right)}{n-i+1}$, which equals:

$$CSERI_i(v) = CEA_i(v) = \frac{C(N)}{n} \qquad \textbf{(9.13)}$$

9.4.6. Serial Cost Sharing (decreasing rule)

Serial Cost Sharing with a decreasing rule (SERD) is a variation of SERI, allocating gains to organizations in decreasing order of demands (Frutos, 1998). This rule is more favorable to larger organizations (and less favorable to smaller organizations) than the increasing rule. The method works as follows. Given a list of demands $q_1,...,q_n$, order them first in decreasing order: $q_n \le ... \le q_2 \le q_1$. Now organization 1 (with the highest demand) receives $GSERD_n = \frac{v(N_n)}{n}$ and $v(N_n) = n \cdot q_n \cdot p(q_n) - n \cdot q_n \cdot p(n \cdot q_n)$. To calculate $GSERD_n$ to $GSERD_1$, we use the following demands: N_n: $\{n \cdot q_n\}$, N_{n-1}: $\{(n-1) \cdot q_{n-1}, q_n\}$, N_i: $\{(n-i+1) \cdot q_i, q_{i+1},...,q_n\}$, N_1: $\{q_1,...,q_n\}$. Thus, $GSERD_{n-1} = \frac{v(N_{n-1})}{n-1} - \frac{v(N_n)}{n(n-1)}$ and $GSERD_i(v) = \frac{v(N_i)}{n-i+1} - \frac{v(N_{i+1})}{(n-i+2)(n-i+1)} - ... - \frac{v(N_n)}{n(n-1)}$. This equals:

$$GSERD_i(v) = \frac{v(N_i) - \sum_{j=0}^{i-1} GSERD_j}{n-i+1} \tag{9.14}$$

The costs are allocated in the same way as $CSERI_i$:

$$CSERD_i(v) = CEA_i(v) = \frac{C(N)}{n} \tag{9.15}$$

9.4.7. Nucleolus

The Nucleolus (NUC) is a method which minimizes the maximum dissatisfaction level of all groups (Borm et al., 2001; Schmeidler, 1969). As a measure for the dissatisfaction level, the excess of group S with respect to allocation x is introduced: $E(S,x) = v(S) - \sum_{i \in S} x_i$.

Furthermore, $\theta(x)$ is the excess vector consisting of the excesses of all groups in a decreasing order. NUC is defined as the unique solution that satisfies IND (see Section 9.5 for a definition of IND) and $\theta(NUC) \le_L \theta(x)$ for all x satisfying IND (e.g., Heijboer, 2003).

The NUC for CP-games can be calculated by using an adapted version of the Aumann-Maschler rule $AM_i(V(N), M_i(v))$, which is equal to:

$$GNUC_i(v) = \begin{cases} CEA_i\left(V(N), \frac{1}{2} \cdot M_i(v)\right), & \sum_{i \in N} M_i(v) \ge 2 \cdot v(N) \\ M_i(v) - CEA_i\left(\sum_{i \in N} M_i(v) - V(N), \frac{1}{2} \cdot M_i(v)\right), & \sum_{i \in N} M_i(v) < 2 \cdot v(N) \end{cases} \tag{9.16}$$

So, in case the maximum claims $M_i(v)$ (see Chapter 8 for further discussions on claims) are relatively high $\sum_{i\in N} M_i(v) \geq 2 \cdot v(N)$, the maximum claims are divided by half and the CEA rule is used to solve the new situation. In case the maximum claims are relatively low, all maximum claims are met and the gains $\sum_{i\in N} M_i(v) - v(N)$ are handed back using the principle of CEA with respect to half of the original maximum claims. The Constrained Equal Award rule CEA is defined by $CEA_i(V(N), M_i(v)) = (\min\{\chi, M_i(v)\})_{i\in N}$ with χ such that $\sum_{i\in N} \min\{\chi, M_i(v)\} = V(N)$. The general idea behind CEA is that one wants to allocate $V(N)$ as equal as possible among the organizations under the restriction that no organization should receive more than its maximum claim $M_i(v)$.

To allocate the costs while using NUC, we use the following method: subtract the net allocated savings per organization (integrate all costs into $V(S)$) from the gross allocated savings per organization (assume there are no costs).

9.4.8. Shapley Value

The Shapley Value (SV) is defined as $SV(v) = \frac{1}{|N|!} \sum_{\sigma\in\Pi(N)} m^{\sigma}(v)$. Here $m^{\sigma}(v)$ is the marginal vector of a game v for a permutation σ and is defined as $m^{\sigma}_{\sigma(k)} = v(\{\sigma(1),...,\sigma(k)\}) - v(\{\sigma(1),...,\sigma(k-1)\})$ with $\sigma \in \Pi(N)$, $\Pi(N) = \{\sigma : \{1,...,|N|\} \to N \mid \sigma \quad bijective\}$ (Shapley, 1953). This value takes different sequences into account of organizations entering a group for all possible groups. When organization A enters an empty group, no pay-offs are allocated to this organization. When organization B enters this group, it receives all the pay-offs this organization creates for the group. For all possible groups for each organization, all its allocations are added up and divided by the total number of groups, which equals each organization's allocation (Shapley, 1953).

To allocate the costs while using SV, we again use the following method: subtract the net allocated savings per organization from the gross allocated savings per organization.

9.4.9. Compromise Value

As mentioned in the previous chapter, the Compromise Value (CV) gain method equals:

$$GCV_i(v) = \beta M_i(v) + (1-\beta)\, mc_i(v) \qquad \textbf{(9.17)}$$

With $\beta \in [0,1]$ unique such that $\sum_{i\in N} GCV_i(v) = v(N)$. The minimum claim is defined as $mc_i(v) = \max_{S:i\in S}\left\{v(S) - \sum_{j\in S, i\neq j} M_j(v)\right\}$.

To allocate the costs while using CV, we again use the following method: subtract the net allocated savings per organization from the gross allocated savings per organization.

9.4.10. Adapted Compromise Value 1

Adding the gains for and by organization *i* from the previous chapter into $mc_i(v)$ gives a new minimum claim for the Adapted Compromise Value 1 (ACV1) method:

$$Gmc_i(v) = \max\left\{\begin{array}{l}\max\limits_{S:i\in S}\left\{v(S) - \sum\limits_{j\in S, i\neq j} M_j(v)\right\} \\ q_i \cdot \left(\min\left\{p\left(\sum\limits_{j\in N\setminus i} q_j\right), p(q_i)\right\} - p\left(\sum\limits_{j\in N} q_j\right)\right)\end{array}\right\} \tag{9.18}$$

The other definitions (e.g., the maximum claim $M_i(v)$) for the ACV1 remain the same. Thus, the ACV1 gains are divided proportionally by the added value of the organizations in a group, while taking into account the minimum claim of an organization. The added value of an organization A equals the difference between the total savings of the group and the savings of the group without organization A. The minimum claim of an organization A equals the savings which are created by and for organization A. In other words, the minimum claim equals the purchased quantities by organization A multiplied by the price difference between the purchase price of the group and the purchase price of the group without organization A.

To allocate the costs while using ACV1, we again use the following method: subtract the net allocated savings per organization from the gross allocated savings per organization. Table 9.1 gives the definitions of the different savings of organization *i*.

Table 9.1 Decomposition of added value into three types of savings

Savings	**Description**
m_i = savings for and by i	$= \left\{\begin{array}{l} q_i \cdot \left(p\left(\sum\limits_{j\in N\setminus i} q_j\right) + \dfrac{C(N\setminus i)}{\sum\limits_{j\in N\setminus i} q_j} - \left(p\left(\sum\limits_{j\in N} q_j\right) + \dfrac{C(N)}{\sum\limits_{j\in N} q_j}\right)\right), p\left(\sum\limits_{j\in N\setminus i} q_j\right) \le p(q_i) \\ q_i \cdot \left(p(q_i) - \left(p\left(\sum\limits_{j\in N} q_j\right) + \dfrac{C(N)}{\sum\limits_{j\in N} q_j}\right)\right), p\left(\sum\limits_{j\in N\setminus i} q_j\right) > p(q_i)\end{array}\right.$
n_i = savings by i for $N \setminus \{i\}$	$= \sum\limits_{j\in N\setminus i} q_j \cdot \left(p\left(\sum\limits_{j\in N\setminus i} q_j\right) + \dfrac{C(N\setminus i)}{\sum\limits_{j\in N\setminus i} q_j} - \left(p\left(\sum\limits_{j\in N} q_j\right) + \dfrac{C(N)}{\sum\limits_{j\in N} q_j}\right)\right)$
o_i = savings for i by $N \setminus \{i\}$	$= \max\left\{q_i \cdot \left(p(q_i) - \left(p\left(\sum\limits_{j\in N\setminus i} q_j\right) + \dfrac{C(N\setminus i)}{\sum\limits_{j\in N\setminus i} q_j}\right)\right), 0\right\}$
Total	$= M_i$

Adding the savings for and by organization *i* into $mc_i(v)$ gives a new minimum claim for the ACV1 costs:

$$Cmc_i(v) = \max\left\{\begin{array}{l}\max\limits_{S:i\in S}\left\{v(S) - \sum\limits_{j\in S, i\neq j} M_j(v)\right\} \\ q_i \cdot \left(\min\left\{p\left(\sum\limits_{j\in N\setminus i} q_j\right) + \dfrac{C(N\setminus i)}{\sum\limits_{j\in N/i} q_j}, p(q_i)\right\} - p\left(\sum\limits_{j\in N} q_j\right) - \dfrac{C(N)}{\sum\limits_{j\in N} q_j}\right)\end{array}\right\} \quad \textbf{(9.19)}$$

9.4.11. Adapted Compromise Value 2

Based on PV, another adaptation of CV is a follows: allocate an amount to an organization which is proportional to the added value of the organization for the purchasing group:

$$GACV2_i(v) = \frac{M_i}{\sum\limits_{j\in N} M_j} \cdot v(N) \quad \textbf{(9.20)}$$

To allocate the costs while using the Adapted Compromise Value 2 (ACV2), we again use the following method: subtract the net allocated savings per organization from the gross allocated savings per organization.

9.4.12. Applications of allocation methods illustrated

In the following example, we illustrate the applications of different allocation methods for purchasing groups. Consider three organizations purchasing 60 items cooperatively. The price for the items as a function of the quantity that will be ordered is $p(q) = p_0 \cdot \left(c_1 + c_2 \cdot q^{-\eta}\right) = 959 \cdot \left(1 + q^{-0.5}\right)$ for $q > 0$.

The management costs made by the organizations are $C_1(N) = 421$, $C_2(N) = 209$, $C_3(N) = 209$, $C(N) = 838$ and the compensation costs are $cc_1 = 500$ and $cc_2 = cc_3 = 0$. Because of cc_1 becoming 500, the savings of the group {1,2,3} drop by 500. Likewise, the savings for groups {1,2} and {1,3} drop by 500. The savings of group {2,3} remain the same because this group does not have to compensate organization 1. This can be modeled into a CP-game with costs as shown in Table 9.2.

Table 9.2 CP-game for three organizations with costs

Purchasing group *S*	**Total quantity of group *S***	**Price per item**	**Total gains of group S**	**Total costs of group *S***	**Total savings of group *S***
{1}	35	1,121	0	0	0
{2}	10	1,262	0	0	0
{3}	15	1,207	0	0	0
{1,2}	45	1,102	2,273	1,225	1,048
{1,3}	50	1,095	2,607	1,225	1,382
{2,3}	25	1,151	1,952	725	1,227
{1,2,3} = *N*	60	1,083	4,992	1,338	3,655

For EA, PV, EPR, EP, SERD, and SERI, compensation costs can be allocated likewise as normal costs. Compensation costs do not influence the cost allocation for these methods. For other allocation methods, compensation costs cannot be treated likewise as normal costs. This is because compensation costs are related to one or more organizations in specific and thus, related to the added value of these organizations for the purchasing group. And in contrast to the non-game theoretical allocation methods, the game theoretical methods take added value into account.

Table 9.3 shows the savings that each individual organization receives when the grand purchasing group uses different allocation methods. The savings can be calculated by subtracting the costs from the gains or by integrating the costs into the total group

$$\text{price } p\left(\sum_{i\in N} q_i\right) = 959 \cdot \left(1 + \frac{1}{\sqrt{\sum_{i\in N} q_i}}\right) - \frac{C(N)}{\sum_{i\in N} q_i}.$$

A remarkable outcome of this example is that using EP may lead to a situation where the largest organization receives the smallest part of the total gains, but has to pay the largest part of the costs.

Note that compared to SERD en SERI, the savings allocated to organization 1 seem low while using NUC, SV, CV, ACV1 or ACV2 (and the savings allocated to organizations 2 and 3 seem high). This can be explained by the fact that organization 1 receives compensation costs of 500. Note that in this example, the combined allocations of CV and NUC are equal, but this is not true in general.

Table 9.3 Allocations of the case savings

Method	**Organization 1 (35 items)**			**Organization 2 (10 items)**			**Organization 3 (15 items)**		
	Savings	**Gains**	**Costs**	**Savings**	**Gains**	**Costs**	**Savings**	**Gains**	**Costs**
Simple method									
1. EA	1,218	1,664	(446)	1,218	1,664	(446)	1,218	1,664	(446)
2. PV	2,132	2,912	(780)	609	832	(223)	914	1,248	(334)
3. EPR	2,050	2,800	(750)	660	901	(241)	946	1,292	(346)
4. EP	560	1,340	(780)	1,572	1,795	(223)	1,523	1,857	(334)
Sophisticated method									
5. SERD	1,953	2,399	(446)	662	1,108	(446)	1,041	1,487	(446)
6. SERI	1,708	2,154	(446)	836	1,282	(446)	1,111	1,557	(446)
7. NUC	1,214	1,990	(776)	1,137	1,335	(198)	1,304	1,668	(364)
8. SV	1,048	1,827	(779)	1,220	1,500	(279)	1,387	1,666	(279)
9. CV	1,214	1,863	(649)	1,137	1,462	(325)	1,304	1,667	(363)
10. ACV1	1,336	2,203	(867)	1,026	1,269	(243)	1,294	1,522	(228)
11. ACV2	1,214	1,863	(649)	1,137	1,462	(325)	1,304	1,667	(363)

9.5. Properties of fairness

The example in the previous section concerns one specific situation. To assess allocation methods in general, we analyze several common properties of fairness from cooperative game theory. In the previous chapter, we already discussed some common properties of

fairness. In this chapter, we zoom in on more properties to be able to make a distinction between all allocation methods. The common properties of fairness we use in this chapter are based on Albizuri (2002), Friedman (2003), Heijboer (2003), Moulin (2001), and Shapley (1953):

- **EFF: Efficiency**
  See Section 8.4 for a description;
- **SYM: Symmetry**
- See Section 8.4 for a description;
- **DUM: Dummy**
  See Section 8.4 for a description;
- **IND: Individual Rationality**
  Not only EFF is satisfied, but also for all organizations i it holds that $f_i(v) \geq v(\{i\})$. It means that for each organization the pay-off of cooperation is equal to or higher than the pay-off of working alone;
- **STA: Stability**
  See Section 8.4 for a description. Note that STA implies that DUM and IND are satisfied (Heijboer, 2002). For CP-games without costs, STA also implies that organization i cannot receive a larger pay-off than $M_i(v)$ or a smaller pay-off than $m_i(v)$ (see the previous chapter for further discussions of these methods);
- **FRAV: Fair Ranking Added Value**
  See Section 8.4 for a description;
- **MON: Monotonicity**
  See Section 8.4 for a description;
- **CMON: Cross Monotonicity**
  If for one organization i, $q_i' \geq q_i$, then $f_j'(v) \geq f_j(v)$ for $j = \{1,2,..,n\}$. Satisfying this property means that if the quantity of items to be purchased by one organization stays equal to or becomes larger than in a former situation, all organizations should receive an equal or larger amount of pay-offs. Note that properties such as CMON can be defined as Strong (S) by replacing ≥ with >.

To this list, we add the following property to be able to make a distinction between PV and EPR (see also Table 9.4):

- **MUL: Multiplication**
  In case for CP-games without costs, the quantities q of all organizations in game v multiplied with a factor γ are equal to the quantities q' of all organizations in game w, then the total savings of game v equal the total savings of game w multiplied with the factor $\gamma^{1-\eta}$. In this case, there should be no difference in the relative pay-offs between the organizations in game v and w. For instance, this means that it should make no difference in the relative pay-offs if a total of two organizations in game v purchase 10 and 20 items, and in game w, two organizations purchase 40 and 80 items. For CP-games with costs, MUL should hold if the costs are multiplied with the factor $\gamma^{1-\eta}$ as well.

9.6. Properties of gain allocation methods for CP-games without costs

In this section, we discuss the properties of fairness of gain allocation methods for CP-games without costs. The gain allocation methods each satisfy some properties of fairness.

Table 9.4 gives an overview of which methods satisfy which properties for CP-games without costs while the steepness η is 0.5. Proofs have been omitted here; instead, we illustrate the behavior of the allocation methods for CP-games with costs in Section 9.8.

Table 9.4 Properties for CP-games without costs

Method	EFF	SYM	DUM	IND	MUL	FRAV	STA	MON	CMON	SCMON
Simple method										
1. EA	✓	✓	×	✓	✓	×	×	✓	✓	✓
2. PV	✓	✓	✓	✓	✓	×	×	✓	×	×
3. EPR	✓	✓	✓	✓	×	×	×	✓	×	×
4. EP	✓	✓	✓	✓	✓	×	✓	×	×	×
Sophisticated method										
5. SERD	✓	✓	✓	×	✓	×	×	✓	×	×
6. SERI	✓	✓	✓	✓	✓	×	✓	✓	✓	×
7. NUC	✓	✓	✓	✓	✓	✓	✓	✓	×	×
8. SV	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
9. CV	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10. ACV1	✓	✓	✓	✓	✓	✓	✓	✓	×	×
11. ACV2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Note: ✓ = satisfied in general, × = not satisfied in general, and $\eta = 0.5$

For CP-games without costs, the table shows, among other things, that using the EA gain method, the PV gain method, the EPR gain method or SER (decreasing) can lead to situations where organizations could want to split up the purchasing group to increase their individual gains (STA property). As noted earlier, the EP gain method does not satisfy MON and FRAV in general.

Unlike the simple gain allocation methods, the game theoretical gain methods and SER (increasing) satisfy most properties associated with fairness. Thus, these gain methods can be considered as theoretically fairer and more stable alternatives. SV, CV, and ACV2 can be considered as the fairest alternatives for allocating gains.

In contrast to methods such as SER (increasing), the (adapted) CVs can be explained relatively easily. Although not directly clear from the table, it can be argued that ACV1 should be fairer than CV because the ACV1 minimum claim seems a reasonable extension of the CV minimum claim. Still, organizations could make objections to this method. This is because ACV1 is slightly more difficult to use in practice as more calculations have to be made. Another disadvantage of ACV1 is that it behaves less streamlined than CV for scenarios related to (1) members increasing or decreasing their purchases through a purchasing group and scenarios related to (2) a constant total volume of a group, but the allocations of the total purchases among the individual organizations differ. These scenarios are discussed in Section 8.7 for EP and are illustrated in Fig. 9.1 to Fig. 9.4 for CV and ACV1 while the steepness η is 0.5.

Fig. 9.1 illustrates the effects of changes in the purchases of an organization through a purchasing group on the added value of the organization for the group and on the allocation this organization receives when using CV. Fig. 9.2 shows, for instance, that an organization purchasing 50% of the total purchasing volume of a purchasing group adds most value to the group. In addition, the figure shows that this organization receives most of the gains

when using CV. Compared to Fig. 9.1 and Fig. 9.2, Fig. 9.3 and Fig. 9.4 show that ACV1 behaves less streamlined than CV. In Section 9.8, we illustrate the behavior of, among other things, ACV1 in more detail.

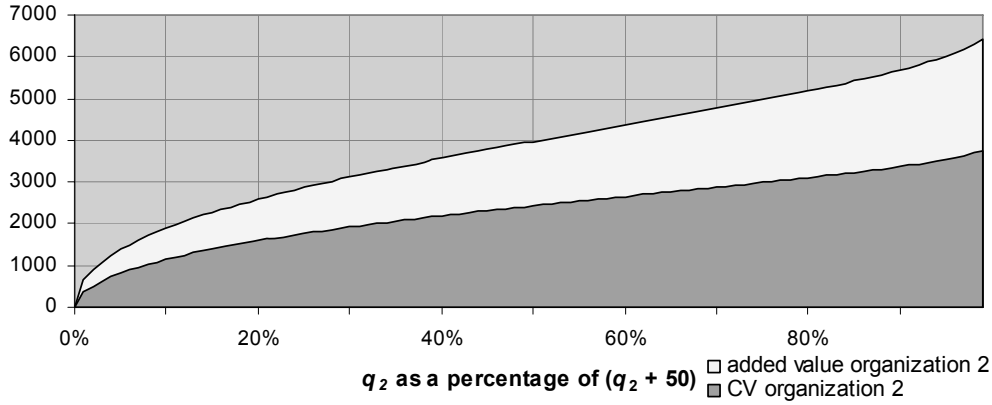

Fig. 9.1 CV and ACV2 effects when a group member increases purchases

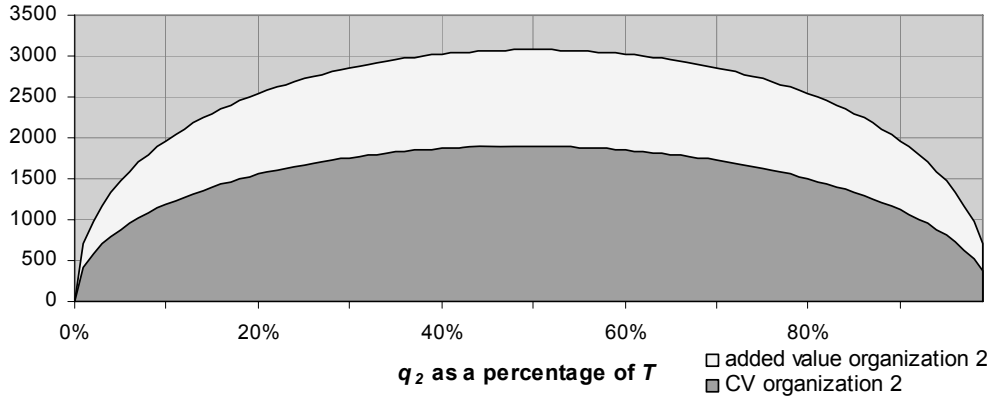

Fig. 9.2 CV and ACV2 effects on all group allocations

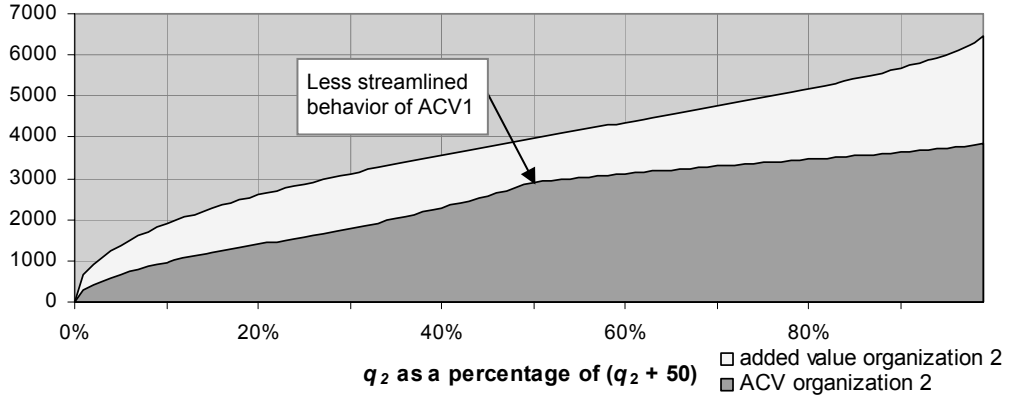

Fig. 9.3 ACV1 effects when a group member increases purchases

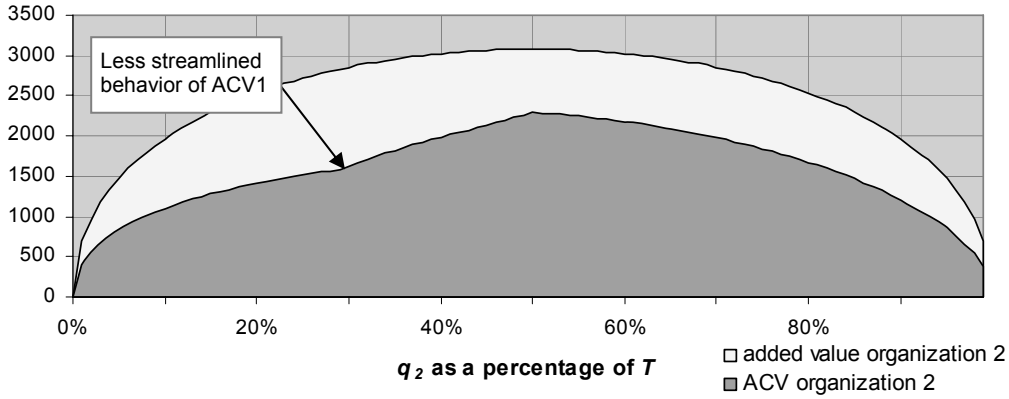

Fig. 9.4 ACV1 effects on all group allocations

If we draw similar figures for EA (see Fig. 9.5 and Fig. 9.6) and PV (see Fig. 9.7 and Fig. 9.8), then we see that EA favors small organizations and PV favors large organizations to a large extent. This is one issue we further explore in Chapter 10. Note that for MON and FRAV, CV behaves very similar as NUC and PV behaves very similar as EPR. Therefore, we did not include figures for these methods.

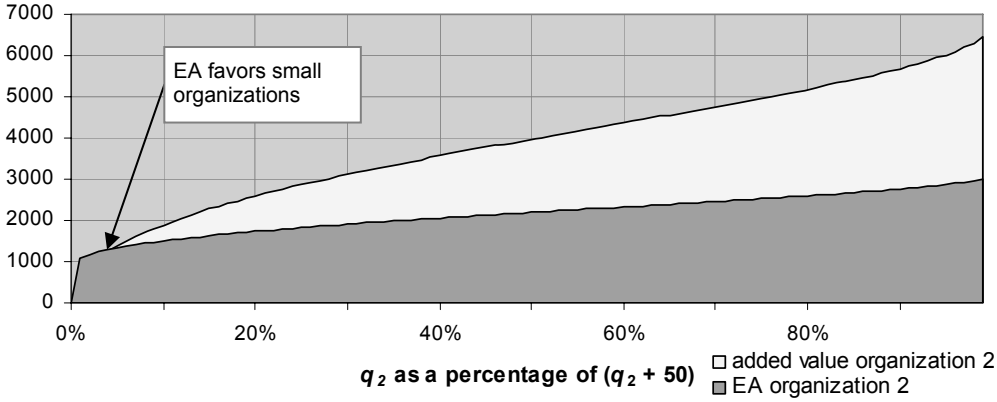

Fig. 9.5 EA effects when a group member increases purchases

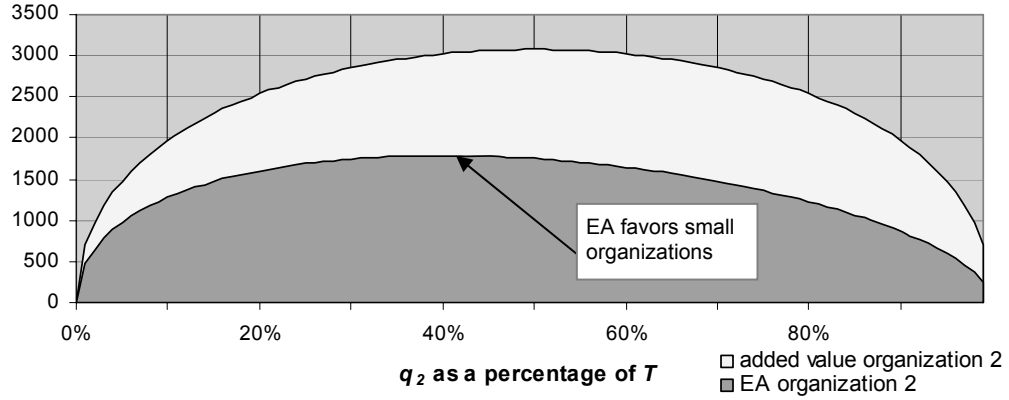

Fig. 9.6 EA effects on all group allocations

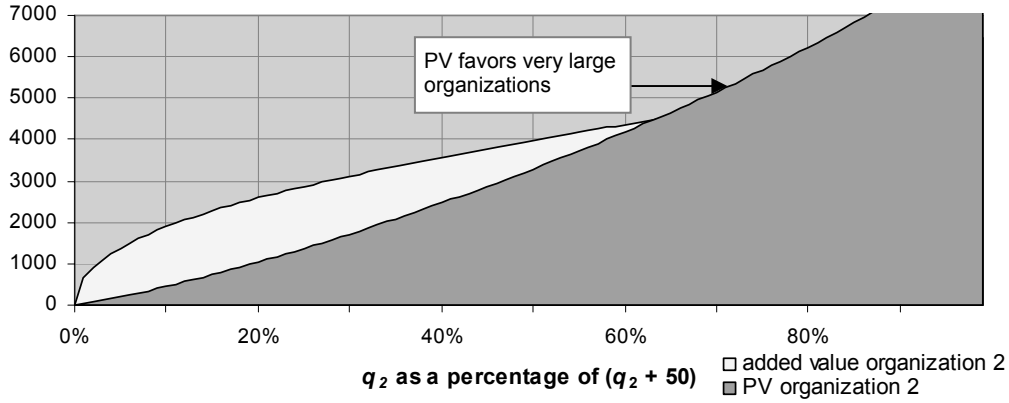

Fig. 9.7 PV effects when a group member increases purchases

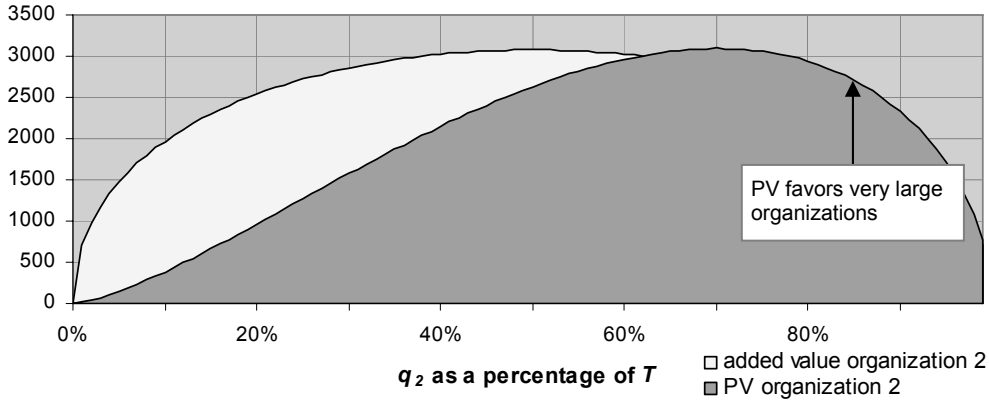

Fig. 9.8 PV effects on all group allocations

9.7. Properties of saving allocation methods for CP-games with costs

In the previous section, we described properties of fairness of gain allocation methods for CP-games without costs. In this section, we describe properties of fairness for saving (i.e., gains minus costs) allocation methods for CP-games with costs. Table 9.5 gives an overview of which saving allocation methods satisfy which properties for CP-games with costs while $v(N) > 0$, $v(N) \geq v(N / \{i\})$, and steepness η is 0.5. In Section 9.8, we illustrate under which conditions the saving allocation methods lead to unfair outcomes.

As CP-games with costs are more complex than CP-games without costs, it is more difficult to allocate the savings in a fair manner in general. Indeed, compared to Table 9.4 (CP-games without costs), Table 9.5 (CP-games with costs) shows that several properties of fairness are not satisfied anymore for several saving allocation methods.

Among other things, the table shows that ACV2 satisfies most properties associated with fairness for CP-games with costs in general. Thus, this method can be considered as a theoretically fair alternative. Note that some of the literature suggests that a proportional allocation of savings would be fair (Polychronakis and Syntetos, 2007). In general, this is not supported by Table 9.5 as PV does not satisfy DUM, FRAV, STA, and (S)CMON.

Table 9.5 Properties for CP-games with costs

Method	EFF	SYM	DUM	IND	MUL	FRAV	STA	MON	CMON	SCMON
Simple method										
1. EA	✓	✓	×	✓	✓	×	×	✓	✓	✓
2. PV	✓	✓	×	✓	✓	×	×	✓	×	×
3. EPR	✓	✓	×	✓	×	×	×	✓	×	×
4. EP	✓	✓	×	×	✓	×	×	×	×	×
Sophisticated method										
5. SERD	✓	✓	×	×	✓	×	×	✓	×	×
6. SERI	✓	✓	×	×	✓	×	×	✓	✓	×
7. NUC	✓	✓	×	✓	✓	×	×	✓	×	×
8. SV	✓	✓	×	×	✓	✓	×	✓	✓	✓
9. CV	✓	✓	×	✓	✓	✓	×	✓	×	×
10. ACV1	✓	✓	×	×	✓	×	×	×	×	×
11. ACV2	✓	✓	✓	✓	✓	✓	✓	✓	×	×

The table also shows that EP (the EP gain method in combination with the PV cost method) can be considered as an unfair alternative in general. EP only satisfies EFF and SYM. Remarkably, such an allocation method is used by a total of 24% of the purchasing groups studied in Chapter 6 (see Section 6.4.4). Most of these purchasing groups have members that differ considerably in organizational size. Using EP in such situations can lead to a theoretically unfair allocation of gains and costs, which can cause allocation problems in the long run[40].

Finally, Table 9.5 shows that using ACV2 has several advantages. Still, applying ACV2 to a combination of different products has two drawbacks: CMON and SCMON are not satisfied in general. However, these properties are not satisfied by most allocation methods. In addition, based on our practical experience with purchasing groups, we argue that these properties do not seem to be very important for purchasing groups. Properties such as STA seem to be more important (see also Chapter 10).

9.8. Under which conditions lead the allocation methods to unfair outcomes?

In this section, we illustrate under which conditions the saving allocation methods lead to unfair outcomes for CP-games with costs. In other words, for Table 9.5, we show under which conditions the properties of fairness are not satisfied. More specifically, in Section 9.8.1, we illustrate different scenarios for a constant total volume of a purchasing group. In Section 9.8.2 and 9.8.3, we show different scenarios for an increasing total volume of a purchasing group. Finally, in Section 9.8.4, we illustrate some special scenarios. These sections may be omitted with no loss of continuity for the remainder of this thesis.

9.8.1. Different scenarios for a constant total volume of a purchasing group (I)

This section shows how the allocation methods behave given a constant total volume of a purchasing group, but the allocations of the total purchases among the individual organizations differ (i.e., situation I). This situation is discussed in Section 8.7 for EP. In

[40] Although it is not statistically tested, it is suggested in Section 6.4.4 that the combination of the EP gain allocation method with the EA cost allocation method occurs more often in successful purchasing groups than the combination of EP with a proportional cost allocation method.

Section 8.7, we only showed the added value and allocation of organization 2 for a purchasing group of three organizations. In this section, we also incorporate the costs of a purchasing group. Here the cost function used is defined as $C(S) = 500 + 300 \cdot |S|^{\frac{3}{2}}$ for $|S| \geq 2$. The total constant purchase volume of the purchasing group is $T = q_1 + q_2 + q_3 = 60$. We also show the added value and allocation of organization 1 and organization 3 in this section. The purchase volumes of these organizations are defined as $q_1 = (T - q_2) \cdot q_2 \cdot T^{-1}$ and $q_3 = (T - q_2) \cdot (1 - q_2 \cdot T^{-1})$.

We have defined q_1 and q_3 as described above to cover a wide range of different scenarios. Specifically, we wanted to include a scenario in which one of the organizations does not add value to the group. In this scenario, it can be tested whether DUM and STA are satisfied. An additional advantage of the equations of q_1 and q_3 is that the purchase volumes of organization 1 and organization 3 equal each other at only one point. Other definitions of q_1 and q_3, such as $q_1 = q_3 = 0.5 \cdot (T - q_2)$, cover a smaller range of different scenarios.

The effects of $q_1 = (T - q_2) \cdot q_2 \cdot T^{-1}$ and $q_3 = (T - q_2) \cdot (1 - q_2 \cdot T^{-1})$ are shown in Table 9.6 for different values of q_2 (from 0% to 100%). Again, the scenario numbers in the table correspond to the scenario numbers in the figures illustrated in this section.

Table 9.6 Quantities of the organizations for several scenarios (I)

Organization	**Scenario number and relative quantities (quantities)**											
	0	**…**	**1**	**…**	**2**	**…**	**3**	**…**	**4**	**…**	**5**	
1	0%	(0)	16%	(10)	24%	(14)	24%	(14)	16%	(10)	0%	(0)
2	0%	(0)	20%	(12)	40%	(24)	60%	(36)	80%	(48)	100%	(60)
3	100%	(60)	64%	(38)	36%	(22)	16%	(10)	4%	(2)	0%	(0)
Total volume	100%	(60)	100%	(60)	100%	(60)	100%	(60)	100%	(60)	100%	(60)
Total gains	0		4.809		5.367		4.937		3.673		0	
Total costs	2,059		2,059		2,059		2,059		2,059		2,059	
Total savings	–2,059		2,750		3,308		2,878		1,614		–2,059	

For instance, for EA, Fig. 9.9 illustrates the different scenarios. The thin lines illustrate the added value of the organizations. The thicker lines illustrate the EA saving allocation for the organizations. For instance, for scenario 2, all three organizations receive $GEA(v) - CEA(v) = \frac{v(N) - C(N)}{n} = \frac{3,308}{3} = 1,103$.

Among other things, Fig. 9.9 shows that an organization adding no value to the purchasing group does receive gains while using EA. Therefore, the properties of fairness DUM and STA are not satisfied in general. The other figures show the behavior of the other methods and indicate when certain properties of fairness are not satisfied. Note that Fig. 9.12 shows that when the EP gain method is combined with the EA cost method, this combination levels out the unfair effects of the original EP method (see also Fig. 9.11) to some extent. This note applies to Section 9.8.2 and Section 9.8.3 as well.

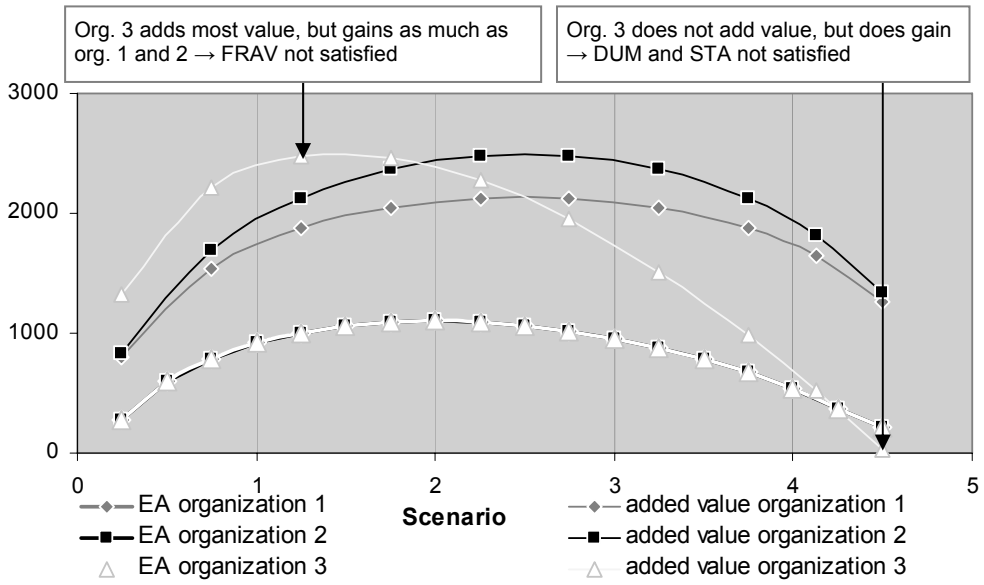

Fig. 9.9 EA effects for three organizations (I)

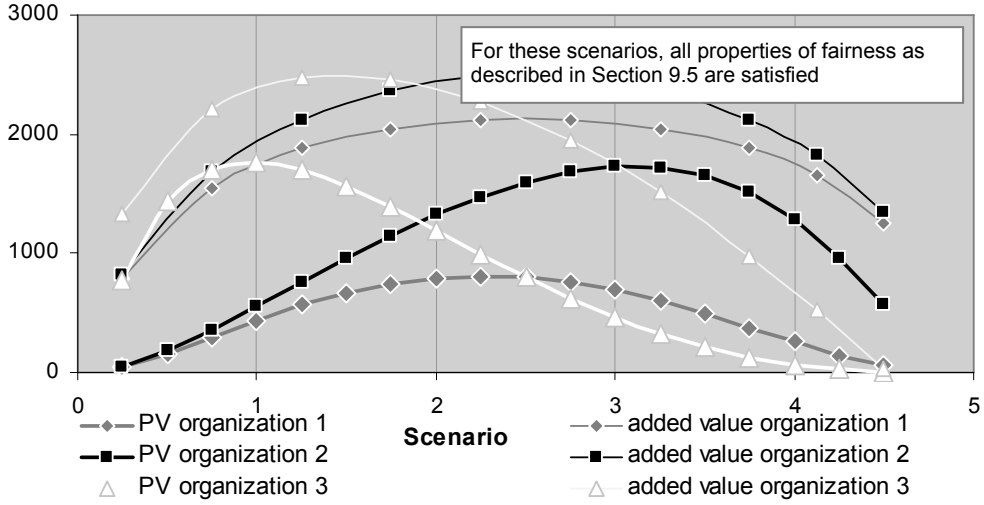

Fig. 9.10 PV effects for three organizations (I)[41]

[41] PV behaves very similar as EPR.

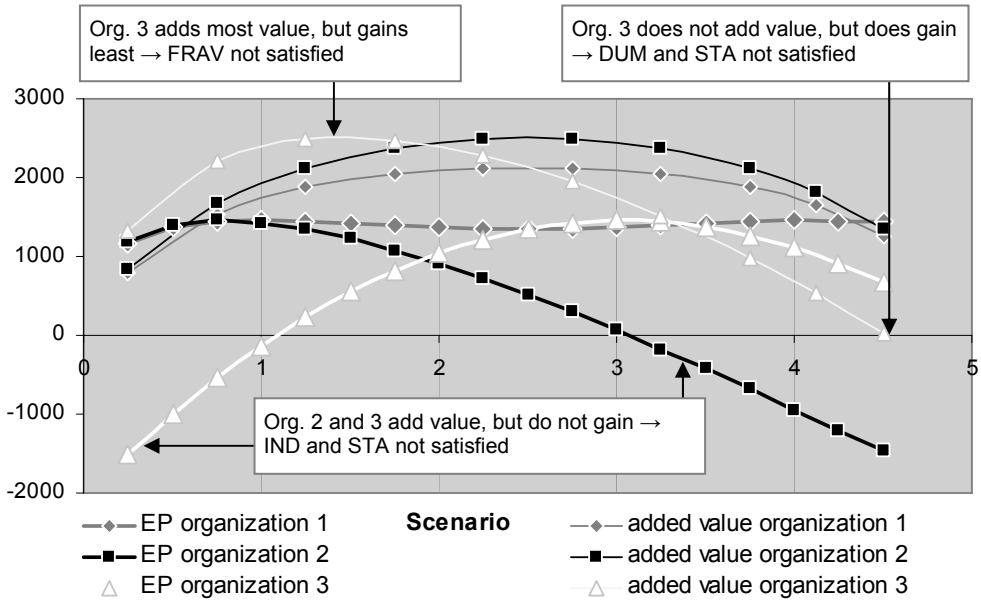

Fig. 9.11 EP effects for three organizations (I)

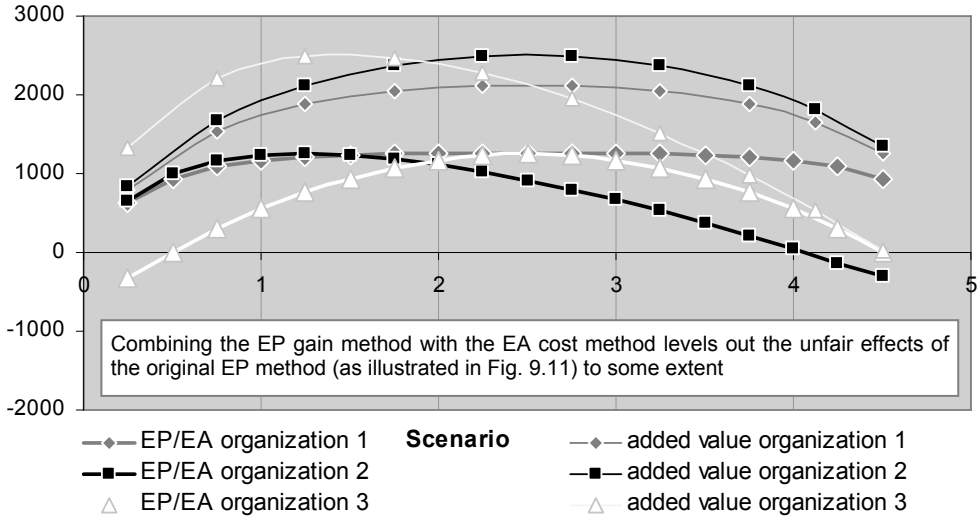

Fig. 9.12 EP gain / EA cost effects for three organizations (I)

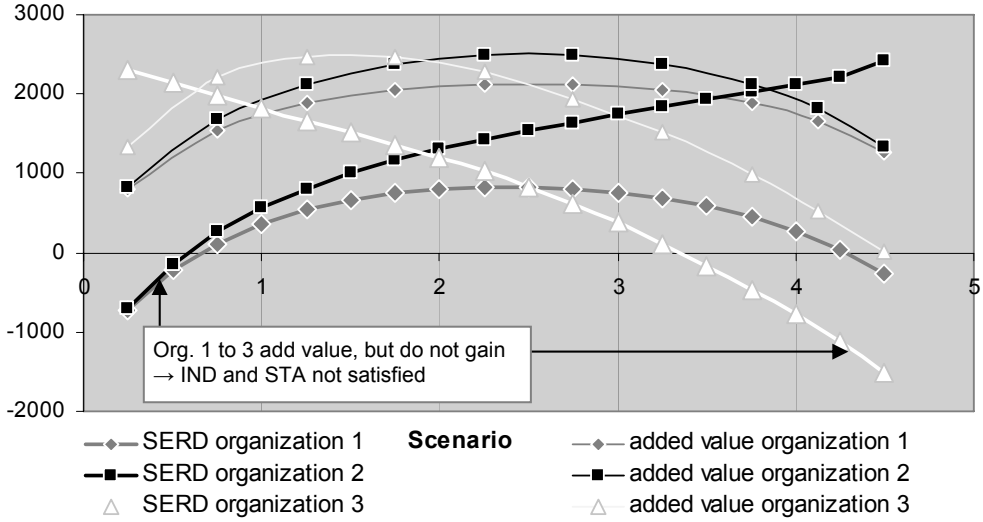

Fig. 9.13 SERD effects for three organizations (I)

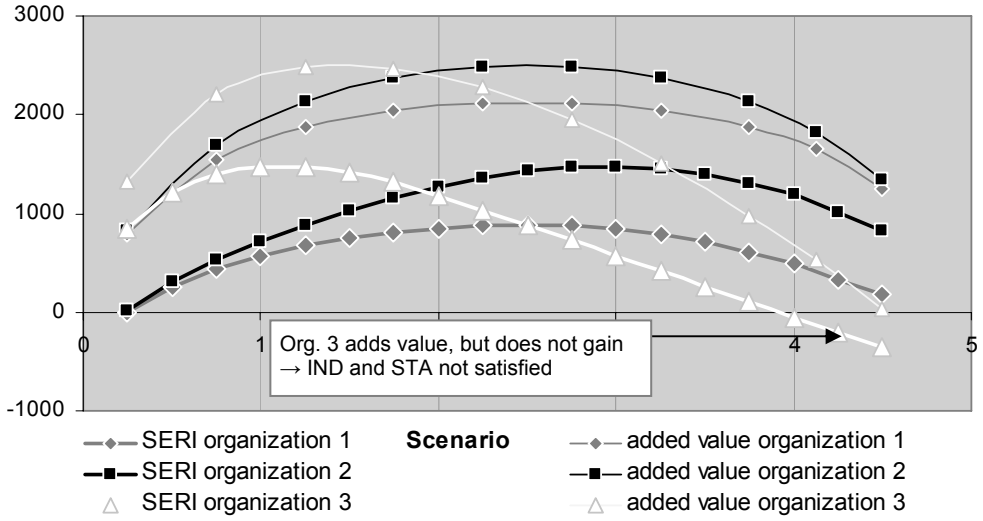

Fig. 9.14 SERI effects for three organizations (I)

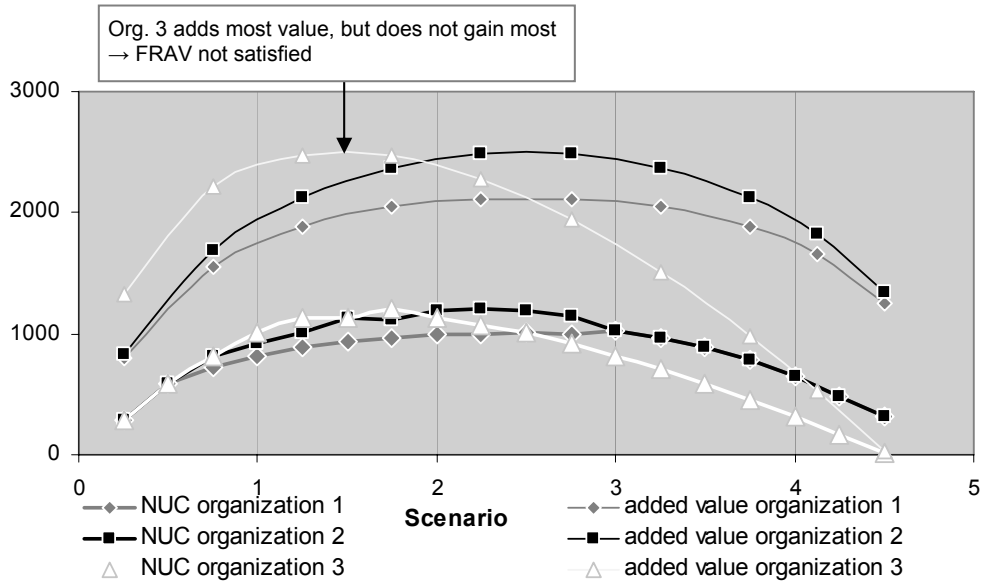

Fig. 9.15 NUC effects for three organizations (I)

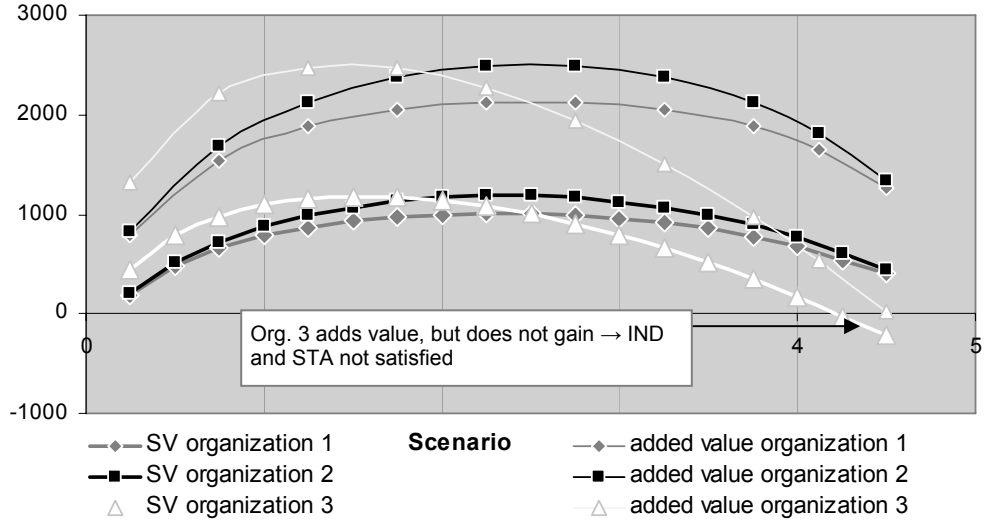

Fig. 9.16 SV effects for three organizations (I)

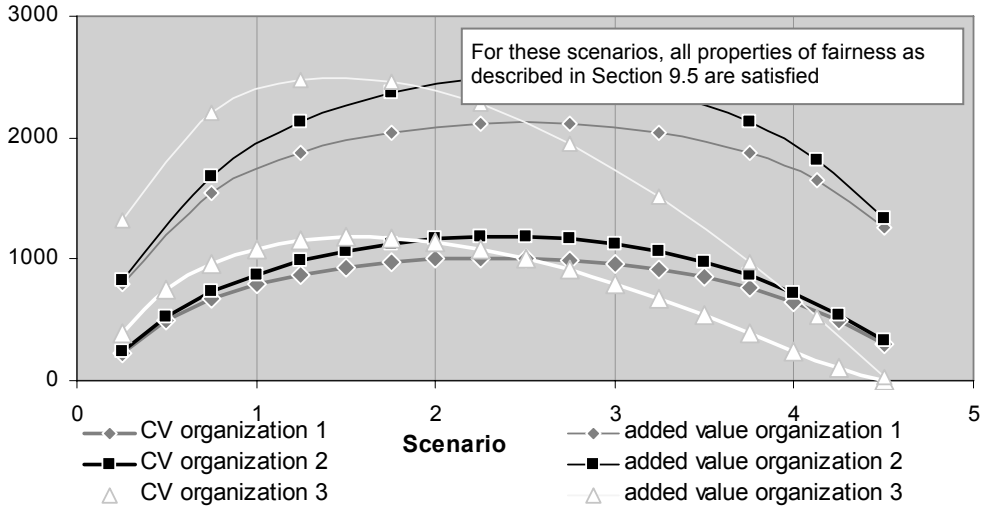

Fig. 9.17 CV and ACV2 effects for three organizations (I)[42]

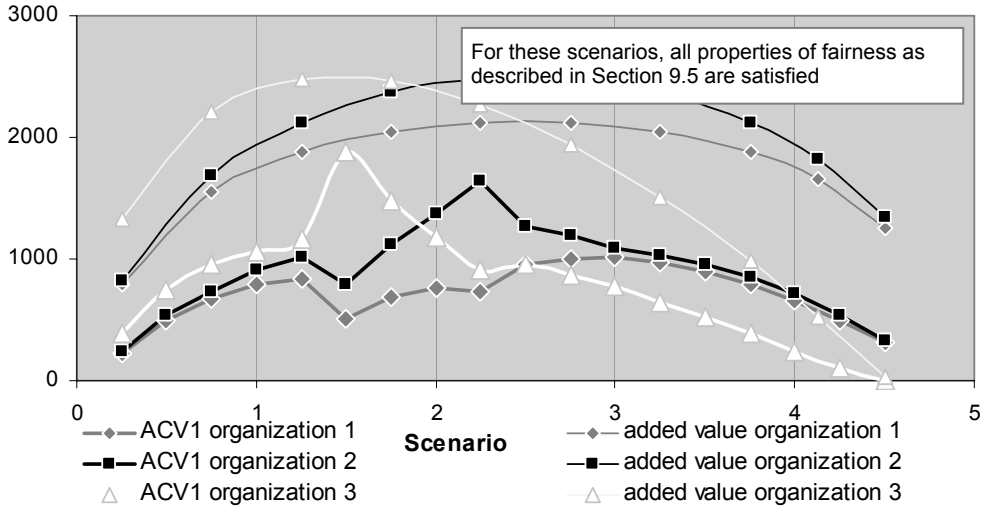

Fig. 9.18 ACV1 effects for three organizations (I)

9.8.2. Different scenarios for an increasing total volume of a purchasing group (II)

In the previous section, we could not show all conditions under which the allocation methods lead to unfair outcomes. Therefore, in this section, we illustrate the behavior of the allocation methods under different circumstances. Here the total number of the needed items for organization 1 and organization 3 is constant. The volume of organization 2 (and the total volume of the purchasing group) increases steadily (i.e., situation II). The cost function used is the same as in the previous section.

[42] For these scenarios, CV and ACV2 lead to the same results.

The effects of the assumptions discussed above are shown in Table 9.7 for different values of q_2 (from 0% to 100%). The scenario numbers in the table correspond to the scenario numbers in the figures illustrated in this section.

Table 9.7 Quantities of the organizations for several scenarios (II)

Organization	**Scenario number and relative quantities (quantities)**									
	0	**…**	**1**	**…**	**2**	**…**	**3**	**…**	**4**	
1	87%	(35)	70%	(35)	52%	(35)	35%	(35)	17%	(35)
2	0%	(0)	20%	(10)	40%	(27)	60%	(60)	80%	(160)
3	12%	(5)	10%	(5)	7%	(5)	5%	(5)	2%	(5)
Total volume	100%	(40)	100%	(50)	100%	(67)	100%	(100)	100%	(200)
Total gains	2,463		4,071		4,941		5,658		6,388	
Total costs	2,059		2,059		2,059		2,059		2,059	
Total savings	404		2,012		2,882		3,599		4,329	

For instance, for EA, Fig. 9.19 illustrates the different scenarios. Again, the thin lines illustrate the added value of the organizations. The thicker lines illustrate the EA saving allocation for the organizations.

Fig. 9.20 shows, for instance, that (S)CMON is not satisfied in general while using PV. The other figures show the behavior of the other allocation methods and indicate when certain properties of fairness are not satisfied. For each allocation method, we only indicate properties of fairness that are not already illustrated in the previous section. We note that EP is the only method analyzed for which the allocation of organization 2 decreases over almost all increasing scenarios. This note applies to Section 9.8.3 as well.

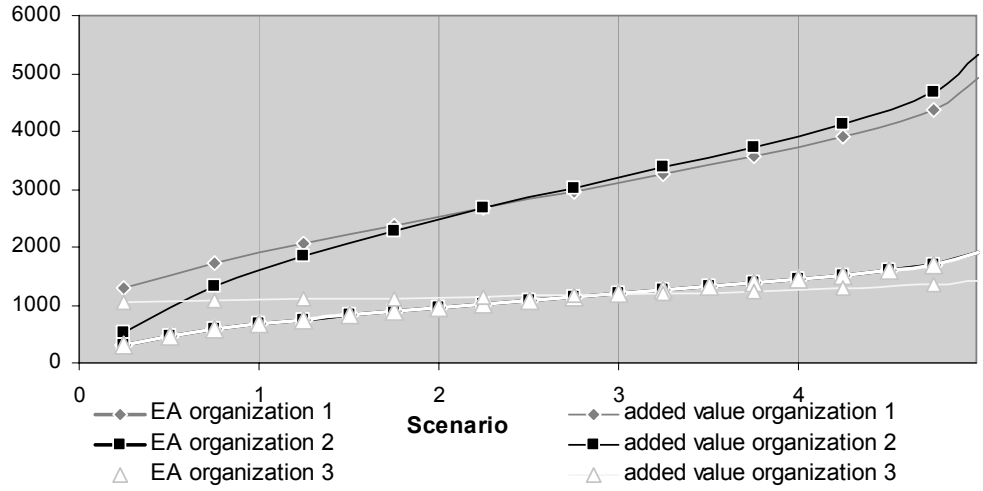

Fig. 9.19 EA effects for three organizations (II)

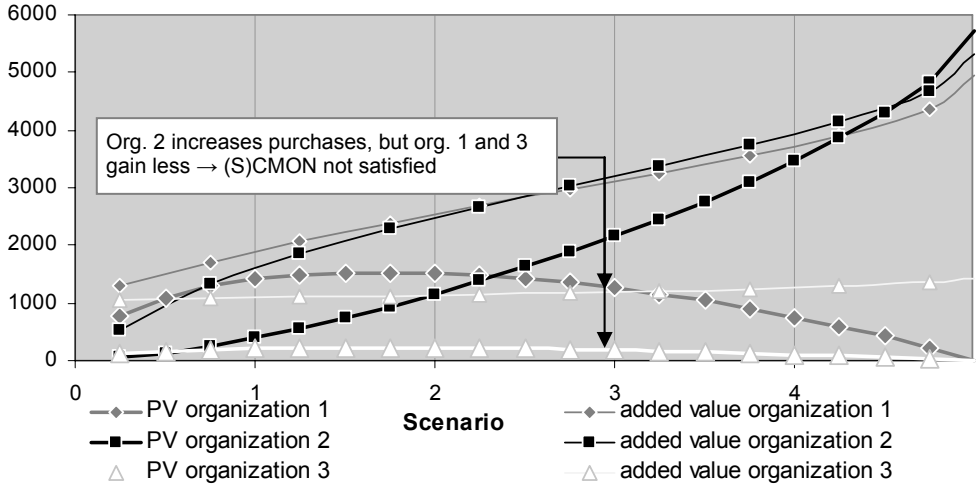

Fig. 9.20 PV effects for three organizations (II)[43]

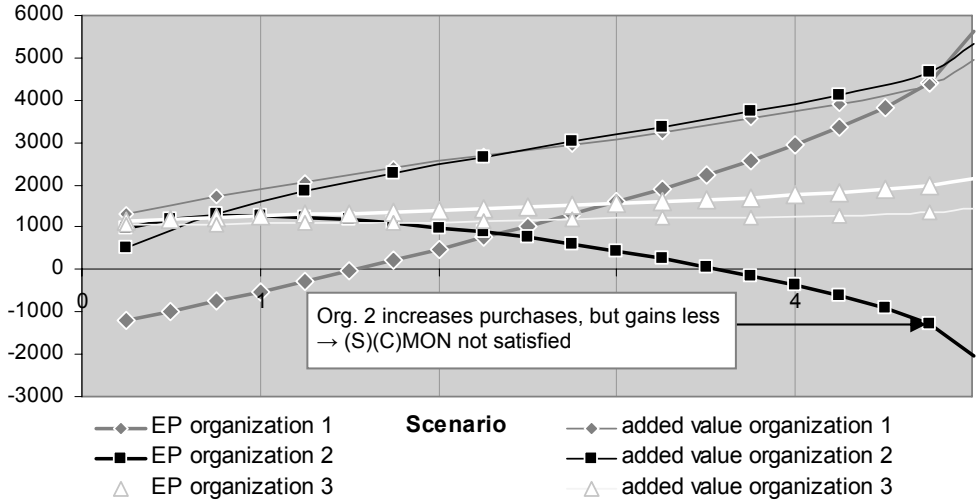

Fig. 9.21 EP effects for three organizations (II)

[43] PV behaves very similar as EPR.

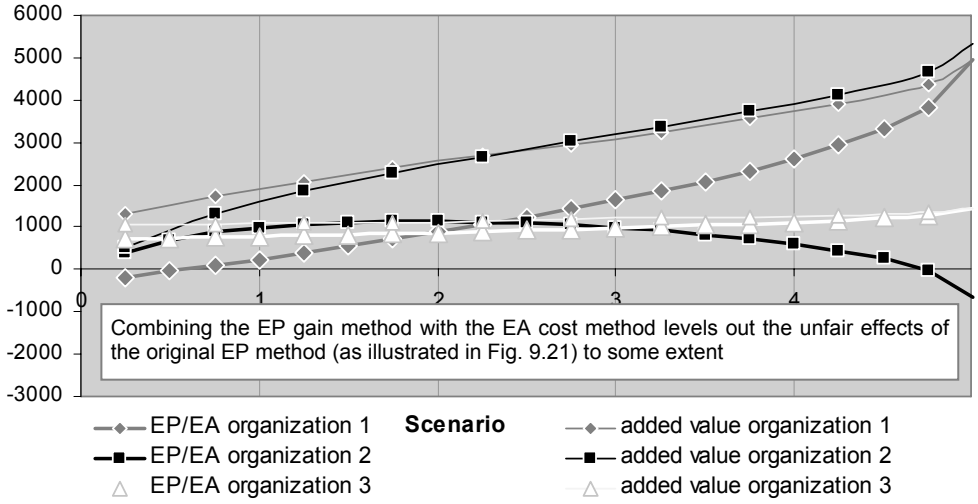

Fig. 9.22 EP gain / EA cost effects for three organizations (II)

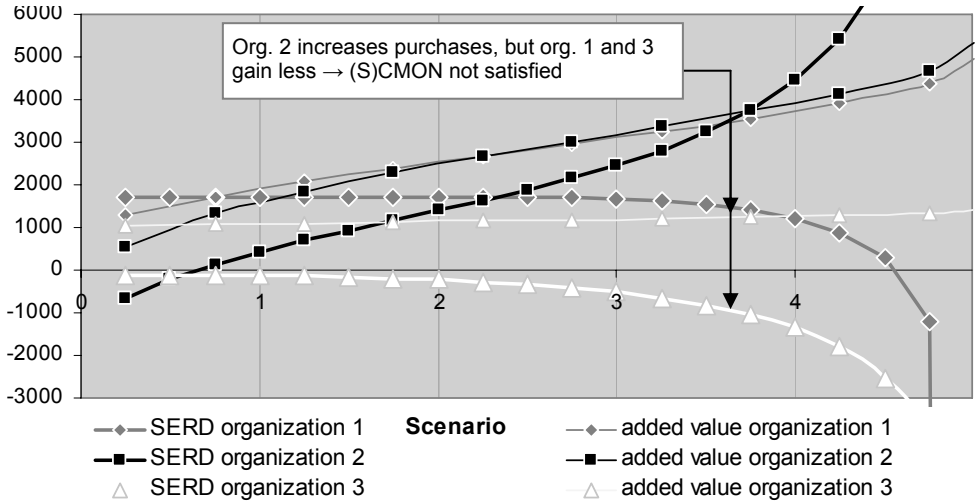

Fig. 9.23 SERD effects for three organizations (II)

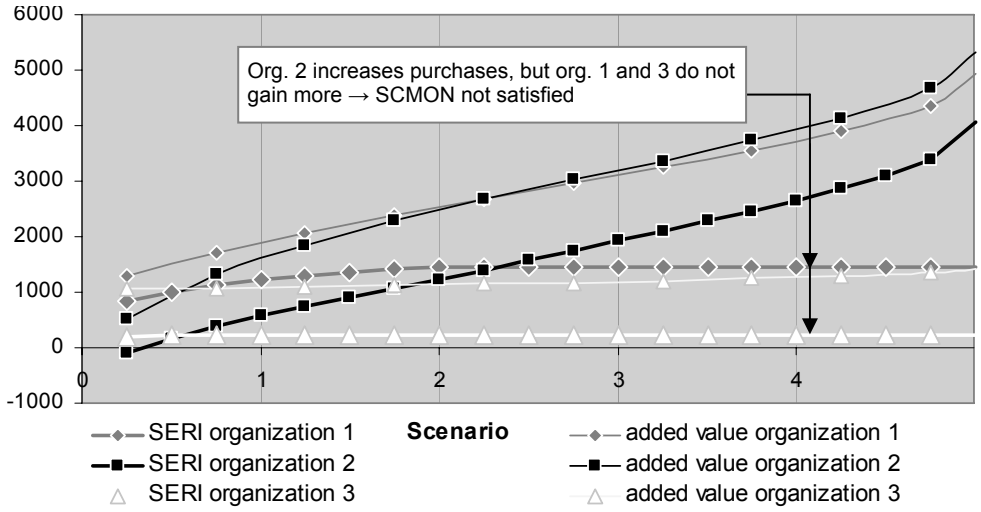

Fig. 9.24 SERI effects for three organizations (II)

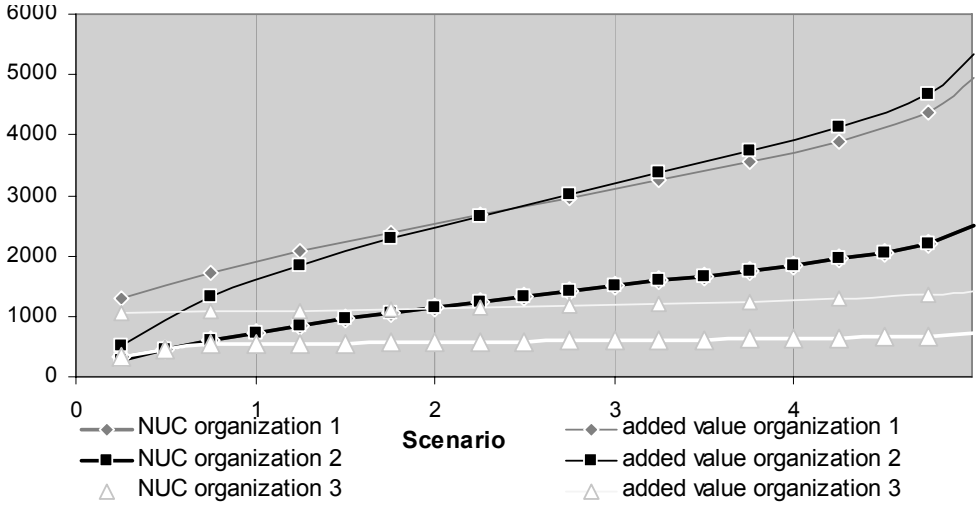

Fig. 9.25 NUC effects for three organizations (II)

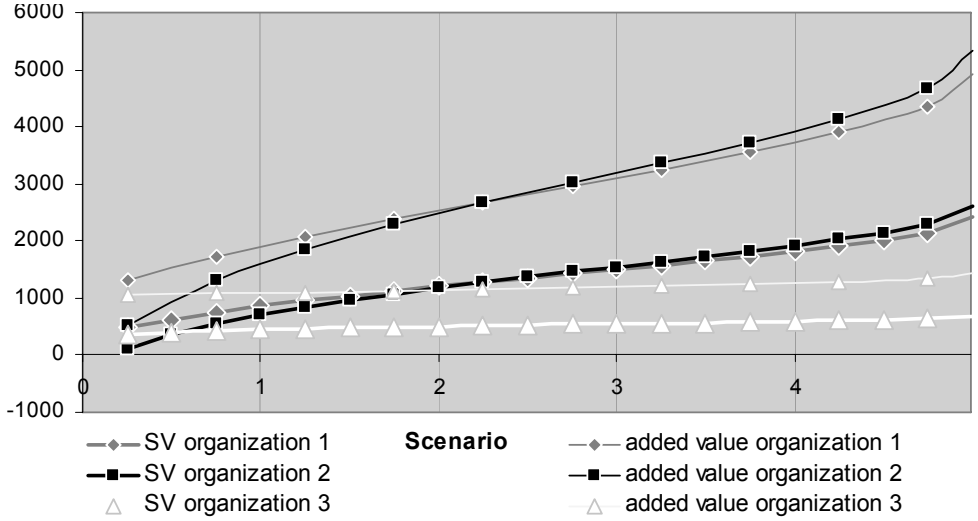

Fig. 9.26 SV effects for three organizations (II)

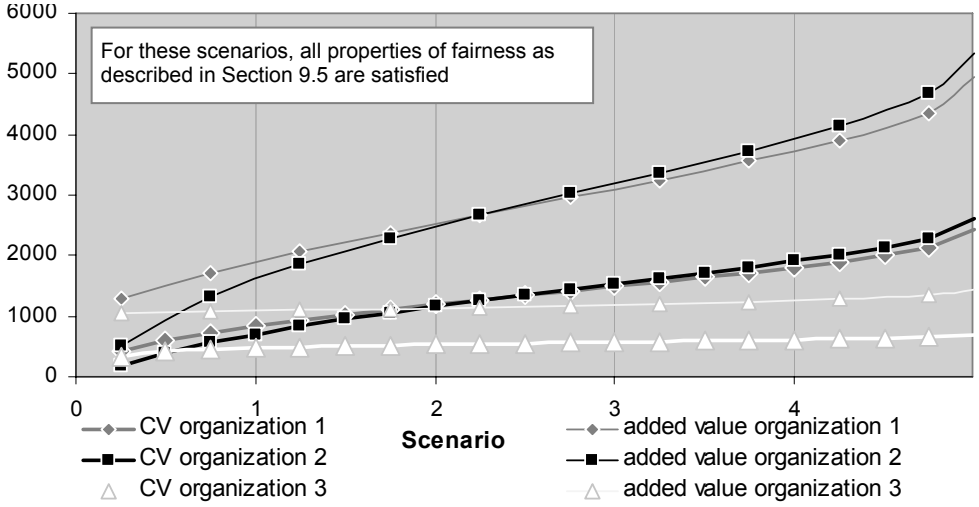

Fig. 9.27 CV and ACV2 effects for three organizations (II)[44]

[44] For these scenarios, CV and ACV2 lead to the same results.

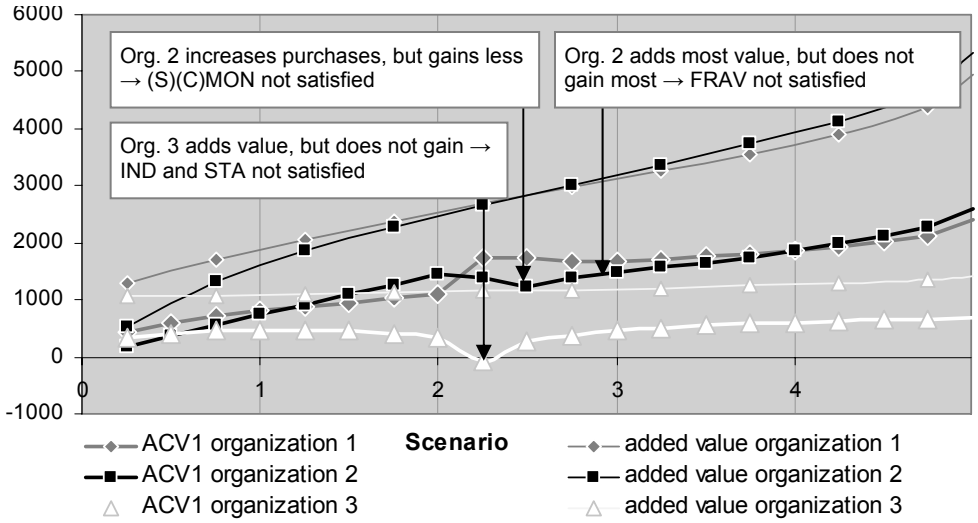

Fig. 9.28 ACV1 effects for three organizations (II)

9.8.3. Different scenarios for four cooperating organizations (III)

To be able to show when the property of fairness DUM is not satisfied for some allocation methods, we need to consider the situation in which at least four organizations cooperate in a purchasing group (i.e., situation III). In this situation, it can happen that an organization does not add value to the purchasing group, but it would add value if one of the other organizations would leave the group. Among other things, this influences $mc_i(v)$.

In this section, the volume of organization 2 (and the total volume of the purchasing group) increases steadily. The total numbers of needed items for organizations 1, 3, and 4 are constant (respectively 155, 40, and 40). We have chosen higher quantities than in the previous sections to be able to indicate differences between allocations more clearly. The cost function used is defined as $C(S) = 500 + 250 \cdot |S|^{\frac{5}{2}}$ for $|S| \geq 2$ (i.e., situation III).

The effects of the assumptions discussed above are shown in Table 9.8 for different values of q_2 (from 0% to 100%). Again, the scenario numbers in the table correspond to the scenario numbers in the figures illustrated in this section.

Table 9.8 Quantities of the organizations for several scenarios (III)

Organization	**Scenario number and relative quantities (quantities)**									
	0	**…**	**1**	**…**	**2**	**…**	**3**	**…**	**4**	
1	66%	(155)	53%	(155)	40%	(155)	26%	(155)	13%	(155)
2	0%	(0)	20%	(59)	40%	(157)	60%	(353)	80%	(940)
3	17%	(40)	14%	(40)	10%	(40)	7%	(40)	3%	(40)
4	17%	(40)	14%	(40)	10%	(40)	7%	(40)	3%	(40)
Total volume	100%	(235)	100%	(294)	100%	(392)	100%	(588)	100%	(200)
Total gains	9,417		14,987		17,097		18,834		20,603	
Total costs	8,500		8,500		8,500		8,500		8,500	
Total savings	917		6,487		8,597		10,334		12,103	

For instance, for EA, Fig. 9.29 illustrates the different scenarios. Again, the thin lines illustrate the added value of the organizations. The thicker lines illustrate the EA saving allocation for the organizations. For each allocation method, we only indicate properties of fairness that are not already illustrated in the previous sections.

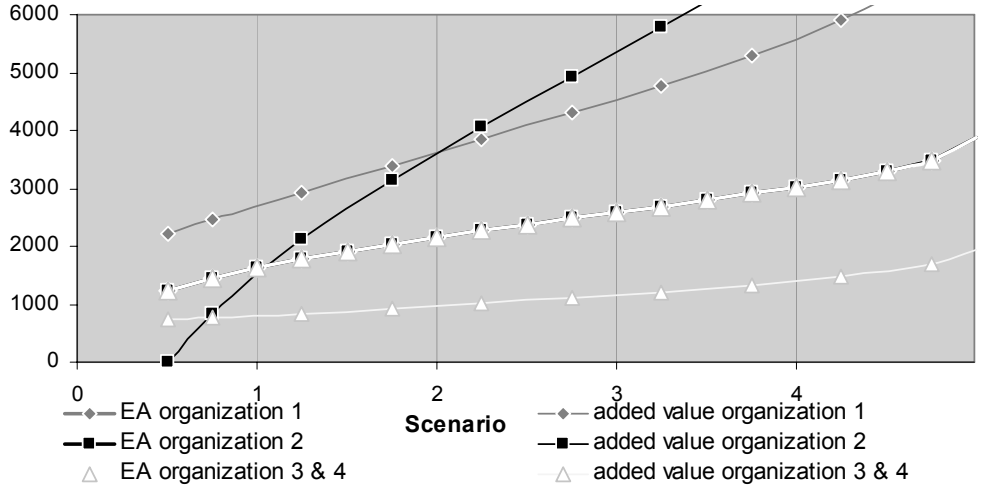

Fig. 9.29 EA effects for four organizations (III)

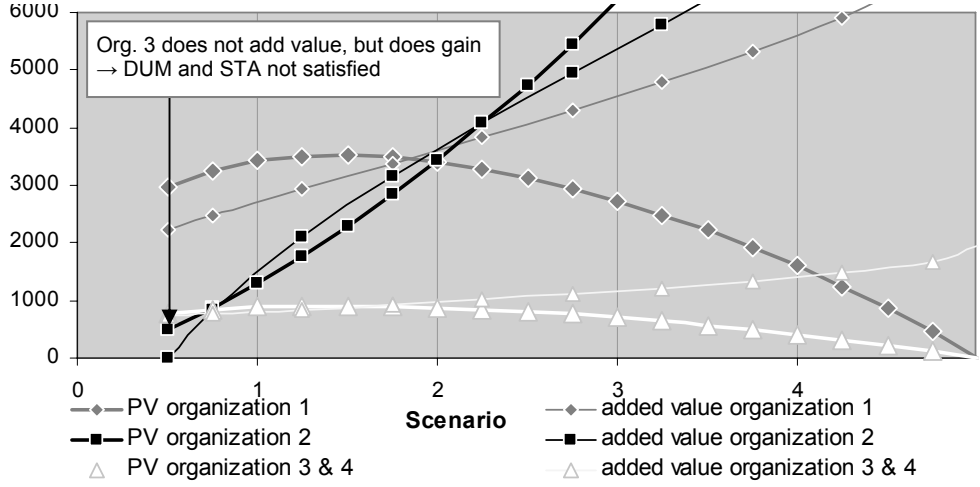

Fig. 9.30 PV effects for four organizations (III)[45]

[45] PV behaves very similar as EPR.

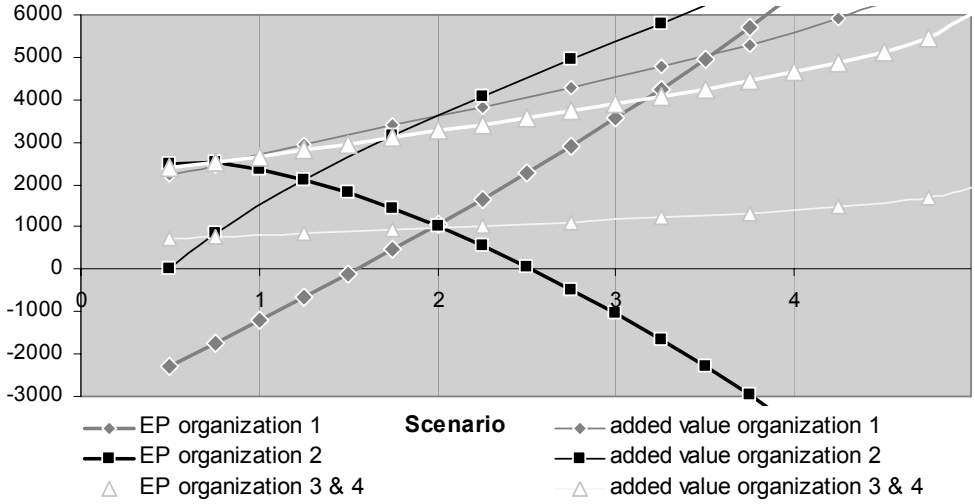

Fig. 9.31 EP effects for four organizations (III)

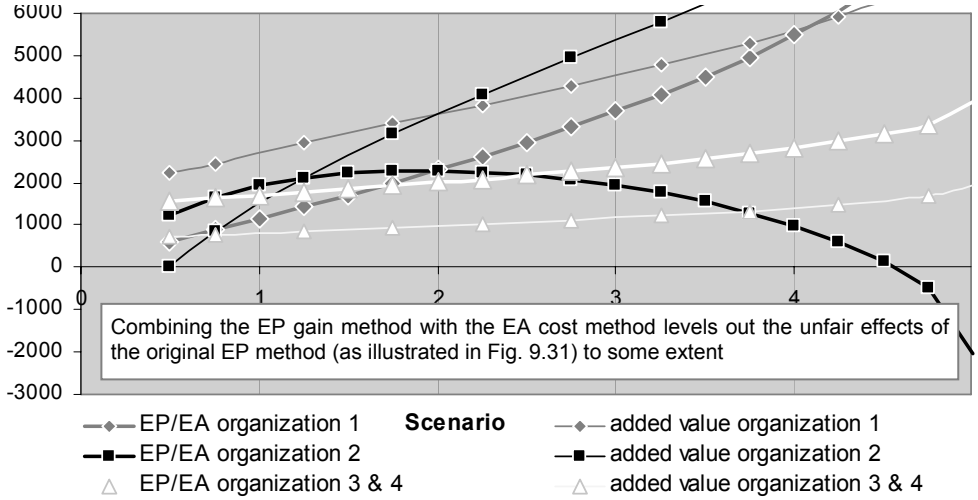

Fig. 9.32 EP gain / EA cost effects for four organizations (III)

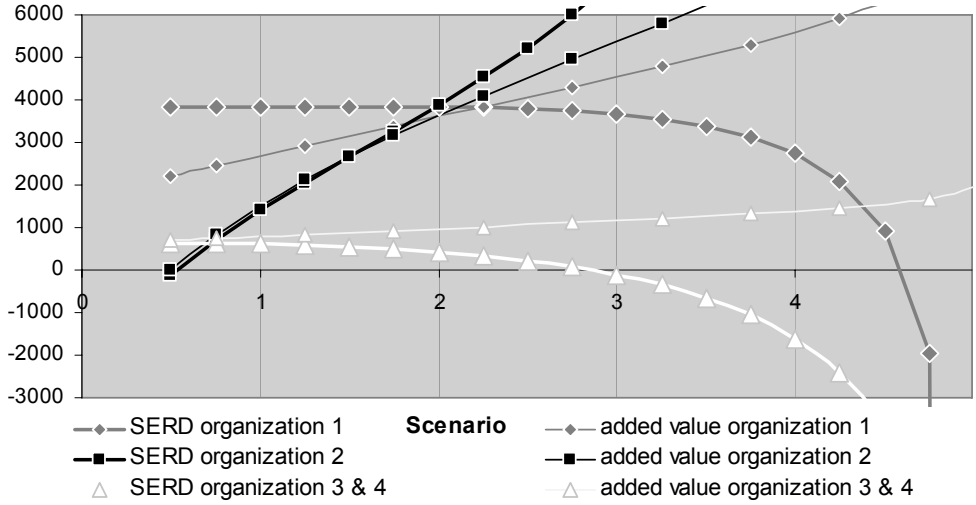

Fig. 9.33 SERD effects for four organizations (III)

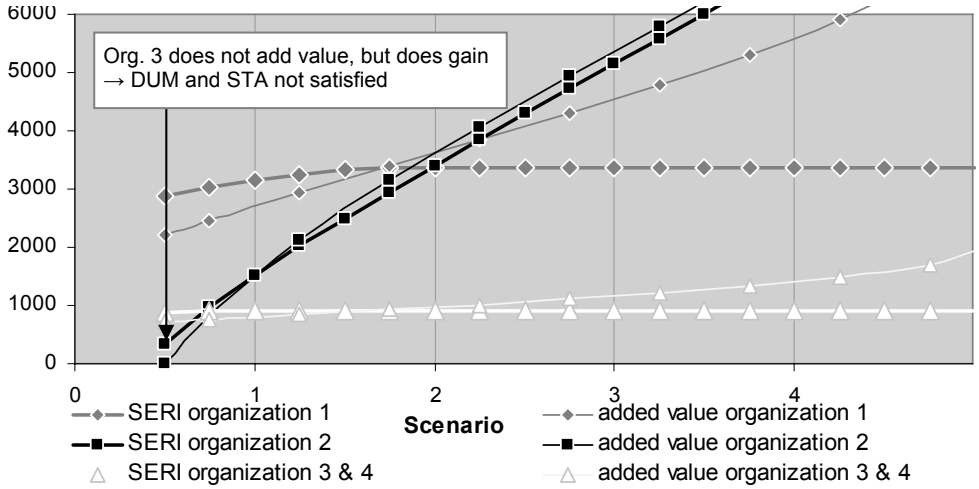

Fig. 9.34 SERI effects for four organizations (III)

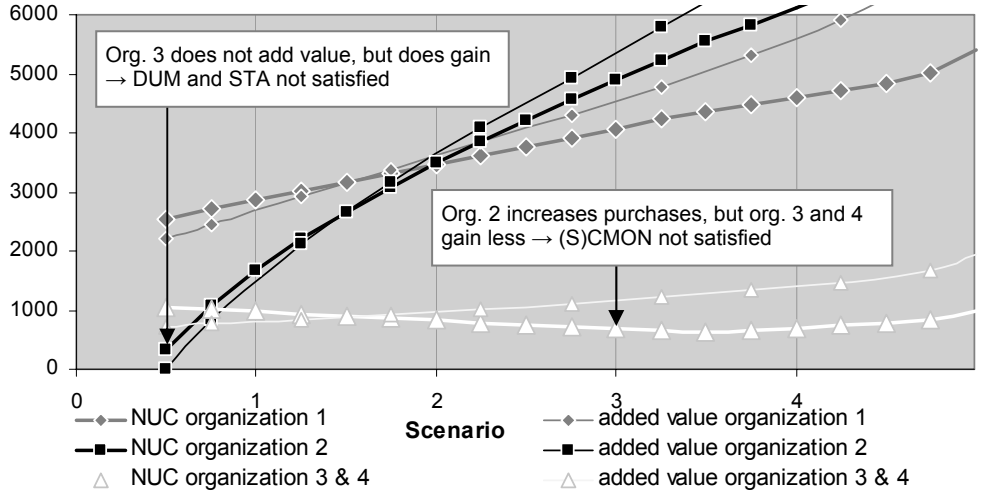

Fig. 9.35 NUC effects for four organizations (III)

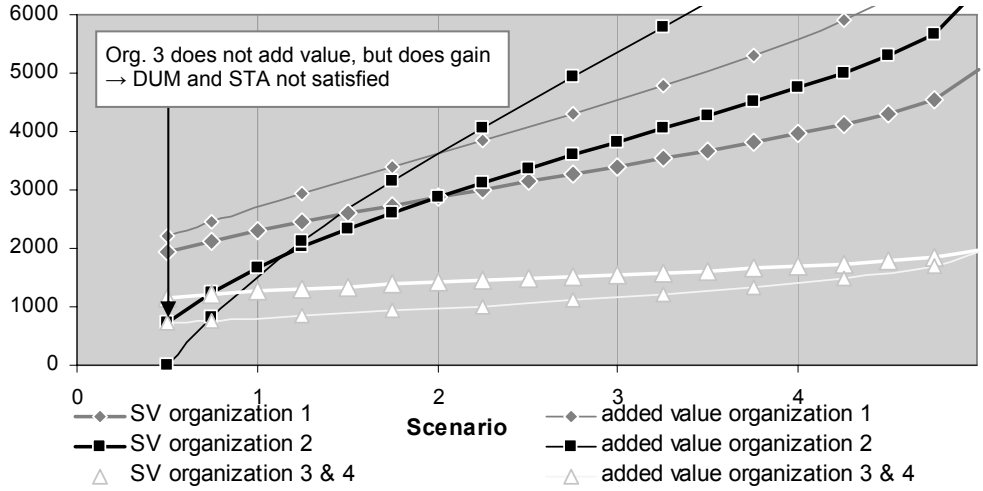

Fig. 9.36 SV effects for four organizations (III)

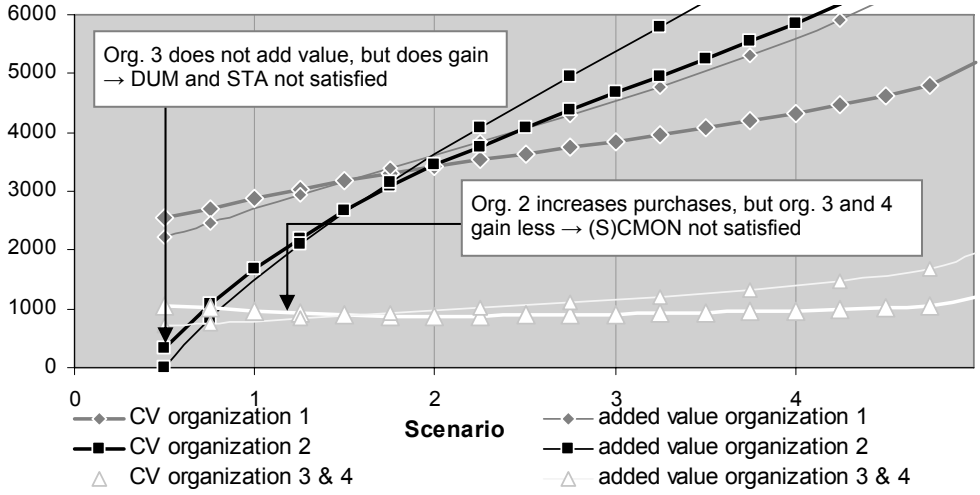

Fig. 9.37 CV effects for four organizations (III)

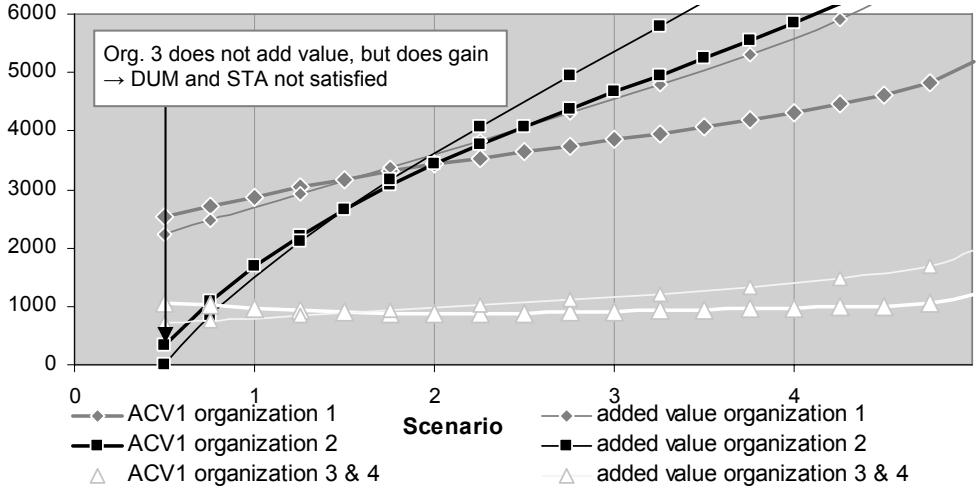

Fig. 9.38 ACV1 effects for four organizations (III)

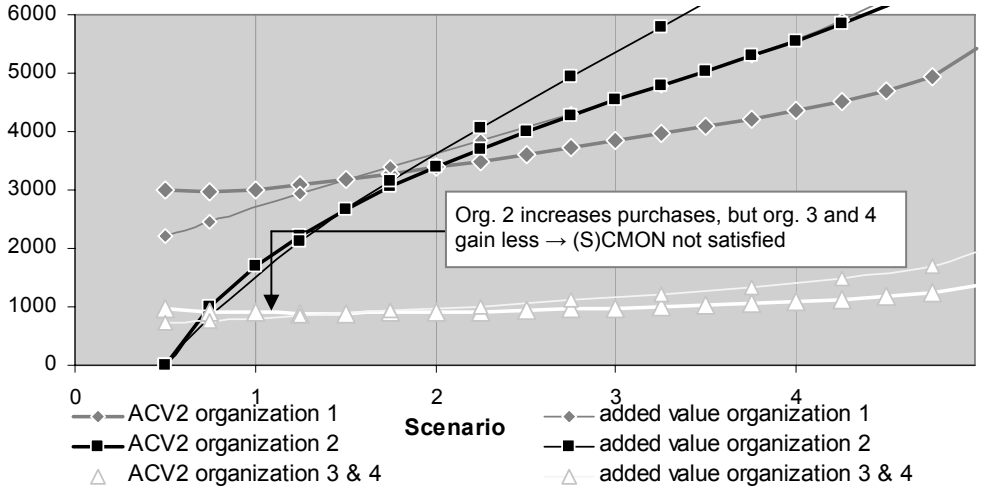

Fig. 9.39 ACV2 effects for four organizations (III)

9.8.4. Other scenarios

For PV, EPR, EP, SERD, and SERI, it can be verified that these methods do not satisfy FRAV in general for CP-games with two organizations. See Table 9.9 for a case example based on the previous section. Here the total savings are 2,700 and both cooperating organizations have an added value of 2,700 for the purchasing group. The only allocation methods satisfying FRAV are EA, NUC, SV, and the (adapted) CVs.

Table 9.9 FRAV effects for two organizations

Method	Savings of organization		Method	Savings of organization	
	1 (155 items)	2 (40 items)		1 (155 items)	2 (40 items)
2. PV	2,146	554	1. EA	1,350	1,350
3. EPR	2,115	585	7. NUC	1,350	1,350
4. EP	–227	2,926	8. SV	1,350	1,350
5. SERD	2,540	159	9. CV	1,350	1,350
6. SERI	1,880	820	10. ACV1	1,350	1,350
			11. ACV2	1,350	1,350

For all allocation methods but ACV2, it can be verified that they do not satisfy DUM and STA in general for CP-games with four organizations and relative high costs. See Table 9.10 for a case example with the cost function $C(S) = 350 \cdot |S|^2$ for $|S| \geq 2$. Here the total savings are 1,761 and the organizations have an added value for the purchasing group of respectively 0, 221, 388, and 388. Thus, the first organization does not add value to the purchasing group. The only allocation method satisfying DUM is ACV2.

Table 9.10 DUM and STA effects for four organizations

Method	Savings of organization			
	1 (11 items)	**2 (14 items)**	**3 (18 items)**	**4 (18 items)**
1. EA	440	440	440	440
2. PV	317	414	515	515
3. EPR	329	417	507	507
4. EP	807	538	208	208
5. SERD	147	396	609	609
6. SERI	176	398	593	593
7. NUC	191	412	579	579
8. SV	298	426	518	518
9. CV	191	412	579	579
10. ACV1	191	412	579	579
11. ACV2	0	391	685	685

Finally, for EPR, it can be verified that the method does not satisfy MUL in general. See Table 9.11 for a case example with the cost function $C(S) = 350 \cdot |S|^2$ for $|S| \geq 2$ for game *v*. For game *w*, the cost function is defined as $C(S) = \gamma^{1-\eta} \cdot 350 \cdot |S|^2$ for $|S| \geq 2$. The quantities of the organizations in game *w* are multiplied with the factor $\gamma = 4$. Again, the steepness $\eta = 0.5$. The total savings of game *v* are 669 and the total savings of game *w* are $669 \cdot \gamma^{1-\eta} = 669 \cdot 4^{0.5} = 1,338$.

Table 9.11 MUL effects for two organizations

Method	Savings of organization				MUL	
	Game *v*		Game *w*			
	1 (10 items)	**2 (20 items)**	**1' (40 items)**	**2' (80 items)**	**1' / 1**	**2' / 2**
1. EA	335	335	669	669	2.00	2.00
2. PV	223	446	446	892	1.96	2.02
3. EPR	234	435	458	880	2.00	2.00
4. EP	815	–146	1631	–292	2.00	2.00
5. SERD	113	556	225	1113	2.00	2.00
6. SERI	188	481	377	961	2.00	2.00
7. NUC	335	335	669	669	2.00	2.00
8. SV	335	335	669	669	2.00	2.00
9. CV	335	335	669	669	2.00	2.00
10. ACV1	335	335	669	669	2.00	2.00
11. ACV2	335	335	669	669	2.00	2.00

9.9. A discrete stepwise quantity discount model

In a slightly different version of the cooperative purchasing model, we could assume for the price per item $p(q)$ that discounts are given stepwise: if $0 < q < k_1$, then $p(q) = p_0$, if $k_1 < q < k_2$, then $p(q) = p_1$, if $k_2 < q < k_3$, then $p(q) = p_2$, and so on.

Besides the disadvantages of a stepwise quantity discount model mentioned in Chapter 7, applying this price structure into our cooperative purchasing model leads to more disadvantages. This is illustrated by the following version of the case example with stepwise quantity discounts (see Section 9.4.11 for the original example): p_0 = 1,300, p_1 = 1,150, p_2 = 1,100, k_1 = 10 and k_2 = 50. So, $p(10)$ = 1,300, $p(15) = p(25) = p(35) = p(45)$ =

$p(50) = 1{,}150$, and $p(60) = 1{,}100$. Table 9.12 shows the savings, gains, and (compensation) costs when the grand purchasing group uses different allocation methods and applies a stepwise quantity discount model. In this table, we have only incorporated the simple methods and the sophisticated method that satisfies most properties associated with fairness for CP-games with costs in general.

Table 9.12 Allocations of the case savings with stepwise quantity discounts

Method	**Organization 1 (35 items)**			**Organization 2 (10 items)**			**Organization 3 (15 items)**		
	Savings	**Gains**	**Costs**	**Savings**	**Gains**	**Costs**	**Savings**	**Gains**	**Costs**
Simple method									
1. EA	1,054	1,500	(446)	1,054	1,500	(446)	1,054	1,500	(446)
2. PV	1,845	2,625	(780)	527	750	(223)	791	1,125	(334)
3. EPR	1,806	2,570	(764)	583	830	(247)	774	1,101	(327)
4. EP	1,304	2,084	(780)	1,554	1,777	(223)	304	638	(334)
Sophisticated method									
5. ACV2	781	1,285	(504)	1,436	1,929	(493)	945	1,286	(341)

A remarkable outcome is that most allocation methods allocate a larger amount to organization 2 (10 items) than organization 3 (15 items), because organization 3 could obtain some economies of scale on its own. Organization 2 cannot obtain this advantage on its own and by joining the group, more savings are generated for organization 2 than for organization 3. Of course, in practice, organization 2 could order 1 item more when buying on its own or could make a special deal with the supplier.

In general, none of the allocation methods handle the stepwise discounts concept well, which is confirmed by the following two tables. These tables give an overview of which methods satisfy which properties for this slightly different version of CP-games without and respectively with costs. The tables show that most methods do not satisfy most properties of fairness for CP-games with stepwise quantity discounts.

Table 9.13 Properties for CP-games with stepwise discounts without costs

Method	**EFF**	**SYM**	**DUM**	**IND**	**MUL**	**FRAV**	**STA**	**MON**	**CMON**	**SCMON**
Simple method										
1. EA	✓	✓	×	✓	✓	×	×	×	×	×
2. PV	✓	✓	×	✓	✓	×	×	×	×	×
3. EPR	✓	✓	×	✓	×	×	×	×	×	×
4. EP	✓	✓	×	✓	×	×	✓	×	×	×
Sophisticated method										
5. ACV2	✓	✓	×	✓	×	✓	×	×	×	×

Note: ✓ = satisfied in general, × = not satisfied in general, $\eta = 0.5$, and $v(N) \geq v(N / \{i\})$

Table 9.14 Properties for CP-games with stepwise discounts with costs

Method	EFF	SYM	DUM	IND	MUL	FRAV	STA	MON	CMON	SCMON
Simple method										
1. EA	✓	✓	×	✓	✓	×	×	×	×	×
2. PV	✓	✓	×	✓	✓	×	×	×	×	×
3. EPR	✓	✓	×	✓	×	×	×	×	×	×
4. EP	✓	✓	×	×	×	×	×	×	×	×
Sophisticated method										
5. ACV2	✓	✓	×	✓	×	✓	×	×	×	×

Note: ✓ = satisfied in general, × = not satisfied in general, $\eta = 0.5$, $v(N) > 0$, and $v(N) \geq v(N / \{i\})$

9.10. Which combinations of allocation methods lead to fair outcomes?

In this and the next section, we venture to answer the section questions by insights from the previous sections. It is not our aim to answer the questions by hard evidence.

Up to now, we only considered combinations of using the same gain and cost allocation methods as described in Section 9.4. In this section, we consider other combinations as well. Table 9.15 gives an overview of which combinations of gain and cost allocation methods can be used. The rows represent the gain allocation methods and the columns represent the cost allocation methods. For instance, if a purchasing group uses the EA to allocate the gains, then we advise to also use EA to allocate the costs.

Table 9.15 Recommended combinations of allocation methods

Gain method	Cost method							
	EA	PV	EPR	NUC	SV	CV	ACV1	ACV2
Simple method								
1. EA	✓	×	×	×	×	×	×	×
2. PV	×	✓	✓	×	×	×	×	×
3. EPR	×	✓	✓	×	×	×	×	×
4. EP	✓	×	×	×	×	×	×	×
Sophisticated method								
5. SERD	✓	×	×	×	×	×	×	×
6. SERI	✓	×	×	×	×	×	×	×
7. NUC	×	×	×	✓	×	×	×	×
8. SV	×	×	×	×	✓	×	×	×
9. CV	×	×	×	×	×	✓	×	×
10. ACV1	×	×	×	×	×	×	✓	×
11. ACV2	×	×	×	×	×	×	×	✓

Note: ✓ = possible combination, × = not advisable in general

The following criteria have been used in drawing up the table containing our advice:

- **Simple gain methods and sophisticated cost methods**
  The costs of a purchasing group are usually smaller than the gains; hence, it seems more important to use a theoretically relatively fair gain allocation method than a theoretically relatively fair cost allocation method. A disadvantage of theoretically fair methods is that they tend to be more sophisticated. Reasoning from above, when using a sophisticated method for the allocation of gains or costs, it seems reasonable to use a sophisticated method for the allocation of gains. Thus, we advice against a combination if the gain allocation method is simple and theoretically relatively unfair (from EA to EP) and the

cost allocation method is more sophisticated and theoretically relatively fair (from NUC to ACV2);

- **Sophisticated gain methods and sophisticated cost methods**
  We advice against a combination if the gain allocation method is sophisticated (from SERD to ACV2), the cost allocation method is also sophisticated (from NUC to ACV2), and the gain allocation method is not the same as the cost allocation method. For instance, we advice against using NUC as a gain allocation method and CV as a cost allocation method. We advice against such combinations as using two different sophisticated methods makes the allocation of gains and costs even more difficult than when using one sophisticated method. In addition, combining two different sophisticated methods reduces the theoretical fairness in general compared to using the same sophisticated method for the allocation of gains and costs. For instance, if the NUC gain method and the CV cost method are combined, then the combination loses, among other things, the property of IND in general.
  Combining sophisticated methods such as NUC or the (adapted) CVs with simple methods (from EA to EP) reduces the theoretical fairness as well. For instance, if the CV gain method and the EA cost method are combined, then the combination loses, among other things, the property of MON in general. Combining the PV or EPR gain allocation method with EA results in losing, among other things, the property IND in general. Therefore, we advice against such combinations;
- **Large and small organizations**
  As noted in Section 8.10, it does not seem to be fair if an organization receives a relatively small amount of the gains and has to pay a relatively large amount of the costs. Therefore, we advice against a combination when a larger organization may receive an equal or smaller amount than a smaller organization as a result of the gain allocation method (EA or EP, see also Fig. 8.3, Fig. 8.5, Fig. 9.5, and Fig. 9.6) and this organization has to pay a larger amount of the costs as a result of the cost allocation method (PV or EPR). This means that we advice combining the EP gain method with the EA cost method. The behavior of this combination is illustrated in Section 9.8.

Some remarks regarding Table 9.15 are the following. First, costs could also be read as efforts, meaning that using an EA cost allocation method implies that all organizations should make an equal effort for the purchasing group. For instance, each organization assigns a purchaser for an equal number of hours per week to the group. If an organization makes a greater effort for the group, then this organization could demand some form of reimbursement of expenses from the other organizations. Second, using EP can be a well thought-out choice for a purchasing group with equal sized organizations, because this method is easy to use.

9.11. Which combination to use in which situation?

In this section, we discuss which combinations of gain and cost allocation methods can be used in which situation. Among other things, we take into account the necessity for allocation methods for purchasing groups as indicated in the extended highway matrix in Fig. 4.1.

As a further refinement, we note that financial risks can play an important role as well. These risks depend, among other things, on the type of products and services purchased and on the purchasing volumes of the individual organizations compared to the total volume of the group. The financial risks of the different organizations are usually about the same in practice. However, if this is not the case, the risk of the organization with the highest financial risk can be taken.

Finally, we also make a distinction between purchasing groups with (all) organizations purchasing an (almost) equal or unequal volume through the group. To determine whether the volumes of (all) organizations are (almost) equal or unequal, one should compare the largest volume with the smallest volume of the different organizations.

For the following scenarios, we have determined which combination to use in which situation given the allocation methods from Section 9.4:

- **(Almost) equal volumes**
  We advise to use the EP gain method and the EA cost method in situations where the cooperating organizations' volumes are (almost) equal. In these situations, all allocation methods provide (almost) the same allocation results. Thus, the choice to use the easiest allocation methods is more or less obvious;
- **Unequal volumes, low necessity, and low financial risks**
  If the organizations' volumes are unequal, the indicated necessity for a formal allocation method is low (see Chapter 4), and financial risks are low, then we advice purchasing groups to use the EP gain method because of the ease of this method. EA can be used to divide the costs. Both allocation methods are easy to use, which suits the low necessity and low financial risks;
- **Equal volumes and a high necessity and/or high financial risks**
  The higher the financial risks and necessity, the higher the chances of purchasing group instability become. If the organizations' volumes are unequal and financial risks are high or the necessity is high, then we advise to use ACV2 (or a similar method) as this method is a theoretically fair allocation method. Using such a method may prevent groups becoming unstable. A disadvantage is that this method is more difficult to calculate.

Summarizing, in case of unequal purchasing volumes and a high necessity and/or high financial risks, we advice using the ACV2 (or a similar method). Otherwise, we advice using the EP gain method in combination with the EA cost allocation method[46].

9.12. Member sizes and group size

In this section, we make some remarks on the size of a purchasing group and on which organizations should cooperate. In contrast to what some of the partnership and alliance literature states (e.g., Hoffmann and Schlosser, 2001), it can be worthwhile adding small(er) organizations to a purchasing group when using an appropriate allocation method such as ACV2. Especially small organizations can profit from a purchasing group as they cannot create much economies of scale advantages on their own. Plus, practice shows that small

[46] Note that Table 6.10 in Section 6.4.4 suggests that this specific combination occurs often in successful purchasing groups. Remarkably, it is also suggested that groups with less uniform members more often combine the EP gain method with a proportional cost method than with the EA cost method.

organizations can usually learn more from larger organizations than the other way around (see also Chapter 6), creating more indirect saving possibilities for the small organizations. Of course, the savings created for and by the small organizations should be larger than the additional costs.

A simple conventional allocation method allocates most savings to the small organizations, because these methods fail to take into account the added value of the input of the (larger) organizations. When using a game theoretical method, the larger organizations can also profit from cooperating with small organizations.

9.13. Limitations

Before we draw conclusions on the basis of our analyses in the previous sections, we point out the main limitations of the research that should be taken into account. First, although the cost function $C(S)$ has been used in previous studies and seems to be a reasonable function, it lacks an empirical basis. Further research could investigate the actual costs that different purchasing group types make. In addition, further research could investigate the perceived importance of the properties of fairness. As we show in Chapter 10, some properties are perceived as more important than other properties.

Second, as mentioned in Chapter 8, we do not take into account other advantages of cooperative purchasing than financial gains. Other advantages, as political control over other organizations or obtaining knowledge from others, could compensate for unfairness.

Third, we studied a selection of allocation methods and properties of fairness. In further research, more methods and properties of fairness could be studied. More specifically, several scenarios could be sketched (e.g., all members differ strongly; one member differs strongly; some members are large and the other members are small; etc.) and for each scenario, it could be tested whether the properties of fairness are satisfied. In addition, if properties of fairness are not satisfied, then it could be tested to what extent the properties are not satisfied. Finally, a distinction could be made between properties of fairness that are perceived as (un)important by practitioners (see Chapter 10 for some analyses on this topic).

9.14. Conclusions

In this chapter, we build further on the link between cooperative purchasing and cooperative game theory. Cooperative gains, costs, and compensation costs have been analyzed using several allocation methods. Among other things, we note that the Equal Amount method favors small organizations and the Proportional by Volume method favors large organizations to a large extent. This is one issue we further explore in Chapter 10.

Regarding compensation costs, we conclude that for the non-game theoretical allocation methods, these costs are allocated likewise as normal costs. Game theoretical methods, such as the Nucleolus and the (Adapted) Compromise Values, do not treat compensation costs likewise as normal costs. These methods are more advantageous to organizations that do not have to be compensated for issues such as changing specifications or supplier preferences.

For all allocation methods, we analyzed whether they satisfy certain properties of fairness for CP-games without costs and for CP-games with costs. For both games, no allocation method satisfies all properties. Still, for CP-games without costs, most properties of fairness are satisfied for most methods. For CP-games with costs, the Adapted Compromise Value 2 satisfies most properties of fairness and is considered as a theoretically fair saving allocation method. Most of the other allocation methods lose most properties of fairness. The common Equal Price saving method (Equal Price gain method in combination with the Proportional by Volume cost method) loses most properties of fairness in general and is considered as a theoretically unfair saving allocation method, especially when group members are relatively dissimilar.

Remarkably, Section 6.4.4 suggests that purchasing groups with less uniform members more often combine the Equal Price gain allocation method with a proportional cost allocation method than with the Equal Amount cost method. We recommend using Equal Price in combination with the Equal Amount cost method in situations with (almost) equally sized organizations in a purchasing group and/or when the necessity for an allocation method is low and the financial risks are low. When organizations are unequally sized and the necessity or the financial risks are high, we recommend using the Adapted Compromise Value 2. When choosing another allocation method in such situations, it seems important that this is an intentional choice and that the organizations in a group are aware that problems could arise, such as STA and MON related problems.

Acknowledgements

We thank Govert Heijboer and Reinoud Joosten from the University of Twente for inspiring discussions of the content of parts of this chapter.

PART V

QUALITATIVE EMPIRICAL APPROACH

In this part of the thesis, we return to a qualitative empirical approach. We study the (perceived) fairness in allocation problems as this is indicated as an important issue in the previous parts of this thesis. Still, in the previous part, we have only studied the theoretical fairness of allocation methods. In this part, we empirically test and discuss theoretical fairness, perceived fairness, and perceived understanding in allocation problems.

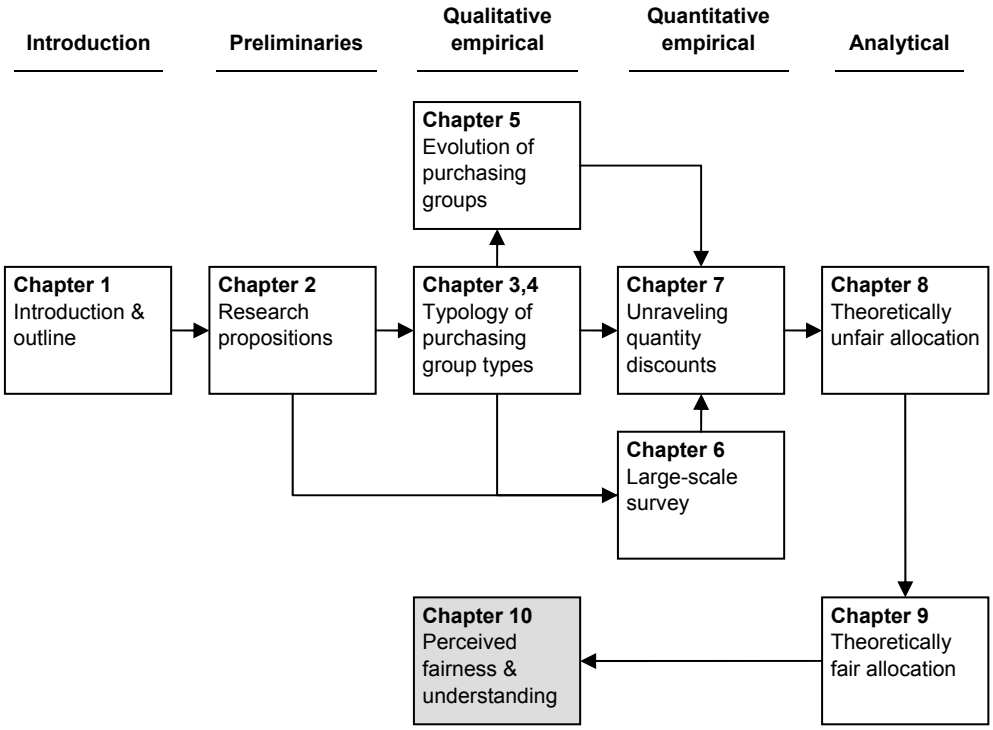

Fig. V.1 Research outline

Chapter 10

Perceived fairness and understanding

In the previous chapters, we have analyzed theoretical fairness and applied mathematical solutions to allocation problems. In this chapter, we add a social psychology perspective to our analysis. The chapter is summarized as follows.

We note that allocation problems occur often and theoretically fair allocation methods are used rarely. To obtain more insight into this issue, we have developed several practical steps for dealing with allocation problems. With these steps we studied allocation problems in purchasing groups using applied mathematics and social psychology.

In two small-scale studies, we found that it can be useful to verify axiomatic understanding and procedural understanding in case of an allocation problem. For purchasing groups, we also found that theoretically fair methods use logical, objective and sophisticated criteria for allocation. We note that theoretically fair methods are more sophisticated than theoretically unfair methods. Remarkably, the actual allocations of sophisticated methods are perceived as more unfair than the allocations of a simple proportional method.

To explain the difference described above, we discuss a pragmatic perspective based on equity theory. In terms of this perspective, we found that the actual allocations of a cooperative purchasing allocation method are perceived as fair if they tend towards proportionality by a reasonable, objective, and simple indicator. Finally, if a purchasing group wants to use a sophisticated allocation method, such as the theoretically fair Adapted Compromise Value 2, then it seems to be important to clearly explain the method and its implications to the group members. Otherwise, the method may not be well understood, which can have a negative effect on its perceived fairness.[47].

10.1. Introduction

Recently, two next-door organizations A and B decided to sell their organizations. The value of organization A amounted to € 4 million and the value of organization B amounted to € 2 million. Organization C showed interest in buying organizations A and B together for € 8 million. Despite or because of the surplus of € 2 million dissension arose between organizations A and B concerning the allocation of the surplus. The dissension that arose was so substantial that the sale for € 8 million to organization C was eventually cancelled.

The example above is perhaps exceptional, but allocation problems occur in all kinds of situations, that is, situations where one has to fairly allocate a certain amount of profits,

[47] Parts of this chapter are based on Schotanus, F., Telgen, J., Boer, L. de, 2006. How to solve an allocation problem? IPSERA conference proceedings, San Diego (United States).

costs or savings among two or more actors. In this chapter, we analyze allocation problems in purchasing groups.

As we illustrated in the example, allocation problems can occur even in mutualistic relationships. The same holds for mutualistic purchasing groups, especially in groups in which its members differ in terms like size or commitment. Due to such differences, it is often difficult to find fair solutions to allocation problems. Both applied mathematics and applied social psychology propose several allocation solutions to such problems.

In the next two sections, we briefly discuss these two perspectives on allocation problems. Subsequently, we explain our main research objective in more detail, which is to gain more insights into dealing with allocation problems by comparing both perspectives. Next, we describe our method and two case studies. In the final sections, we discuss the results, limitations, and conclusions.

10.2. An applied mathematical perspective

10.2.1. Theoretical realization and fairness

The analytical body of knowledge about mathematical and game theoretical solutions to allocation problems is large. Consequently, we already know several basic, game theoretical, and compensation allocation methods, such as the Compromise Value (Borm et al., 1992; Driessen, 1985), pay for performance (Aguinis, 2007), and contingent pay (Aguinis, 2007). A selection of allocation methods which are discussed in the previous chapters is described in Table 10.1. Based on the previous chapter, the table also roughly indicates the type of group members that benefit most of the method. Note that ACV2 satisfies most properties associated with fairness for CP-games with costs in general.

Table 10.1 Type of group members that benefit most of allocation methods

Allocation method	Type of group members that benefit most of the method
Proportional by Volume (PV)	Favors large members
Adapted Compromise Value 2 (ACV2)	Relatively neutral
Equal Price (EP)	Favors small members
Equal Amount (EA)	Favors small members to a large extent

As mentioned earlier, the theoretical fairness of allocation methods can be analyzed in terms of cooperative game theory. This can be done by assessing whether allocation methods satisfy one or more formal properties of fairness, which are described by, among others, Friedman (2003), Heijboer (2003), Moulin (2001), and Shapley (1953). In this chapter, we use four simple properties of fairness: Dummy (DUM), Fair Ranking Volume (FRV), Monotonicity (MON), and Stability (STA)[48]. These properties are relatively easy to understand and distinguish most allocation methods discussed in this chapter.

Note that several properties of fairness conflict and cannot be satisfied at the same time in specific situations (e.g., Herrero, 1999). As a result, it is theoretically impossible to satisfy all properties of fairness in different situations while using one allocation method. Thus, one theoretically fairest method for all allocation problems cannot exist. Note that this

[48] The properties or similar properties are discussed in Section 9.5.

corresponds to Arrow's (1950) impossibility theorem, which demonstrates that no voting system based on ranked preferences can possibly meet a certain set of reasonable criteria – so-called unrestricted domain, non-imposition, non-dictatorship, monotonicity, and independence of irrelevant alternatives – when there are three or more alternatives to choose from (Füssel, 2007). Fig. 10.1 summarizes the above discussion and represents the allocation process steps:

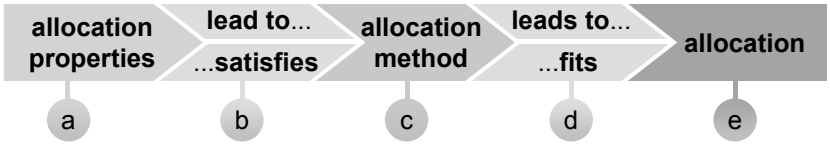

Fig. 10.1 Generic representation of the allocation process

Thus, we already know (a) numerous theoretical properties of fairness. We know (b) how to develop (c) theoretically fair allocation methods building on these properties. And we know (d) how to calculate (e) theoretically fair allocations using these methods. Steps (a), (c), and (e) deal with theoretical fairness. Steps (b) and (d) deal with theoretical realization, that is, how a previous step mathematically leads to a next step.

The two most popular allocation methods in the literature are the Shapley Value (SV) and the Nucleolus (NUC) (Meurer, 1999). Both methods are relatively sophisticated and are considered to be theoretically fair in various situations (Heijboer, 2003). Still, only a few real-life applications exist of NUC. SV has been applied in some real-life situations, like calculating political power (Shapley and Shubik, 1954), calculating landing and take-off fees for airports (Littlechild and Thompson, 1977), and allocating railway infrastructure costs (Fragnelli et al., 2000). Still, the application of SV has been very limited.

10.3. An applied social psychological perspective

Within social psychology, two concepts are related to allocation problems. These are defined as perceived understanding and perceived fairness. We discuss both concepts in the next sections.

10.3.1. Perceived understanding

Perceived understanding refers to whether or not a person understands how a step in an (allocation) process leads to a next step. Thus, perceived understanding is the psychological counterpart of theoretical realization. We assume that the more sophisticated an allocation problem and/or allocation method is, the more difficulties may arise concerning the perceived understanding of allocation methods (based on Walker and Wooldridge, 1995). With sophistication, we refer to cognitive psychology by looking at how complicated allocation problems and allocation methods are from the perspectives of all those involved (Funke, 1998). For instance, if the number of operations required in a method is high, then this method is typically perceived as sophisticated.

Perceived understanding can be positively influenced by increased knowledge. Nevertheless, in practice, it might be difficult to positively influence the perceived understanding of sophisticated allocation problems and methods.

Finally, we note that the perceived understanding of an allocation method might influence the perceived fairness of this method. If it is not clearly understood how a method works, then the outcome might be perceived as unfair (based on Kim and Mauborgne, 1993; Leventhal, 1980).

10.3.2. Perceived fairness

Usually, several decisions have to be taken within the steps of an allocation process. Examples of such decisions are determining which allocation methods to compare and how to involve all those concerned. Mainly based on empirical research, numerous authors have proposed solutions to perceived unfairness of decisions in allocation problems. They suggest that the perceived fairness of decisions concerns three aspects (e.g., Tax et al., 1998):

- Procedural fairness (Thibaut and Walker 1975; Leventhal, 1980): how are the decisions made (Tang and Baldwin, 1996)?
- Distributive fairness (Thibaut and Walker 1975; Alexander and Ruderman, 1987): what are the decisions (Tang and Baldwin, 1996) and/or how do the decisions affect me and my comparable others (Xia, 2004)?
- Interactional fairness (Bies and Moag, 1986; Tax et al., 1998): how are the decisions presented and implemented (Hoffman and Kelly, 2000)?

The body of knowledge about how people perceive the fairness of procedures and its outcomes is large (Alexander and Ruderman, 1987; Bolton et al., 2005; Kagel and Roth, 1995). Consequently, we know that the aspects of perceived fairness interact in complex ways (Skarlicki and Folger, 1997). In addition, it is widely accepted that the perceived fairness of decisions can be positively influenced if (Folger and Konovsky, 1989; Johnson et al., 1997; Kim and Mauborgne, 1993; Leventhal, 1980; Moorman, 1991; Tang and Baldwin, 1996):

- There is two-way respectful communication between all those concerned;
- The procedures are applied consistently and accurately;
- The procedures are correctable, ethical, and bias is suppressed;
- All those concerned may express concerns and influence the procedures;
- All those concerned are familiar and well-informed with the situation, with the procedures, and the procedure outcomes.

In addition, perceived fairness of decisions can be positively influenced if:

- The actual received allocations exceed the expected allocations (Crosby, 1976);
- The ratio of inputs and outputs of those concerned equals the inputs and outputs of comparable others (Adams, 1965);
- Revenue management research suggests that the perceived fairness of pricing can be positively influenced by framing (Kimes, 2003; Kimes and Wirtz, 2004), that is, the presentation of economic equivalent prices as a gain or loss. We suggest that the same effect applies to allocation problems. Thus, in mutualistic relationships, the emphasis should be placed on the fact that all participating organizations gain by cooperating. An emphasis on some organizations receiving fewer gains than the others should be prevented. In other words, in a purchasing group, the presentation of group savings in stead of individual savings can positively influence the perceived fairness of an allocation method.

The perceived fairness of an allocation method might differ between individuals as we illustrated in the example in the beginning of this chapter. Dooms and Oijen (2005) note that perceived unfairness in organizations may lead to frustration, noncompliance with rules and procedures, negative evaluations of superiors, negative influence on the quality of decisions and their implementation, distrust, low quality of work life, sabotage, low commitment to the organization, and poor performance (Cropanzano and Randall, 1993; Folger and Konovsky, 1989; Kim and Mauborgne, 1998; Lind and Tyler, 1988). In addition, perceived unfairness by individuals in allocation problems tends to lead to reactions of these individuals to restore fairness in terms of equity theory (Adams, 1963; Adams, 1965). Some individuals are even willing to impose a cost – both on self and others – to resist perceived unfairness (Greenberg, 1990).

10.4. Specific research objectives

The previous sections have argued that the analytical body of knowledge about theoretically fair allocation solutions is large. They have also argued that the body of knowledge about influencing perceived fairness is large. Still, allocation conflicts occur often and we cannot fully explain that despite frequent allocation conflicts due to perception differences, theoretically fair allocation methods are rarely used.

Therefore, it is our main objective to obtain more insights into effectively dealing with allocation problems. We do this by comparing theoretical fairness and realization to perceived fairness and understanding in several steps of the allocation process (see Fig. 10.2). A new aspect of our study is that we compare the two different perspectives on allocation problems.

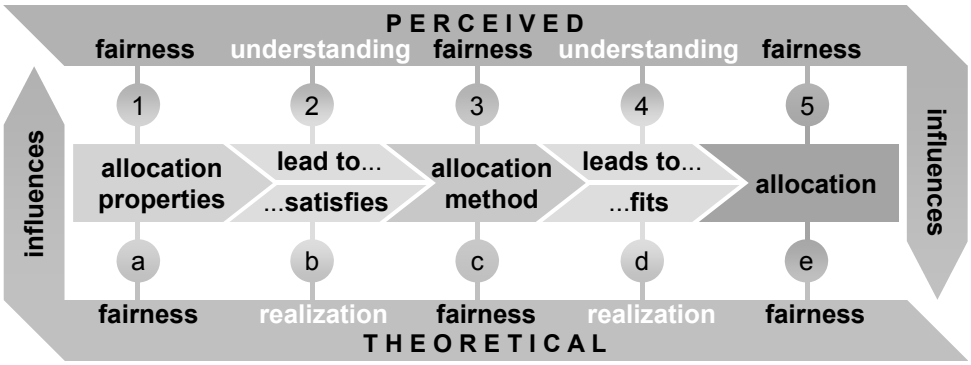

Fig. 10.2 Applied mathematics and social psychology in the allocation process

As mentioned before, in this chapter we analyze a typical allocation problem in a purchasing group. Five specific objectives are linked to cooperative purchasing. In cooperative purchasing, it is currently not known:

Step (1a): What the perceived fairness is of allocation methods based on the perceived importance of properties of fairness in terms of cooperative game theory;

Step (2b): Whether it is perceived that an allocation method satisfies certain properties of fairness. For instance, it might be that practitioners think that a method satisfies a property of fairness, but that it can be proven theoretically that this is false;

Step (3c): Whether (un)fair allocation methods in terms of cooperative game theory are perceived to be fair in practice as well;
Step (4d): Whether it is perceived that the allocation of a method is perceived as fair as the corresponding method. For instance, it might be that practitioners perceive a certain method as fair, but perceive the matching allocation as unfair;
Step (5e): Whether the actual allocations of theoretically (un)fair allocation methods are perceived to be (un)fair as well.

To achieve our research objectives, two studies were conducted. One study in which responses of individuals involved in a purchasing group were included (Study 1) and the other study in which responses of groups of individuals were included (Study 2).

The chapter is written in the context of theory development. Therefore, we carried out qualitative small-scale studies to be able to obtain a better understanding of allocation processes. We do use quantitative measures and quantitative survey data in both studies, but the data is only used to support our qualitative results. It is not our ambition to find significant differences.

10.5. Method

In this section, we discuss the methodology which we used to achieve our objectives. First, we describe the participants and research procedure of Study 1. Next, we develop the measures used in Study 1 and 2 and integrate those with the procedures. Finally, we describe the participants and procedure of Study 2.

10.5.1. Study 1

In Study 1, responses of individuals involved in one purchasing group are included. We constructed this study this way to obtain insights in the views of different individuals on an allocation problem. The study is conducted within the public health sector and focuses on cooperative purchasing issues.

10.5.2. Participants Study 1

The heads of purchasing of nine medical organizations – the nine members of one purchasing group – are involved in Study 1. The group has been active for more than 14 years, is well-known in the public sector in its homeland, and is considered an example of successful cooperative purchasing. The group booked plenty purchasing savings, employs one full time independent manager, and has several cooperative contracts. Nevertheless, the cooperating organizations are not always at ease with the situation. The added value of cooperating is sometimes a discussion point, as is the allocation of gains. For this reason, we chose this group as our first object of analysis.

The allocation of the group's gains is difficult because the cooperating organizations differ from each other objectively (e.g., differences in purchasing volume) and subjectively (e.g., professional level of the purchasing function, commitment, and level of involvement). See Table 10.2 for some quantitative properties of the organizations. Large organizations often have a somewhat higher professional level of the purchasing function. Differences in commitment and level of involvement are not clearly determined by the size of an

organization. Both small and large organizations can have a somewhat higher or lower level of involvement.

Table 10.2 Size of the participating organizations

Size	Organization	Annual purchasing in million €	% Annual purchasing	Number of beds	Annual purchasing in € per bed
Relatively large	1	55.0	21%	881	62,429
	2	54.0	21%	712	75,843
	3	40.6	16%	617	65,802
Medium	4	28.8	11%	600	48,000
	5	23.0	9%	390	58,974
	6	21.5	8%	359	59,889
Relatively small	7	12.0	5%	275	43,636
	8	11.5	4%	187	61,497
	9	9.5	4%	140	67,857
Total		255.9	100	4,161	

Recently, two large organizations left the group. To prevent more organizations leaving, the gain allocation method was brought up for discussion. The gains were usually allocated with EP, that is, all organizations pay the same price per item. However, this method was perceived as unfair by relatively large organizations with an average annual procurement of more than € 50 million. For this reason, a new method called Differential Pricing (DP) was tested in one tender. This method implies that all organizations receive a small fixed discount percentage. On top of that, larger organizations receive a larger extra discount percentage. DP was however perceived as unfair by relatively small organizations with an average annual procurement of less than € 11 million.

10.5.3. Procedure Study 1

We first carried out interviews with two key stakeholders to improve our understanding of the allocation problem. Based on these interviews and secondary data, such as internal reports, we built a draft questionnaire with a mix of question types. The questionnaire was first sent to a focus group to test the questions. Based on the comments of the focus group, we paid special attention to the clear explanation of properties of fairness and allocation methods. The final questionnaire was filled in by all nine organizations and consisted of three parts:

Part (1): The first part consisted of some general questions;

Part (2): The second part consisted of questions related to two contracts of the group. For both contracts, we provided several allocations of gains, but we did not provide information on which allocation methods were used. For all different allocations, the respondents were asked to indicate whether they perceived the allocation as fair. We also asked the respondents to explain their choices. One of the respondents did not fill in part 2. These missing values were excluded listwise from our analysis;

Part (3): The third part consisted of questions related to the perceived importance of several properties of fairness. In addition, we asked whether properties of fairness are perceived as realized for the purchasing group for the well-known EP method. Finally, we asked whether several allocation methods are perceived as fair. Again, we also asked the respondents to explain their choices.

The next phase of our study consisted of sending a report of a theoretical analysis of allocation problems to all the respondents. We sent this report in order to increase their knowledge on fairness properties and allocation methods. The final phase consisted of a discussion of our findings at a workshop with all respondents. During the entire study, there was frequent contact with the key stakeholders to discuss the allocation problem.

10.5.4. Measures Study 1 and 2

Perceived Fairness. Distributive fairness (see step 5e in Fig. 10.2) and procedural fairness (step 3c) are both measured directly on scales ranging from 1 (very unfair) to 5 (very fair). Axiomatic fairness (step 1a) cannot be measured directly as it consists of several properties of fairness. For this reason, we developed an indirect measure for axiomatic fairness.

We measure axiomatic fairness by taking into account the perceived importance of properties of fairness. The importance of the properties perceived by the respondents is measured on a scale ranging from 1 (very unimportant) to 5 (very important). We state that a method is axiomatically fairer than another method if it satisfies more properties of fairness that are perceived as important. Note that one general mark for the axiomatic fairness of a method cannot exist as the perceived importance of properties of fairness may differ per situation.

As a measure for axiomatic fairness, we assign a 5 (very fair) to a method that theoretically satisfies all properties used. We assign a 1 (very unfair) to a method that theoretically satisfies none of the properties used. For the methods k in between, we calculate the axiomatic fairness af_k by taking into account the average perceived importance API_p of each allocation property p for m properties. The variable s_{kp} has a value 1 or 0 if property p is satisfied or not satisfied in theory by method k for the purchasing situations of the group. We formulate af_k as:

$$af_k = 1 + \frac{4 \cdot \sum_{p=1}^{m} \left(s_{kp} \cdot API_p \right)}{\sum_{p=1}^{m} API_p} \qquad \textbf{(10.1)}$$

Although there are some issues regarding multiplicative scores (Trauer and Mackinnon, 2001), importance weight factors can be useful and valid (Hsieh, 2003). Nevertheless, as similar means can be obtained by different combinations of API_p and s_{kp} scores, we have to be cautious by interpreting the means of multiplicative scores (Trauer and Mackinnon, 2001).

Note that we could also have used the individual scores in stead of the average scores API_p. Still, both measures lead to about the same results. The results of both measures deviate by less than 2%, which is comparable to differences due to round-off in our study.

Similarities in Distributive Fairness. The allocation produced by a method could be perceived as fair in one situation, but in another situation, the same allocation could be perceived as unfair (step 5e). To measure such an effect, we asked the respondents for the perceived fairness of six allocations for two different contracts. We did not provide

information on which six allocation methods were used to calculate the allocations. For both contracts, the same total amount of gains was allocated among the organizations. The only difference between the contracts concerned the used quantity discount price function (i.e., a derived function from quantity discount schedules. This difference has implications for which organization adds most value to a group (see Chapter 7).

We state that perception similarities are higher if the differences between the perceived fairness of the allocations are lower. As a measure, we assign a 5 (very high) if there are no differences. We assign a 1 (very low) if the differences are maximal. For the methods k in between, we formulate perception similarities ps_k in distributive fairness between the first contract DF_{ik1} and the second contract DF_{ik2} for each organization i for n organizations as:

$$ps_k = 5 - \frac{\sum_{i=1}^{n} \left| DF_{ik1} - DF_{ik2} \right|}{n} \qquad \textbf{(10.2)}$$

Although difference scores have been used widely, polynomial regression is often preferred over using difference scores (Edwards, 2001). However, as mentioned earlier, it is not our ambition to find significant differences. In addition, for some other exploratory studies, difference scores have been regarded as appropriate (e.g., Lubatkin et al., 1999). Still, our results can only survive an initial screening and may merit further research using more sophisticated analytical methods (Edwards, 2001) and larger samples.

Perceived Understanding. We developed two measures for perceived understanding. The first measure concerns procedural understanding. This measure refers to whether a respondent understands the results of an allocation method (step 4d). For this measure, we compare distributive fairness with procedural fairness, which are both measured directly in our studies. We chose an indirect measure for procedural understanding to reduce the number of questionnaire questions.

We state that procedural understanding is higher if differences are lower between procedural fairness and distributive fairness. As a measure, we assign a 5 (very high) if there are no perception differences, that is, a method is perceived as fair and its allocation is also perceived as fair. We assign a 1 (very low) if the differences are maximal, that is, a method is perceived as very unfair, but its allocation is perceived as very fair. For the methods k in between, we calculate the procedural understanding pu_k by comparing the procedural fairness PF_{ik} with the distributive fairness DF_{ik} for each organization i for n organizations. We formulate pu_k as:

$$pu_k = 5 - \frac{\sum_{i=1}^{n} \left| PF_{ik} - DF_{ik} \right|}{n} \qquad \textbf{(10.3)}$$

The second measure for perceived understanding concerns axiomatic understanding. This measure refers to whether a respondent understands which properties of fairness are theoretically satisfied by an allocation method (step 2b).

We state that axiomatic understanding is higher if differences between theoretical satisfaction and perceived satisfaction are lower. As a measure, we assign a 5 (very high) if there are no differences between theory and perception, that is, all properties are satisfied in theory and are also perceived as satisfied. We assign a 1 (very low) if the differences are maximal, that is, no properties are satisfied in theory, but all are perceived as satisfied. For the methods k in between, we calculate the axiomatic understanding au_k by comparing the theoretical satisfaction with the average perceived satisfaction APS_{kp} of each allocation property p for m properties. Perceived satisfaction by the respondents is measured on a true (1) or false (0) scale with a 'do not know' option (0.5). The variable s_{kp} has a value 1 or 0 if property p is satisfied or not satisfied in theory by method k for the purchasing situations of the group. We formulate au_k as:

$$au_k = 5 - \frac{4 \cdot \sum_{p=1}^{m} \left| s_{kp} - APS_{kp} \right|}{m} \qquad \textbf{(10.4)}$$

Similar tests of understanding have been carried out by Jasien and Oberem (2002) and Behr et al. (1985) in educational journals. These authors also compared differences between right and wrong answers. Again, note that we could also have used the individual scores in stead of the average scores APS_{kp}. Nevertheless, both measures lead to the same results.

10.5.5. Procedure and measures integrated for Study 1 and 2

We developed several steps for dealing with allocation problems (see Fig. 10.3). These steps integrate the procedures and measures discussed in the previous sections.

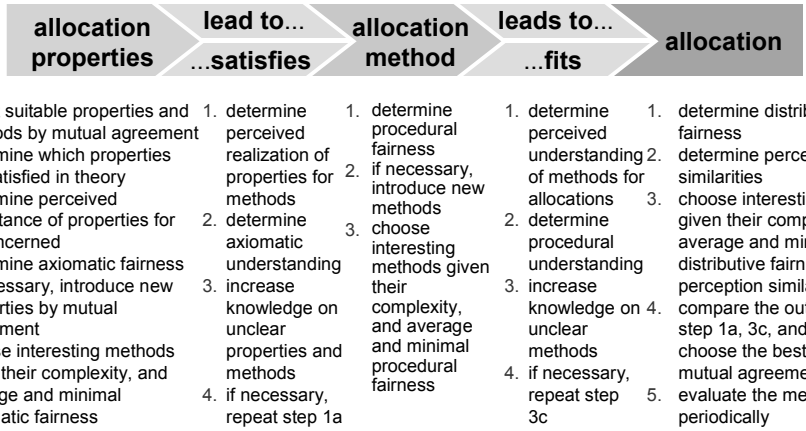

Fig. 10.3 Several steps for dealing with allocation problems

Among other things, the steps imply that all those concerned in the allocation problem are familiar with the situation, understand it, and are involved in the complete allocation process. In this way, interactional, distributive, procedural, and axiomatic fairness are enhanced. The steps took the respondents about three hours for filling in the questionnaire, explaining their motivations, reading relevant materials, and attending a workshop.

10.5.6. Study 2

In Study 2, responses of groups of individuals are included. We constructed this study this way to obtain insights in the views of more groups on an allocation problem.

10.5.7. Participants Study 2

A total of 48 purchasers and purchasing managers from 10 different universities are involved in our study. All respondents are members of the same purchasing group. Although the group has fewer joint contracts than the group in Study 1, it is considered as successful by its members.

We chose this group as our second object of analysis because all persons involved are experienced in cooperative purchasing. Just like the group in Study 1, this group has members which differ from each other in terms of size and the professional level of the purchasing function.

10.5.8. Procedure Study 2

To be able to compare Study 1 with Study 2, we developed a fictional case study. The group described in this case study is similar to the group in Study 1. It also has a gain allocation problem (costs are omitted) and it has large, medium, and small members which differ from each other (see Table 10.3). Compared to Study 1, we reduced the number of organizations to six. We did this to simplify the case study.

Table 10.3 Size of the fictional case study organizations

Size	Organization	% Annual purchasing through the group
Relatively large	1	30
	2	30
Medium	3	15
	4	15
Relatively small	5	5
	6	5
Total		100

The 48 respondents attended a conference at the beginning of 2006. As part of this conference, the respondents were divided in eight groups. These groups consisted of different universities. All groups were asked to fill in a similar questionnaire as the questionnaire used in Study 1. The questionnaire was based on the case study we developed. To reduce the number of questions in our questionnaire, we left axiomatic understanding (step 2b) out of it. We only measured axiomatic fairness, procedural fairness, and distributive fairness for one contract. Note that the measures used in this study are the same measures as used in Study 1.

10.6. Perceived fairness and understanding

In this section, we discuss the outcomes of Study 1 and 2 by using the five main steps described in Fig. 10.2 and Fig. 10.3 as a connecting thread. We discuss axiomatic fairness and understanding, procedural fairness and understanding, and distributive fairness.

10.6.1. Step 1a: Axiomatic fairness

For this first step in the allocation process, we asked the respondents for the perceived importance of several properties of fairness. In Table 10.4, we show the average perceived importance of these properties. The table also shows whether the properties of different methods are theoretically satisfied for the purchasing situations of the group. There were not many differences between the scores of the individual respondents, which enabled us to use the multiplicative axiomatic fairness measure. The allocation methods are ranked by axiomatic fairness, that is, the perceived fairness of allocation methods based on their properties of fairness. Overall, ACV2 is considered as the fairest and relatively least sophisticated method. The simple methods EP and PV are relatively fair alternatives.

Table 10.4 Axiomatic fairness

Property of fairness	**Average perceived importance Study 2**	**Average perceived importance Study 1**	**EA**	**EP**	**PV**	**ACV2**
STA	4.0	4.4	×	✓	×	✓
FRV	3.8	4.0	×	×	✓	✓
DUM	3.1	4.2	×	✓	✓	✓
MON	3.6	3.3	✓	×	✓	✓
Axiomatic fairness Study 2			2.0	3.0	3.9	5.0
Axiomatic fairness Study 1			1.8	3.2	3.9	5.0

Note: ✓ (×) means theoretically (not) satisfied for purchasing situations of the group; the 2nd and 3rd column are measured on a five point Likert scale from 1 (not important) to 5 (very important); the final two rows are measured on a five point Likert scale from 1 (very unfair) to 5 (very fair); $n = 8$ for Study 2; $n = 9$ for Study 1

The property STA is perceived as the most important one in both studies. The respondents do acknowledge that the most important property of fairness should be that all differences between the cooperating organizations are taken into account. However, the respondents indicated that it is subjective and not pragmatic to take into account differences related to the professional level of the purchasing function, commitment, and level of involvement.

10.6.2. Step 2b: Axiomatic understanding

For the second step, we asked the respondents which properties of fairness are satisfied by the well-known EP method. In Table 10.5, we compare the method's theoretical realization with the average perceived realization of the respondents. In addition, the factor axiomatic understanding is given. This factor indicates how well the respondents understood the relationship between the fairness properties and the allocation method. For the factor, we did not expect nor found differences between different groups of respondents.

The table shows that it is not well understood which properties of fairness are satisfied by EP. For instance, several respondents thought that the method satisfies FRV in general, while it does not in theory.

Table 10.5 Axiomatic understanding

Property of fairness	Theoretical realization	Average perceived realization Study 1
STA	1	0.4
FRV	0	0.6
DUM	1	0.3
MON	0	0.9
Axiomatic understanding Study 1		2.1

Note: The 3rd column is measured on a true (1) or false (0) scale with a 'do not know' option (0.5); the final row is measured on a five point Likert scale from 1 (very low) to 5 (very high); $n = 9$

10.6.3. Step 3c: Procedural fairness

For the third step, we asked the respondents for the perceived fairness of several allocation methods. This concerns a direct measurement of procedural fairness. In Table 10.6, we show the average procedural fairness for different groups of organizations.

The respondents indicated that an ideal allocation method combines purchasing volume, professional level of the purchasing function, commitment, and level of involvement. However, the respondents indicated that such a method would not be pragmatic.

The respondents perceive PV on average as the fairest method. In addition, this method has a relatively high minimum score when considering the different groups in Study 1. The respondents indicated choosing this method because it takes some mutual differences proportionally into account in a simple manner.

A theoretically fair method as ACV2 is perceived as relatively unfair in both studies. This despite the fact that this method takes some mutual differences proportionally into account as well. However, the method was perceived as too difficult by most of the respondents.

Perception differences between different groups of organizations – which are mentioned in the participants section of Study 1 and in Table 10.1 – were confirmed in Study 1: as expected, small (large) organizations dislike (like) PV. Mathematically, this method favors larger organizations. As expected, large (small) organizations dislike (like) EP and EA. Mathematically, these methods favor smaller organizations.

Table 10.6 Procedural fairness

Allocation method	Average procedural fairness		Average procedural fairness by size		
	All groups Study 2	All org. Study 1	Large org. Study 1	Medium org. Study 1	Small org. Study 1
EA	1.6	2.1	2.0	1.0	3.3
EP	3.6	3.8	3.0	4.0	4.3
PV	4.3	3.8	4.0	4.7	2.7
ACV2[a]	3.3	2.7	–[b]	–	–

Note: The columns are measured on a five point Likert scale from 1 (very unfair) to 5 (very fair); $n = 8$ for Study 2; $n = 3$ for large organizations; $n = 3$ for medium organizations; $n = 3$ for small organizations

[a] As mentioned earlier, we left the most sophisticated methods out of one of the studies

[b] We did not expect nor found large differences between different groups of organizations (see also Table 10.1)

10.6.4. Step 4d: Procedural understanding

For the fourth step, we compared procedural fairness and distributive fairness. In this way, we tested how well the respondents understood the relationship between the allocation method and its allocations. In Table 10.7, we show the procedural understanding of several methods for Study 1 and 2. The simplest methods EA and PV are well understood in both studies. The more sophisticated methods EP and ACV2 are fairly understood.

Table 10.7 Procedural understanding

Allocation method	**Average procedural understanding**	
	Study 2	**Study 1**
EA	4.8	4.4
EP	3.5	3.3
PV	4.1	4.3
ACV2	3.6	3.4

Note: The columns are measured on a five point Likert scale from 1 (very low) to 5 (very high); $n = 8$ for Study 2; $n = 8$ for Study 1

10.6.5. Step 5e: Distributive fairness

For the fifth step, we asked the respondents to indicate the perceived fairness of the actual allocations of two contracts, which concerns distributive fairness. In Table 10.8, we show the average distributive fairness of the most common contract. The final column shows perception similarities between the two contracts.

Remarkably, clear differences between the different groups in Study 1 are not found. Another remarkable outcome is that the allocations of ACV2 – a theoretically fair method – are perceived as unfair. The allocations of a theoretically less fair method as PV are perceived as fair. Most of the respondents indicated that they searched for proportionality by a simple indicator in the allocations.

EP is perceived inconsistently with a low similarity score. When using a linear quantity discount price function, the method is perceived as fair, but when using a curved function, the method is perceived as unfair. Dooms and Oijen (2005) note that some researchers claim that inconsistent methods increase the likelihood of perceived unfairness (e.g., Leventhal, 1980). Note that in case of a linear price function, EP behaves like PV.

Table 10.8 Distributive fairness of allocation methods

Allocation method	**Average distributive fairness**		**Average distributive fairness by size**			**Average perception similarities**
	All groups Study 2	**All org. Study 1**	**Large org. Study 1**	**Medium org. Study 1**	**Small org. Study 1**	**Study 1**
EA	1.5	1.5	2.0	1.0	1.5	4.9
EP	2.0	2.0	2.0	2.0	2.0	1.9
PV	3.8	4.1	4.0	4.3	4.0	4.8
ACV2	3.1	2.0	–[a]	–	–	4.3

Note: The distributive fairness columns are measured on a five point Likert scale from 1 (very unfair) to 5 (very fair); The final column is measured on a five point Likert scale from 1 (very dissimilar) to 5 (very similar); $n = 8$ for Study 2; $n = 3$ for large organizations; $n = 3$ for medium organizations; $n = 3$ for small organizations

[a] We did not expect nor found large differences between different groups of organizations (see also Table 10.1)

10.6.6. Perceived fairness recapitulated

PV scored best on average in the different allocation steps in our studies (see Table 10.9, Fig. 10.4, and Fig. 10.5). The method lies in between EP and DP when looking at favoring respectively small or large organizations in general. As mentioned before, EP is perceived as fair by small organizations and DP is perceived as fair by large organizations in Study 1.

A disadvantage of PV is that it does not satisfy STA in general, which is an important fairness property. ACV2 is a theoretically fairer alternative, but this method and its allocations are not perceived as very fair by the respondents. EP is a simple alternative, but it is less fair theoretically. In addition, the method is inconsistent, what means that it can lead to fair allocations in one situation and to unfair allocations in another situation.

Table 10.9 Perceived fairness of allocation methods summarized

Properties and allocation methods[a]	**EA**		**EP**		**ACV2**		**PV**	
	Study 2	**Study 1**	**Study 2**	**Study 1**	**Study 2**	**Study 1**	**Study 2**	**Study 1**
STA		×		✓		✓		×
FRV		×		×		✓		✓
DUM		×		✓		✓		✓
MON		✓		×		✓		✓
Axiomatic fairness	2.0	1.8	3.0	3.2	5.0	5.0	3.9	3.9
Procedural fairness	1.6	2.1	3.6	3.8	3.3	2.7	4.3	3.8
Distributive fairness	1.5	1.5	2.0	2.0	3.1	2.0	3.8	4.1

Note: ✓ (×) means theoretically (not) satisfied for purchasing situations of the group; fairness is measured on a five point Likert scale from 1 (very unfair) to 5 (very fair); $n = 8$ for Study 2; $n = 9$ for Study 1

[a] The allocation methods are ranked by the extent in which they favor large organizations

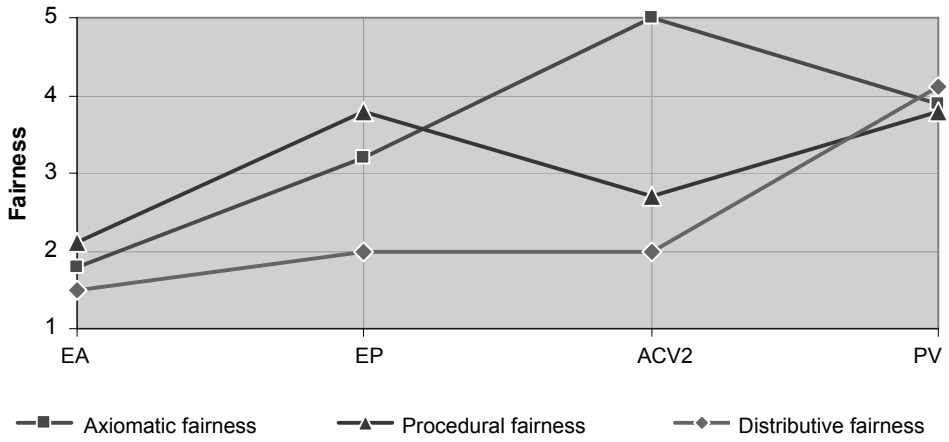

Fig. 10.4 Allocation methods and different measures of fairness for Study 1

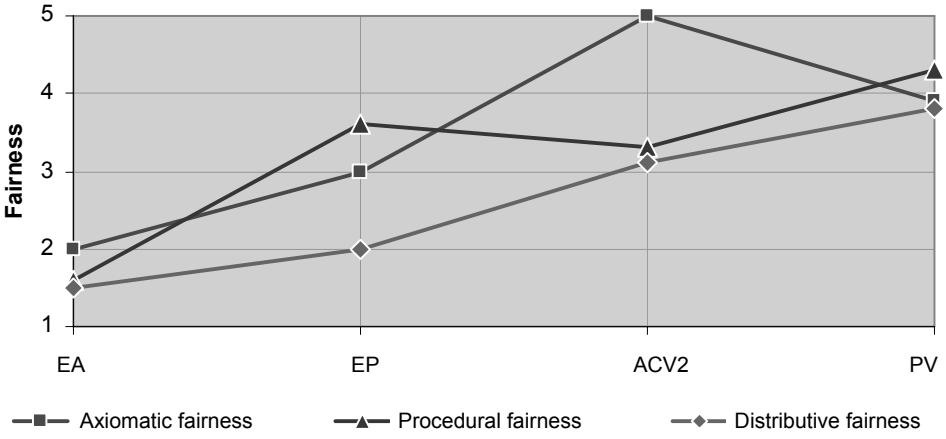

Fig. 10.5 Allocation methods and different measures of fairness for Study 2

10.7. Discussion and implications

In Section 10.6, we found some differences between the different measures of fairness (see Table 10.9, Fig. 10.4, and Fig. 10.5). In this section, we discuss these differences and some issues related to sophistication, proportionality, and stability. We conclude the section by discussing the implications of our findings.

10.7.1. Differences between Equal Amount and Proportional by Volume

In Section 10.6, we found some differences when comparing the fairness measures of the different allocation methods. For instance, compared to PV, EA is perceived as an unfair method. All three fairness measures score much higher for PV than for EA.

We explain the differences between EA and PV as follows. The methods and the actual allocations of the methods (i.e., the implications of the methods) are perceived as simple and are well understood by the respondents. In this case, we argue that the only important distinguishing properties between the methods are the methods' mathematical properties. Therefore, we explain the fairness differences between the methods by these mathematical properties.

10.7.2. Differences between fairness measures for the Adapted Compromise Value 2

For ACV2, we found a high theoretical fairness in Section 10.6. For instance, the allocation method satisfies more properties of fairness than PV. Nevertheless, ACV2 has a relatively low procedural fairness and distributive fairness in our studies.

We explain the differences between the fairness measures due to the fact that the respondents perceive ACV2 as sophisticated and do not understand the implications of the method well. We argue that this has negative effects on the procedural fairness and distributive fairness.

The argument above is confirmed by the literature (Kim and Mauborgne, 1993; Leventhal, 1980) in that the respondents perceive a method as less fair if they are not sure what the

method's outcomes are. This notion was confirmed by the respondents in our study during the workshop, which was organized to discuss the questionnaire outcomes.

10.7.3. Differences between fairness measures for Equal Price

In Section 10.6, we also found some differences between the different measures of fairness for EP. For EP, we found a relatively low distributive fairness compared to the theoretical fairness and procedural fairness.

We explain the relatively high procedural fairness (compared to the distributive fairness) due to the fact that EP seemed reasonable, objective, and simple to the respondents. Nevertheless, the implications of EP were not well understood. Thus, although the principle behind the method seemed simple to the respondents, the actual functioning of the method was perceived as sophisticated (compared to EA and PV). Similar to the arguments used in Section 10.7.2, we explain the relatively low distributive fairness due to the perceived sophistication of the implications of EP.

10.7.4. Sophistication dilemma

The balance between sophistication and theoretical fairness of an allocation method is related to what we call the sophistication dilemma. Some allocation methods satisfy the same properties of fairness as other methods and satisfy some extra properties as well. Those methods are theoretically fairer than the others, that is, those have a higher axiomatic fairness. However, theoretically fairer allocation methods tend to be more sophisticated and therefore, there is a sophistication dilemma in which a comparative assessment of sophistication and theoretical fairness seems to be made by the respondents. For instance, our research suggests that although ACV2 is theoretically fair, it is usually considered as sophisticated and not well understood, which has a negative effect on the perceived procedural and distributional fairness of the allocation method.

10.7.5. Proportionality

Even for assessing the fairness of the actual allocations of the allocation methods, the respondents looked for proportionality by a reasonable, objective, and well understood indicator. The respondents reasoned that if an organization purchases x% of the total purchasing volume of a group, then it should also receive x% of the total gains. Indeed, we found that PV is perceived as the fairest method. The distributional fairness of the other methods – including the sophisticated ones – decreases steadily when the methods deviate more from PV.

The notion above provides a pragmatic perspective on equity theory. Equity theory states that allocations are perceived as fair if the ratio of inputs and outputs of those concerned equals the inputs and outputs of comparable others. Indeed, this is true in an ideal situation. However, in our studies, some level of pragmatism is accepted by the respondents. The respondents do acknowledge that some sophisticated methods – such as ACV2 – are fairer in terms of equity theory. They also acknowledge that in an ideal allocation, all important mutual differences are taken into account. However, according to the respondents, this is difficult and subjective. Therefore, they settle for a reasonable, objective, and well understood proportional indicator. As a result, allocation methods and allocations which

satisfy such conditions are perceived as 'fair enough'. Sophisticated methods, such as ACV2, do not satisfy such conditions and are perceived as less fair.

10.7.6. Stability

It is noteworthy that the literature related to perceived fairness does not seem to incorporate the STA property of fairness, which is perceived as important in both our studies. STA means that for each organization, the pay-off of cooperation in the grand group is equal to or higher than the pay-off of working alone or in any other subgroup. The respondents indicated that it is important that the group does not break into parts. It is stated that in the long term, the largest savings can be achieved if all cooperate. A fairness property satisfying this condition is therefore perceived as important by the respondents.

Note that the actual allocations that are perceived as fair in both studies do not satisfy STA. This can be explained by our proposition that allocation methods are perceived as fair if they use a reasonable, objective, and well understood proportional indicator. The methods which satisfy STA are either sophisticated (e.g., ACV2) or not proportional (e.g., EP).

10.7.7. Implications

Given the multiple definitions of fairness and a possible lack of understanding of how allocation methods function, we note that it can be useful to verify axiomatic understanding and procedural understanding in case of an allocation problem. Thus, to be able to make a well-founded decision concerning an allocation method, special attention needs to be given to important allocation properties with large differences between perceived understanding and theoretical realization. The same applies if there are many 'do not know' answers for a certain property, that is, if the respondents do not know whether an allocation method satisfies certain properties of fairness. If there is a lack of understanding, then the previous steps in the allocation process need to be reconsidered (see also Fig. 10.3). A similar argument applies to procedural understanding. Special attention needs to be given to allocation methods with a low procedural understanding, especially if these methods are considered as interesting outcomes of other steps in the allocation process.

Our study of the fifth step in the allocation process indicates the importance of considering more than one case when choosing an allocation method for the long run. This is because some allocation methods, such as EP, have inconsistent allocations.

A final implication of our work concerns allocation methods. We found that the allocations of cooperative purchasing allocation methods are perceived as fair if they tend towards proportionality by a reasonable, objective, and well understood indicator. In addition, we noted that theoretically fair cooperative purchasing allocation methods use logical, objective and sophisticated criteria for allocation. These methods are not easily understood by the respondents. The implication of this is that if a purchasing group wants to use a sophisticated method, such as ACV2, then it seems to be important to clearly explain the method and its implications to the group members. Otherwise, the method may not be well understood and the perceived fairness of the method may be relatively low.

10.8. Limitations

A strong feature of our study is that the respondents were not students, but experienced group purchasers. In addition, Study 1 and 2 show similar results, indicating that our measures seem reliable. Nevertheless, there are some limitations that should be kept in mind when interpreting our results.

First of all, we delayed issues of generalizability. This is usually considered to be appropriate when engaging in the initial stages of method development (Barling et al., 2002). Still, to further generalize our results and to find significant differences between different groups, a large-scale study is necessary.

Second, allocation problems become more complicated when also considering cooperative costs and logistical gains. Finding a fair solution in these situations might become very difficult without assuming that some aspects, such as logistical gains, should be considered as limiting conditions.

Third, not all specific aspects of perceived fairness are taken into account in our questionnaire. To reduce the number of questions, we did not use a construct for perceived fairness. In addition, we note that factors such as national culture might influence perceived fairness as well (based on Tata, 2005).

Fourth, the two cases we used in step 5e differ only in one aspect. More aspects could be considered in further research. Finally, we note that we did not consider extreme scenarios in which one group member is very large. In such scenarios, the largest organization benefits a lot, while small organizations hardly benefit while using PV (see also Fig. 9.8). In that case, the perceived fairness of PV might decrease drastically for the small organizations.

10.9. Conclusions

This chapter set out to obtain more insights into effectively dealing with allocation problems. First, we conclude that more research seems necessary on comparing theory and perception of fairness and understanding to be able to fully understand and solve allocation problems. Second, both theory and perception can be modeled into five main steps (see Fig. 10.3). The steps deal with (1) axiomatic fairness, (2) axiomatic understanding, (3) procedural fairness, (4) procedural understanding, and (5) distributive fairness. For each step, a comparable measure is developed which can be used to deal with allocation problems. Third, the consideration between theoretical fairness and sophistication leads to a sophistication dilemma: theoretically fair allocation methods tend to be more sophisticated than theoretically unfair methods.

We found that the theoretical realization of allocation methods was not clear to most respondents. For instance, sometimes they thought that a well-known method such as Equal Price satisfies a certain property of fairness, while it does not in theory. Therefore, we note that it can be useful to verify axiomatic understanding in case of an allocation problem. A similar argument applies to procedural understanding. In our study, we found that the Equal Price method is perceived as relatively fair, but the actual allocations of the method are not

always perceived as fair. Here we note that if the members of a purchasing group perceive a method as fair and choose to use this method, then this may lead to allocation problems in the long run when it turns out that the actual allocations of the method are not perceived as fair.

We also found that the perceived fairness of allocations of the Equal Price method is inconsistent. In one tender, its allocations are perceived as fair and in another (more common) tender as unfair. Remarkably, the allocations of the Adapted Compromise Value 2 – a theoretically fair allocation method – are also perceived as unfair. Here we note that if the respondents are not sure what the outcomes of a (sophisticated) method are, then they might perceive a method as less fair.

Our data supports the proposition that allocation methods are perceived as relatively fair if these methods tend towards proportionality by a reasonable, objective, and well understood indicator. We found that the Proportional by Volume method is perceived as the fairest allocation method for the purchasing groups studied. The distributional fairness of the other methods decreases steadily when the methods deviate more from the Proportional by Volume method. Still, note that the Proportional by Volume method is perceived as less fair by small organizations than large organizations in our study.

Finally, we note that the properties of fairness used in this study can be defined more specifically in further research. Other properties and (cost) allocation methods might be considered as well. Especially properties and methods related to proportionality would be interesting areas for further research. Note that it can be difficult for people to fully grasp more sophisticated properties and methods than we used. We already encountered practical difficulties with explaining the properties and methods used in our studies. Further research to new theoretical allocation methods might therefore need a new rigorous way of thinking.

Acknowledgements

We thank the referees of WION 2006 for their useful comments and contributions to this chapter.

PART VI

SUMMARY AND OUTLOOK

In this final part, we summarize the most important parts of this thesis. In addition, we provide several recommendations for further research.

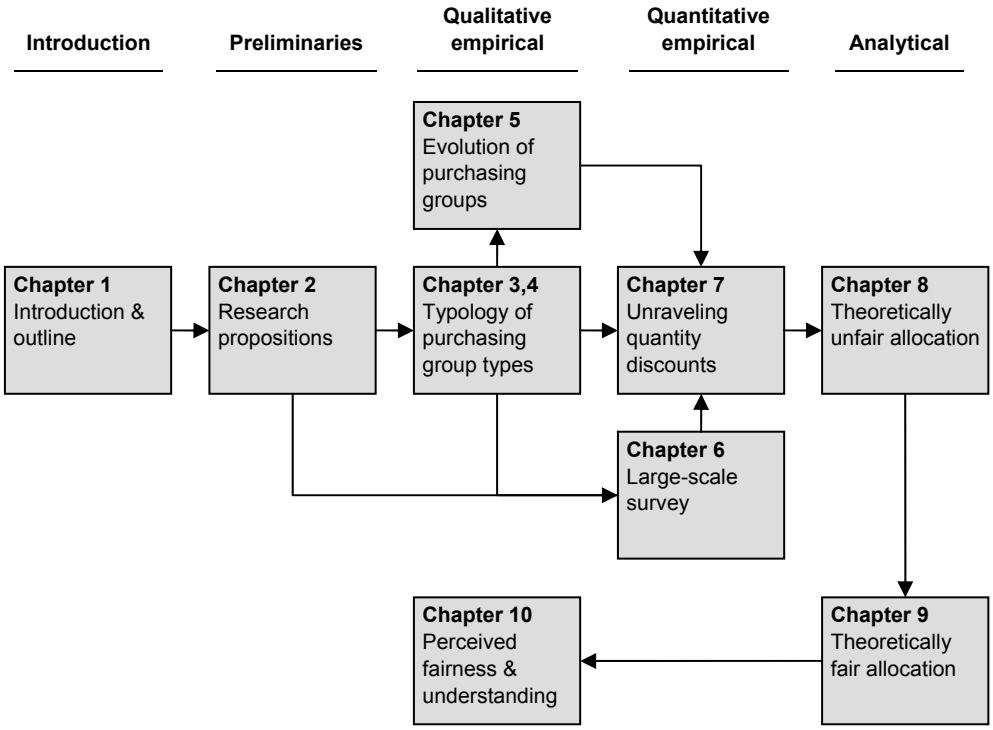

Fig. I.1 Research outline

Chapter 11

Summary and outlook

Purchasing in groups is a concept that is becoming increasingly popular in both the private and public sector. Often, the advantages such as lower purchase prices, learning from each other, and reduced transaction costs outweigh set-up and management costs and drawbacks such as disclosure of sensitive information and the fear of free-riding group members. The concept is not always successful though. Still, it has received relatively little attention in management research.

In this thesis, we study the establishment and management of purchasing groups. We define purchasing groups as organizations in which horizontal cooperative purchasing takes place. We define horizontal cooperative purchasing as the operational, tactical, and/or strategic cooperation between two or more organizations in one or more steps of the purchasing process by pooling and/or sharing their purchasing volumes, information, and/or resources.

As an aid to the reader, the next sections restate the research objectives and review the methods used. Next, we draw the main conclusions for each research objective and provide several recommendations for further research.

11.1. Research objectives

The overall research objective of this thesis is to analyze, model, and improve the establishment and management of purchasing groups. We employ both an empirical approach (qualitative and quantitative) and an analytical approach. These approaches are aimed at the development of empirically tested propositions, formal models, and mathematically rigorous theorems. The specific research objectives are as follows and are discussed in more detail in the next sections:

- To develop a set of research propositions about cooperative purchasing, thereby laying a research basis for this thesis (Chapter 2);
- To describe the main purchasing group types, to develop a typology of purchasing group types, and to position the group types with respect to each other (Chapter 3);
- To find out how Chapter 3 can be extended by a dimension concerning the allocation of the gains and costs of a purchasing group (Chapter 4);
- To describe the main micro-evolutions that take place in intensive purchasing groups over time (Chapter 5);
- To identify differences between organizations involved and not involved in a purchasing group regarding motives for cooperative purchasing and to identify critical success factors for managing purchasing groups (Chapter 6);
- To describe a general Quantity Discount Function (QDF) defined by a limited number of parameters, to test how well the QDF represents different types of quantity discount schedules, and to develop several practical QDF indicators (Chapter 7);

- To find out how and under which conditions the so-called Equal Price gain allocation method leads to theoretically unfair outcomes given a QDF (Chapter 8);
- To find out how to allocate purchasing group gains and costs in a theoretically fair manner among the members of a group given a QDF (Chapter 9);
- To obtain more insights into effectively dealing with allocation problems by comparing theoretical fairness and realization to perceived fairness and understanding (Chapter 10).

11.2. Methods used

In this thesis, we used several research approaches (see also Section 1.4). The first four chapters have an explorative character and are written in the context of discovery (Reichenbach, 1938; see also Section 2.3). The approach used in these chapters is qualitative empirical. The next two chapters have a confirmative character and are written in the context of justification (Reichenbach, 1938). The approach used in these chapters is mainly quantitative empirical. The empirical approach served both as an inspiration and background for an analytical approach used in the next two chapters. In the final chapter, we return to a qualitative empirical approach in which we empirically test some of our analytical results. In the remainder of this section, we provide a short overview of the specific methods used in each chapter.

In Chapter 2, we lay a research basis for this thesis and develop several propositions. The research basis is based on studies of purchasing groups in the United Nations (UN), the literature, and theory. We studied cooperative purchasing in the UN by conducting several semi-structured interviews with key stakeholders and by studying internal documents. With a small-scale survey among 19 UN agencies, we triangulated the document and interview data. To compensate for nonresponse bias and possible misinterpretations, we discussed the final results with the heads of procurement of all 47 agencies during a discussion meeting.

In Chapter 3, we provide a typology of purchasing group types. We determined the typology by theoretical specification. The theoretical specification required expert raters to develop several so-called dimension scores for different purchasing group types. During 21 semi-structured interviews and two focus group meetings, dimension properties and dimension scores were therefore discussed with practical and academic experts in cooperative purchasing. Simultaneously, theoretical foundations of the dimension scores were developed. Our results were published in a book, which was distributed to 4,000 members of a purchasing association and is available online with a request for feedback on the key issues and any perceived discrepancies.

In Chapter 4, we extend the typology with a so-called symbiosis dimension that provides information about the necessity for a formal allocation method for savings distribution. To this purpose, 51 cases of cooperative purchasing have been analyzed and positioned according to the typology of Chapter 3. Furthermore, all cases have been appointed a symbiosis dimension which is considered most appropriate. At least one and usually two researchers positioned the cases.

In Chapter 5, we describe the main micro-evolutions that take place in intensive purchasing groups over time. To this end, we collected several sources of data of three purchasing groups. For each purchasing group, we created a detailed timeline from its start to the time

of collecting the data. The largest timeline consisted of 132 points and the smallest timeline consisted of 75 points. In the timelines of the purchasing groups, we searched for patterns. We identified similarities and differences between the groups and coded all issues found. Subsequently, we classified the codes by using several dimensions (e.g., 'size of the group', 'activities of the group', etc.). For each dimension, we placed all codes in chronological order. Finally, we identified several micro-evolutions for each dimension that take place in intensive purchasing groups over time.

In Chapter 6, we test some of the propositions developed in Chapter 2. More specifically, we are interested in differences between successful and unsuccessful purchasing groups (i.e., critical success factors) and differences between organizations involved and not involved in a purchasing group (i.e., motives for cooperative purchasing). To this end, we conducted a large-scale survey among 224 organizations. We used independent samples t-tests to identify variables that differ significantly between successful and unsuccessful purchasing groups. Next, we conducted a discriminant analysis to the variables identified in the previous step. When variables significantly influence the success of purchasing groups, we refer to them as critical success factors. We used a similar procedure for comparing differences between organizations involved and not involved in a purchasing group.

In Chapter 7, we describe a general Quantity Discount Function (QDF) defined by a limited number of parameters. We tested how well the general QDF fits with 66 quantity discount schedules. For each schedule, we estimated the parameters of the QDF with several nonlinear least squares algorithms, which are commonly used in curve fitting. The R^2 used in the quality measurement of the fit is calculated based on the comparison of the QDF prices with the actual prices of the quantity discount schedules.

In Chapter 8, we aim to find out how and under which conditions the Equal Price (EP) gain allocation method leads to unfair outcomes given the QDF. We model a purchasing group by assuming purchase price savings due to economies of scale. We refer to the model as a Cooperative Purchasing game (CP-game) without costs. Given the EP method, we analyze the effects on theoretical fairness of QDF parameters, the number of members of a purchasing group, and the quantities purchased by the members.

In Chapter 9, we intend to find out how to fairly divide purchasing group gains and costs among the members of a purchasing group given the QDF. We extend the model of Chapter 8 by introducing management costs of a purchasing group and compensation costs for members that have to change product specifications, supplier preferences, and so on. We refer to the model as a CP-game with costs. Given several allocation methods, we analyze whether the methods satisfy several properties of fairness in general.

In Chapter 10, we aim to obtain more insights into effectively dealing with allocation problems by comparing theoretical fairness and realization to perceived fairness and understanding. To this end, we conducted two studies in which we studied allocation problems. The first study included one purchasing group and nine heads of purchasing involved in the group. The second study included 48 individuals experienced in cooperative purchasing. In both studies, we conducted similar small-scale surveys with questions about the effects of allocation methods and differences on perceived fairness, perceived understanding, and theoretical fairness.

11.3. Conclusions

In this section, we draw the main conclusions of the thesis. We provide the main conclusions for the preliminaries, the qualitative and quantitative empirical approach, the analytical approach, and again a qualitative empirical approach.

11.3.1. Chapter 2 Research propositions

In the explorative Chapter 2, it is our main objective to lay a research basis for this thesis. We add to the existing literature by developing several propositions related to the establishment and management of purchasing groups. These propositions are based on qualitative empirical data from the United Nations, the literature, and theory. The propositions are mostly related to different purchasing group types, negative motives, and critical success factors for managing purchasing groups. Negative motives are defined as organizational motives not to purchase cooperatively.

We propose that important negative motives are a lack of 'management support' and 'cooperation opportunities'. A 'lack of goodwill trust' seems not to be an important negative motive for cooperation between public organizations. To improve the viability of cooperation, we next address issues related to critical success factors, such as 'choosing suitable items'. We propose that the most important properties that make products and services suitable for cooperative purchasing are 'similar needs of cooperating organizations', 'standardized items', and/or 'not customized items'. Other issues and important success factors discussed are, among other things, 'commitment and internal support', 'the competence level of purchasing functions', 'communication', 'voluntary participation', 'uniformity of the members', and 'control over the purchasing process'.

We discuss in the chapter that small organizations may be more vulnerable to losing control than large organizations. This could lead to fewer purchasing groups consisting of organizations that strongly differ in terms of size. A limited number of small organizations with a sufficiently competent purchasing function could lead to fewer purchasing groups consisting of organizations that are all small. In such cases, a third party could help initiating purchasing groups.

Regarding different purchasing group types, we note that small organizations could profit from piggy-backing on contracts of large organizations. For large organizations, there may be no strong incentive to allow piggy-backing though. Adequate saving allocation methods could attenuate this piggy-backing problem and increase cooperative opportunities for heterogeneous purchasing groups.

11.3.2. Chapter 3 A typology of purchasing group types

In Chapter 2, it is noted that more research on different purchasing group types would be worthwhile. In the explorative Chapter 3, it is our objective to describe the main purchasing group types, to develop a typology of purchasing group types, and to position the group types with respect to each other. Chapter 3 has a qualitative empirical approach.

In the typology, five main purchasing group types are distinguished based on seven main dimensions (e.g., 'life span of the group', 'size of the group', etc.). These group types are identified and described based on the literature, theory, and interviews with experts in

cooperative purchasing. The group types range from non-intensive types as piggy-backing and third-party groups to intensive types as lead buying, project, and program groups. Here intensiveness is defined as the extent to which a group member is compelled to perform an active role in a purchasing group.

Piggy-backing typically involves a large organization that establishes a contract on its own specifications. This contract may be used by other organizations under (almost) the same contract conditions. Third party purchasing mostly involves large-scale and long-term piggy-backing made possible by a third party. Lead buying involves outsourcing purchasing activities to one of the members of a purchasing group: each item is purchased by the most suitable party. Typically, a project group is a small one-time purchasing group for a shared purchasing project. For a shared problem, the members of the group bundle their forces for one time and together they carry out the purchasing activities. A program group is typically a small long-term purchasing group. Cooperative projects are usually carried out by representatives of all cooperating organizations.

The five main purchasing group types are positioned in a matrix according to two distinguishing dimensions (see also Fig. 4.1). These two dimensions are the 'influence by all members on the group activities' and the 'number of different group activities'. Underlying the two-dimensional matrix, there are five other dimensions that do not distinguish all group types from each other, but further detail them.

This chapter adds to the literature by providing more insight into several dimensions of different group types, which is crucial to better understand why different group types fit different situations. The typology can serve as a guideline for purchasing groups when a suitable group type needs to be established. In a suitable group, the dimensions of a group have certain typical scores. For instance, some purchasing group types perform best as long-term groups (dimension 'life span of the group') with few members (dimension 'size'). Other purchasing group types perform best as long-term groups as well, but have many members. Finally, we observe that different group types imply different research models and may have different advantages, disadvantages, and critical success factors.

11.3.3. Chapter 4 A symbiotic extension of the typology

In the explorative Chapter 4, it is our objective to find out how a proposed extension of Chapter 3 can increase its usefulness in determining how to allocate cooperative gains and costs. Chapter 4 has a qualitative empirical approach and extends Chapter 3 by incorporating the relationships between the members involved in the typology. In other words, it extends Chapter 3 by adding a so-called symbiosis dimension to the typology. We find empirical support for this dimension based on an analysis of 51 cases described in the literature. The dimension provides information for purchasing groups about the necessity for a formal saving allocation method.

The symbiosis dimension is important as cooperative savings are not always fairly allocated among the members of a purchasing group (as noted in Chapter 2). This may put a strain on the relationships within some purchasing group types. Chapter 4 adds to the literature by providing initial support for the new symbiosis dimension of the typology.

Finally, it is discussed that program and lead buying groups have relatively little need for a special allocation method for savings distribution, whereas piggy-backing and third party groups have a high need in order to run the group successfully. Still, if some members of, for example, a program group add much more value to the group than other members, then the need for a formal method also increases for a program group (see Chapter 8 to Chapter 10 for the actual application of allocation methods).

11.3.4. Chapter 5 Micro-evolutions of purchasing groups

In Chapter 3 and Chapter 4, it is noted that several purchasing group types exist. Some of these group types have a long expected life span and may develop on several dimensions over time. In the explorative Chapter 5, we build on the results of Chapter 3 and Chapter 4 and it is our objective to describe the so-called micro-evolutions that take place in the so-called macro-phases in intensive purchasing group types, such as program groups. Thus, we study interorganizational management dynamics of purchasing groups at a detailed level and we add to the existing literature on macro-evolutionary models.

We identified five interorganizational management dimensions of micro-evolutions on which development may take place: 'member relationships', 'objectives', 'activities', 'organization', and 'resources'. Based on three case studies, evolutionary theory, and organizational learning theory, five tables are developed that provide an overview of micro-evolutions (see Table 5.3 to Table 5.7). These tables can be used by practitioners to guide purchasing groups in developing each dimension step by step. In addition, the tables provide more insight into micro-evolutions, which is crucial to better understand how purchasing groups (can) develop and should be managed over time.

Finally, the results also include solutions to several cooperative purchasing problems. Still, it turned out that some cooperative problems are hard to solve. Among other things, this applies to calculating (see Chapter 7) and allocating the savings of a purchasing group among its members (see Chapter 8 to Chapter 10).

11.3.5. Chapter 6 A large-scale survey

In Chapter 2, it is stated that further research is necessary for justifying several propositions related to cooperative purchasing. In Chapter 6, we test some of these propositions in a large-scale survey among 224 organizations. Specific objectives are to identify differences between organizations involved and not involved in a purchasing group regarding motives for cooperative purchasing and to identify critical success factors for managing lead buying and program purchasing groups. Chapter 6 adds to the literature by providing quantitative empirical evidence for (parts of) several propositions.

The motives analyzed in Chapter 6 help us better understand why organizations choose (not) to join or establish a purchasing group. It turns out that the most important motives why organizations are not involved in a purchasing group are 'a lack of cooperation opportunities', 'disclosure of sensitive information (applies to the private sector)', 'supplier resistance', 'fear of free-riding group members', and 'a lack of cooperation priority'. Our results also suggest that it is more difficult than expected to deal with 'reduced throughput times' in a purchasing group.

We discuss that 'the lack of cooperation opportunities' implies that more efforts concerning the encouragement of cooperative purchasing might be worthwhile in both the private and public sector. The literature suggests using an independent third party in case of potential 'disclosure of sensitive information'. In case of 'supplier resistance', purchasing groups could share some of the transaction cost savings with the supplier. In Chapter 8 and Chapter 9, we note that fair allocation methods could reduce, among other things, the 'fear of free-riding group members'.

Regarding differences between group members, we found that intensive purchasing group types are less viable when members differ strongly. This is because we found significant differences between successful and unsuccessful groups concerning similar 'objectives', 'influence', 'contributions of knowledge', 'commitment', and 'internal support'. Note, however, that we did not find a significant difference concerning 'similar organizational cultures'. Regarding properties that make items suitable for cooperative purchasing, we conclude that suitable items are general, similar, bulk, standardized, routine, and leverage items. Customized, strategic, local, and bottleneck items are less suitable for cooperative purchasing. Finally, regarding differences between small and large organizations, we found that small organizations not involved in a purchasing group rate 'losing control over the purchasing process' higher than large organizations not involved in a purchasing group. Small organizations might expect that due to their smaller size, they have less control in groups in which larger organizations participate. Nevertheless, based on an analysis of organizations that are involved in a purchasing group, we found that this motive turns out to be less negative than anticipated.

The most important critical success factors are 'voluntary participation', 'sufficient total contribution of efforts', 'all members contribute unique knowledge', 'all members rarely change representatives', 'fair allocation of gains and costs', and 'communication'. Using the most important critical success factors, we could correctly predict whether a purchasing group is perceived as successful or not successful in 89.3% of the cases.

In contrast to our results of Chapter 2, we found that the factors studied that are related to the 'formality of the group' and 'interorganizational trust' are not critical success factors for managing purchasing groups. These factors are mostly important when establishing a purchasing group. The differences between Chapter 2 and Chapter 6 can be explained due to the methods used. In Chapter 2, we studied the perceived importance of success factors. In Chapter 6, we determined the factors by studying differences between successful and unsuccessful purchasing groups.

11.3.6. Chapter 7 Unraveling quantity discounts

In Chapter 7, our objectives are to describe a general Quantity Discount Function (QDF) defined by a limited number of parameters, to test how well the QDF represents different types of quantity discount schedules, and to develop several practical QDF indicators. More specifically, we consider the situation in which a buying organization has to deal with a discrete quantity discount schedule. We assume that the buying organization can negotiate with the supplier about the lot size and purchase price, but does not know the underlying function that was used by the supplier to determine the discount schedule.

We add to the literature by providing an analytical and quantitative empirical basis for one general QDF that can be used to describe the underlying function of almost all different quantity discount types. Namely, we show that the QDF fits very well with 66 discount schedules found in practice. In addition, our data set shows that quantity discounts can have a major impact on the total purchase costs. We found a maximum quantity discount of 90.1% and a mean discount of 31.3%.

We discuss that the QDF and related indicators can be a useful tool in supplier selection and negotiation processes. Among other things, given a simple quantity discount schedule, this QDF enables buying organizations to calculate detailed prices for a large number of purchase quantities. The QDF can also be used in competitive analyses, multiple sourcing decisions, and for calculating savings for purchasing groups. To summarize, the QDF reduces the price information deficiency for organizations regarding quantity discount schedules provided by suppliers. This reduced information deficiency could lead to lower purchase prices and/or better quality for buying organizations. Finally, the QDF can be included in studies regarding commodity market characterization from a demand elasticity point of view and in models incorporating quantity discounts, as we do in the next chapters.

11.3.7. Chapter 8 Theoretically unfair allocation of gains

As indicated in Chapter 2 to Chapter 6, the fair allocation of gains and costs is an important issue for purchasing groups. An indicated reason for the fact that some purchasing groups do not flourish is a creeping dissatisfaction among various members of a group with the allocation of the gains and costs. In Chapter 6, we found that the Equal Price (EP) gain allocation method is commonly used in intensive purchasing groups. In the analytical Chapter 8, we add to the literature by finding out how and under which conditions the EP method leads to theoretically unfair outcomes given the QDF.

To be able to analyze EP, we use a Cooperative Purchasing (CP)-game model. We analyze unfairness resulting from using EP for allocating cooperative gains among the members of a purchasing group. We demonstrate that unfairness is caused by neglecting a particular component of the added value of individual group members.

We develop two fairness ratios and tie these to fairness properties from cooperative game theory. We prove that under our assumptions and while using EP, organizations increasing their volume past 38% (first fairness ratio) of the total volume of a purchasing group will receive fewer gains, even though their added value for the purchasing group increases and the total gains of the group increase. Furthermore, we prove that under our assumptions and while using EP, an organization in a purchasing group receives its maximum pay-off when its share of the total group volume is 25% (second fairness ratio). Thus, the fairness ratios show, among other things, that being too-big a player in a purchasing group can lead to decreasing gains. The ratios can be used to assess whether EP is an unfair method in specific scenarios.

Finally, we discuss measures a purchasing group could consider in order to attenuate perceived unfairness and improve its stability and prosperity. Suggested measures are using another gain allocation method than EP and/or compensating the unfair effects of EP by a cost allocation method that favors larger organizations in a purchasing group. We discuss these measures in more detail in Chapter 9.

11.3.8. Chapter 9 Theoretically fair allocation of gains and costs

The analytical Chapter 9 builds further on existing saving allocation methods and adapts them to purchasing groups. The chapter adds to the literature by indicating how to allocate gains and costs in a theoretically fair manner among purchasing group members given the QDF. To be able to analyze cost allocation methods, we add a cost element to the CP-game from Chapter 8. In addition, new allocation methods – the Adapted Compromise Value (ACV) 1 and 2 – are introduced and compared to existing methods using several properties of fairness. Among other things, we note that the Equal Amount (EA) method favors small organizations and the Proportional by Volume (PV) method favors large organizations to a large extent. This is one issue we further explore in Chapter 10.

ACV2 satisfies most properties of fairness and is considered as a theoretically fair method for allocating gains and costs. We recommend against combining the EP gain method with the PV cost method if members of a purchasing group differ strongly in aspects such as organizational size. For such situations, we recommend against this common combination as it does not satisfy several properties of fairness from cooperative game theory.

Remarkably, in Chapter 6, it is suggested that purchasing groups with less uniform members more often combine EP with a proportional cost allocation method than with the EA cost method. We recommend using the EP gain method in combination with the EA cost method in situations with (almost) equally sized organizations in a purchasing group and/or when the necessity for a formal allocation method is low (see Chapter 4) and the financial risks are low. When organizations are unequally sized and the necessity or the financial risks are high, we recommend using ACV2. When choosing another method in such situations, we argue that it is important that this is an intentional choice and that the group members are aware that several properties of fairness may not be satisfied.

11.3.9. Chapter 10 Perceived fairness and understanding

In Chapter 8 and Chapter 9, we have analyzed mathematical solutions to allocation problems. In Chapter 10, we add a social psychology perspective to our analysis. We add to the literature by obtaining more insights into dealing with allocation problems by comparing theoretical fairness and realization (mathematical perspective) to perceived fairness and understanding (social psychological perspective).

We start the chapter by noting that allocation problems occur often and theoretically fair allocation methods are used rarely. To obtain more insight into this issue, we have developed several steps for dealing with allocation problems. The steps deal with:

1. **Axiomatic fairness**
   Does a method satisfy properties of fairness that are perceived as important?
2. **Axiomatic understanding**
   Is it understood whether or not a method satisfies certain properties of fairness?
3. **Procedural fairness**
   What is the perceived fairness of a method?
4. **Procedural understanding**
   Is it understood whether or not a method leads to a certain allocation?
5. **Distributive fairness**
   What is the perceived fairness of the allocation of a method?

For each of the steps, a comparable measure is developed which can be used to deal with allocation problems. We used the steps in two small-scale studies (see Fig. 10.3 for an overview of the steps). In the studies, we found that it can be useful to verify axiomatic understanding and procedural understanding in case of an allocation problem. For instance, sometimes the respondents thought that the well-known EP gain allocation method satisfies a certain property of fairness, while it does not in theory. Thus, even a common allocation method as EP does not seem to be well understood by the respondents. We also found that EP is perceived as relatively fair, but that the actual allocations of the method are not perceived as fair in general.

Remarkably, the actual allocations of ACV2 – a sophisticated and theoretically fair allocation method – are perceived as less fair than the allocations of a well understood but theoretically less fair proportional allocation method. To explain this issue, we discuss sophistication issues and a pragmatic perspective based on equity theory. In terms of this pragmatic perspective, we found that the actual allocations of a cooperative purchasing allocation method are perceived as fair if they tend towards proportionality by a reasonable, objective, and well understood indicator. Indeed, we found that the simple PV method is perceived as the fairest gain allocation method for the purchasing groups studied. Still, note that PV is perceived as less fair by small organizations than large organizations.

If a purchasing group wants to use a sophisticated allocation method, such as the theoretically fair ACV2 method, then it seems to be important to clearly explain the method and its implications to the group members. Otherwise, the method may not be well understood, which can have a negative effect on its perceived fairness.

11.4. Recommendations for further research

In this thesis, we suggested several research avenues on cooperative purchasing. This section gives the main recommendations for further research, which are:

- **A typology of purchasing group types**
  The typology of purchasing group types developed in this thesis can be tested on a large scale in further research. This can be done by examining the extent to which deviation from the ideal scores on the dimensions predicts failure or a relatively low performance of a purchasing group (based on Doty and Glick, 1994). In addition, in further research, a refinement of the high-way matrix may be possible by discussing more detailed descriptions of hybrid group types. A further refinement of the matrix may be possible by adapting the two distinguishing dimensions or by introducing more dimensions;
- **Application of allocation methods**
  As noted in this thesis, the piggy-backing problem may hamper the development of certain purchasing group types. In further research, it would be interesting to find out whether reallocating some of the gains of piggy-backing organizations to organizations that allow piggy-backing leads to more piggy-backing initiatives. In addition, it can be tested whether more usage of the concept of piggy-backing by using a saving allocation method results in more savings for both small and large organizations. It can also be tested whether the application of fair allocation methods leads to more successful purchasing groups consisting of organizations that strongly differ. Finally, it would be interesting to extend the case study discussed in Chapter 10 with costs of cooperating;

- **Communication structure for different purchasing group types**
  In their study, Laing and Cotton (1997) found that communication was almost uniformly viewed as problematic by purchasing groups. It is also one of the main critical success factors found in Chapter 6. Further research could be carried out to find out what an effective and efficient communication structure is for different purchasing group types;
- **Cooperative Purchasing-games (CP-games)**
  The CP-games discussed in this thesis can be extended by taking more benefits of cooperation into account than only volume discounts, for instance by using multi-attribute utility functions (Keeney and Raiffa, 1976). To empirically support the cost function used in CP-games, further research could investigate the actual costs that different purchasing group types make;
- **Cooperative purchasing in developing countries**
  According to Kalinzi (2005), several studies have concluded that retail prices of some essential drugs are higher in developing countries than in developed countries (MOHU et al., 2004; MSF and HAI, 2000). This is attributed to high overhead costs paid on importation, clearing, handling, verification, and license charges. The concept of cooperative purchasing might reduce such costs. Further research is needed to learn how cooperative purchasing can benefit organizations in developing countries;
- **Development of allocation methods and properties of fairness**
  In this thesis, we studied a selection of allocation methods and properties of fairness. In further research, more allocation methods and properties of fairness could be studied. More specifically, several scenarios could be sketched (e.g., all members differ strongly, one member differs strongly, some members are large and the other members are small, etc.) and for each scenario, it could be tested whether the properties of fairness are satisfied. In addition, if properties of fairness are not satisfied, then it could be tested to what extent the properties are not satisfied. Finally, a distinction could be made between properties of fairness that are perceived as important or unimportant by practitioners;
- **Impact of cooperative purchasing on employment**
  The concept of cooperative purchasing can reduce duplications of efforts and activities (Tella and Virolainen, 2005), thereby affecting employment negatively. It can also bring learning opportunities (Nollet and Beaulieu, 2005) and new challenges to employees involved in a purchasing group, thereby affecting employment positively. Overall, it is interesting to find out what the impact is of cooperative purchasing on employment;
- **Interorganizational relationships**
  One of the propositions developed in this thesis concerns ‘lack of trust in loyalty and honesty’ (see Section 2.5.5). In further research, it can be tested whether ‘lack of trust in loyalty and honesty’ is a less important negative motive for cooperation between public organizations than cooperation between private organizations. Another proposition that can be tested is whether ‘lack of trust in other organizations’ competences’ is more difficult to deal with than expected in cooperative purchasing. Finally, note that an important decisive negative motive for organizations not to become involved in interorganizational relationships could be ‘intraorganizational support’. In further quantitative empirical research, it could be tested whether this is true and if so, how organizations can improve ‘intraorganizational support’ for cooperative purchasing;
- **Micro-evolutions of purchasing groups**
  The five dimensions used in our micro-evolutionary study are quite broad (e.g., ‘activities’, ‘resources’), which – although they have given an initial insight into micro-

evolutions – may need fine-tuning in further research. In addition, in our analysis, we focused on the main problematic events and reactions for a limited number of dimensions. In further research, more dimensions and more steps, problems, and possible solutions could be studied and added to our results. More longitudinal studies could also help to asses the validity of our findings, as they could enable us to observe closely what happens at the time when problems and changes occur. Finally, our research results show that how purchasing groups score on the five dimensions can vary under different circumstances. Purchasing groups do not have to develop the different dimensions simultaneously. This raises intriguing research questions related to which ideal combinations of dimension scores should be established under which circumstances;

- **Optimal size of different purchasing group types**
  To our knowledge, no instruments have yet been developed which can determine the optimal number and size of purchasing group members under different circumstances (e.g., different markets, different price elasticity, etc.). The involvement of many members will lead to high transaction costs. On the other hand, the involvement of few members will lead to less economies of scale. Hence, an interesting topic for further research seems the optimal size of a purchasing group;
- **Small and Medium-sized Enterprises (SMEs)**
  SMEs are often interested in the concept of cooperative purchasing, but many SMEs believe that SME purchasing groups are not feasible (Quayle, 2002a). In further research, it would be interesting to understand how cooperative purchasing can benefit SMEs. More specifically, it could be tested whether small organizations give a lower priority to cooperative purchasing than large organizations due to lower organizational support, commitment, and resources. In addition, it would be interesting to find out whether the limited number of small organizations with a sufficiently competent purchasing function to manage relatively complex cooperation processes leads to fewer purchasing groups consisting of organizations that are all small. Finally, it could be studied whether more usage of third parties to initiate purchasing groups and new (or existing) staff members to manage these groups results in more groups consisting of organizations that are all small;
- **Sustainable purchasing and cooperative purchasing**
  Sustainable purchasing is becoming increasingly popular in practice. Recent studies suggest that cooperative purchasing can benefit sustainable purchasing (e.g., Fletcher, 2007). Still, research to this topic is in its infancy. Hence, an interesting topic for further research seems the relationship between cooperative and sustainable purchasing;
- **Quantity Discount Function (QDF)**
  In further research, the QDF developed in this thesis could be reformulated as, among other things, an exponential function or a spline function. The question is then whether these reformulated functions better represent quantity discounts than our QDF. In addition, further case study research among suppliers and buying organizations could be carried out to empirically test our preference for continuous quantity discount functions.

From the list above, it becomes clear that there remain several interesting avenues for further research. Some of these, such as avenues related to adding a dimension to the typology of purchasing group types, can relatively simply be explored in further research. Other research avenues, such as avenues related to ideal combinations of dimension scores under different circumstances, might however need a new rigorous way of thinking.

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Glossary of symbols

Allocation methods

$ACV1_i(v)$	Adapted Compromise Value 1 allocation of organization i in game v
$ACV2_i(v)$	Adapted Compromise Value 2 allocation of organization i in game v
$CV_i(v)$	Compromise Value allocation of organization i in game v
$EA_i(v)$	Equal Amount allocation of organization i in game v
$EP_i(v)$	Equal Price allocation of organization i in game v
$EPR_i(v)$	Equal Percentage allocation of organization i in game v
$NUC_i(v)$	Nucleolus allocation of organization i in game v
$PV_i(v)$	Proportional by Volume allocation of organization i in game v
$SERD_i(v)$	Serial Cost Sharing (decreasing) allocation of organization i in game v
$SERI_i(v)$	Serial Cost Sharing (increasing) allocation of organization i in game v
$SV_i(v)$	Shapley Value allocation of organization i in game v

Miscellaneous functions

af_k	Axiomatic fairness of method k
$AM_i(v$	Aumann-Maschler allocation of organization i in game v
au_k	Axiomatic understanding of method k
$CEA_i(v$	Constrained Equal Award allocation of organization i in game v
$C(S)$	Cost function of group S
$E(S,x)$	Excess of group S with respect to allocation x
$\theta(x)$	Excess vector consisting of the excesses of all groups in a decreasing order
$FRAVFR$	Fair Ranking Added Value Fairness Ratio
$f(v)$	Allocation vector for each game v
φ	Golden mean
m_i	Gains for and by organization i created by joining a group
M_i	Maximum amount of the total pay-offs that each organization i can reasonably claim
mc_i	Minimum amount of the total pay-offs that each organization i can reasonably claim
$MONFR$	Monotonicity Fairness Ratio
n_i	Gains created by organization i for the other organizations in a group
o_i	Gains for organization i created by the other organizations in a group
σ	Permutation
$p(q)$	Price of quantity q
ps_k	Perception similarities in distributive fairness between different contracts for method k
pu_k	Procedural understanding of method k
$QDF(q)$	Price of quantity q
s_{kp}	Property p is satisfied or not satisfied by method k
T	Total quantity of all organizations in a group

$TQDF(q)$	Total purchase costs of quantity q
$v(S)$	Total savings of group S

Variables and parameters

α	Proportionality of variable costs to S
API_p	Average perceived importance of allocation property p
APS_{kp}	Average perceived satisfaction of allocation property p for method k
c	Variable costs
c_1	Price scaling parameter one
c_2	Price scaling parameter two
C_0	Fixed costs
cc_i	Compensation costs for organization i
DF_{ik}	Average distributive fairness for organization i of method k
DF_{ikc}	Distributive fairness for organization i of method k and contract c
E_d	Price elasticity of demand
η	Price steepness
N	Total number of organizations in a group
PF_{ik}	Procedural fairness for organization i of method k
p_m	Minimum or maximum price
q_i	Quantity of organization i
S	Price scaling parameter

List of abbreviations

ACV1	Adapted Compromise Value 1
ACV2	Adapted Compromise Value 2
ANOVA	Analysis of variance
CAPS	Center for Advanced Procurement and Supply
CMON	Cross Monotonicity
CP	Cooperative Purchasing
CV	Compromise Value
DP	Differential Pricing
DUM	Dummy
e.g.	For example
Ed(s).	Editor(s)
etc.	And so on
EA	Equal Amount
EPG	Electronic Purchasing Group
EFF	Efficiency
EMAC	European marketing academy
EP	Equal Price
EPR	Equal Percentage
Freq.	Frequency
FTEs	Full Time Employees
FRAV	Fair Ranking Added Value
FRAVFR	Fair Ranking Added Value Fairness Ratio
FRV	Fair Ranking Volume
GP	General Practice
H	Hypothesis
HAI	Health Action International
i.e.	That is
I	Organizations involved in a purchasing group
IAPSO	Inter-Agency Procurement Services Office
IND	Individual Rationality
IPSERA	International Purchasing and Supply Education and Research Association
IRSPP	International Research Study of Public Procurement
L	Large sized organization
M	Medium sized organization
Max.	Maximum
MBA	Master of Business Administration
Min.	Minimum
MOHU	Ministry of Health Uganda
MON	Monotonicity
MONFR	Monotonicity Fairness Ratio
MSF	Medicines without Borders
MUL	Multiplication

N	Organizations not involved in a purchasing group
NAPM	National Association of Purchasing Management
NEVI	Dutch association for purchasing management
MHEC	Massachusetts Higher Education Consortium
NHS	National Health Service
NRS	NEVI research foundation
NUC	Nucleolus
NWO	Netherlands organisation for scientific research
Org.	Organization
Ph.D.	Doctor of Philosophy
P	Proposition
PIA	Professional purchasing and tendering
PIANOo	Professional and innovative tendering, network for public purchasing principals
PV	Proportional by Volume
QDF	Quantity Discount Function
S	Small sized organization
SCMON	Strong Cross Monotonicity
SERD	Serial Cost Sharing with a Decreasing rule
SERI	Serial Cost Sharing with an Increasing rule
SIAM	Society for Industrial and Applied Mathematics
Sign.	Significance
SMEs	Small and Medium sized Enterprises
SPSS	Statistical Package for the Social Sciences
STA	Stability
SV	Shapley Value
SYM	Symmetry
UK	United Kingdom
UN	United Nations
UN/IAPWG	United Nations Inter Agency Procurement Working Group
US	United States
VMI	Vendor Managed Inventory
WION	Dutch Purchasing Research Workshop

Samenvatting

Inkoopsamenwerking is een steeds populairder wordend concept, zowel in de publieke als in de private sector. De voordelen van het concept, zoals lagere inkoopprijzen, leereffecten en lagere transactiekosten, wegen vaak op tegen de nadelen, zoals een hogere complexiteit, een lagere flexibiliteit en minder controle over het inkoopproces. Inkoopsamenwerking verloopt echter niet altijd succesvol. Desalniettemin is er tot nu toe relatief weinig wetenschappelijk onderzoek uitgevoerd naar inkoopsamenwerking.

In dit proefschrift behandelen we het opzetten en managen van inkoopsamenwerkingsverbanden. Hierbij definiëren we inkoopsamenwerking als de operationele, tactische en/of strategische samenwerking tussen twee of meer organisaties middels het bundelen en/of delen van inkoopvolumes, informatie en/of hulpmiddelen. In de volgende paragrafen vatten we achtereenvolgens de onderzoeksdoelstellingen, de gebruikte onderzoeksmethoden en de belangrijkste conclusies van dit proefschrift samen.

Onderzoeksdoelstellingen

Het overkoepelende onderzoeksdoel van dit proefschrift is het analyseren, modelleren en verbeteren van het opzetten en managen van inkoopsamenwerkingsverbanden. Hiertoe hanteren we zowel een empirische aanpak (kwalitatief en kwantitatief) als een analytische aanpak. De aanpakken zijn gericht op de ontwikkeling van empirisch geteste hypotheses, formele modellen en wiskundige stellingen. De specifieke onderzoeksdoelstellingen zijn als volgt geformuleerd en worden in nader detail besproken in de volgende paragrafen:

- Het ontwikkelen van hypotheses op het gebied van inkoopsamenwerking om zodoende een onderzoeksbasis voor dit proefschrift te leggen (hoofdstuk 2);
- Het beschrijven van inkoopsamenwerkingsverbandtypes, het ontwikkelen van een typologie van inkoopsamenwerkingsverbanden (i.e., de snelwegmatrix) en het ten opzichtte van elkaar positioneren van de verschillende inkoopsamenwerkingsverbandtypes (hoofdstuk 3);
- Onderzoeken hoe hoofdstuk 3 uitgebreid kan worden met een dimensie betreffende het alloceren van de opbrengsten en kosten van een inkoopsamenwerkingsverband (hoofdstuk 4);
- Het beschrijven van de belangrijkste micro-evoluties die plaatsvinden in de loop der tijd in intensieve inkoopsamenwerkingsverbanden (hoofdstuk 5);
- Het identificeren van verschillen tussen organisaties die wel of niet betrokken zijn in een inkoopsamenwerkingsverband betreffende motieven voor inkoopsamenwerking en het identificeren van kritische succesfactoren voor het managen van inkoopsamenwerkingsverbanden (hoofdstuk 6);
- Het beschrijven van een generieke kwantumkortingfunctie (KKF) gedefinieerd door een klein aantal parameters, testen hoe goed de KKF verschillende kwantumkortingtypes beschrijft en het ontwikkelen van praktische KKF-indicatoren (hoofdstuk 7);
- Onderzoeken hoe en onder welke condities de Gelijke Prijs opbrengstenallocatiemethode leidt tot theoretisch oneerlijke uitkomsten gegeven een KKF (hoofdstuk 8);

- Onderzoeken hoe de opbrengsten en kosten van een inkoopsamenwerkingsverband op een theoretisch eerlijke wijze onder de leden van een inkoopsamenwerkingsverband gealloceerd dienen te worden gegeven een KKF (hoofdstuk 9);
- Het verkrijgen van meer inzichten in het effectief omgaan met allocatieproblemen middels het vergelijken van theoretische eerlijkheid en realisatie met gepercipieerde eerlijkheid en begrip (hoofdstuk 10).

Gebruikte onderzoeksmethoden

In dit proefschrift gebruiken we verschillende onderzoeksaanpakken. De eerste vier inhoudelijke hoofdstukken hebben een exploratief karakter. De gebruikte aanpak in deze hoofdstukken is veelal kwalitatief empirisch. De volgende twee hoofdstukken hebben een confirmatief karakter. De gebruikte aanpak in deze hoofdstukken is met name kwantitatief empirisch. De empirische aanpak heeft zowel als een inspiratie en achtergrond gediend voor de analytische aanpak die de volgende twee hoofdstukken hebben. Tot slot keren we in het laatste hoofdstuk terug naar een kwalitatieve empirische aanpak waarin we een deel van onze analytische resultaten toetsen in de praktijk (zie ook paragraaf 1.4). In het vervolg van deze paragraaf geven we per hoofdstuk een kort overzicht van de gebruikte onderzoeksmethoden.

In hoofdstuk 2 leggen we een onderzoeksbasis voor dit proefschrift en ontwikkelen we verscheidene hypotheses. De onderzoeksbasis is gebaseerd op studies van inkoopsamenwerkingsverbanden in de Verenigde Naties (VN), de literatuur en theorie. We hebben inkoopsamenwerking in de VN bestudeerd middels verscheidene semi-gestructureerde interviews met belangrijke stakeholders en middels het bestuderen van interne documenten. Aan de hand van een kleinschalige enquête onder 19 VN-organisaties hebben we de documenten en interview data getrianguleerd. Tot slot hebben we om non-respons bias en eventuele verkeerde interpretaties te compenseren onze resultaten met de inkoophoofden van alle 47 VN-organisaties besproken tijdens een discussiebijeenkomst.

In hoofdstuk 3 ontwikkelen we een typologie van inkoopsamenwerkingsverbandtypes. We hebben deze typologie bepaald middels theoretische specificatie. De theoretische specificatie benodigde expertbeoordelaars voor het ontwikkelen van zogeheten ideale dimensiescores voor verschillende inkoopsamenwerkingsverbandtypes. Gedurende 21 semi-gestructureerde interviews en twee focusgroepbijeenkomsten hebben we eigenschappen van dimensies en dimensiescores bediscussieerd met praktijk- en academische experts in inkoopsamenwerking. Tegelijkertijd hebben we de theoretische bases voor de dimensiescores ontwikkeld. Onze resultaten zijn gepubliceerd in een boek dat gedistribueerd is onder de 4.000 leden van NEVI en online beschikbaar is met een verzoek om feedback betreffende gepercipieerde discrepanties.

In hoofdstuk 4 breiden we de typologie uit met een zogeheten symbiosedimensie welke informatie verschaft over de noodzakelijkheid van een formele allocatiemethode voor het alloceren van besparingen. Hiertoe hebben we 51 inkoopsamenwerkingsverbanden geanalyseerd en gepositioneerd aan de hand van de typologie uit hoofdstuk 3. Vervolgens is aan elk inkoopsamenwerkingsverband een van toepassing zijnde symbiosedimensie

toegewezen. Tenminste een en meestal twee onderzoekers positioneerden de samenwerkingsverbanden.

In hoofdstuk 5 beschrijven we de belangrijkste micro-evoluties welke plaatsvinden in de loop der tijd in intensieve inkoopsamenwerkingsverbanden. Hiertoe hebben we veel verschillende data verzameld betreffende drie inkoopsamenwerkingsverbanden. Voor elk inkoopsamenwerkingsverband creëerden we vervolgens een gedetailleerde tijdslijn vanaf de start van het samenwerkingsverband. De langste tijdlijn bestaat uit 132 punten en de kortste tijdlijn uit 75 punten. In de tijdlijnen van de inkoopsamenwerkingsverbanden zochten we hierna naar patronen. We identificeerden belangrijke overeenkomsten en verschillen tussen de samenwerkingsverbanden en codeerden deze. Daarna classificeerden we de codes aan de hand van verschillende dimensies (e.g., 'grootte van het samenwerkingsverband', 'activiteiten van het samenwerkingsverband', etc.). Voor elke dimensie plaatsten we vervolgens de codes in chronologische volgorde. Tot slot identificeerden we voor elke dimensie verschillende micro-evoluties die zich kunnen voltrekken binnen inkoopsamenwerkingsverbanden in de loop der tijd.

In hoofdstuk 6 testen we enkele hypotheses welke in hoofdstuk 2 ontwikkeld waren. We zijn met name geïnteresseerd in het vinden van verschillen tussen succesvolle en niet-succesvolle inkoopsamenwerkingsverbanden (i.e., kritische succesfactoren) en verschillen tussen organisaties die wel of niet betrokken zijn in een inkoopsamenwerkingsverband (i.e., motieven voor inkoopsamenwerking). Hiertoe hebben we een grootschalige enquête uitgevoerd onder 224 organisaties. We gebruikten onafhankelijke t-testen om variabelen te identificeren die significant verschillen tussen succesvolle en niet-succesvolle inkoop-samenwerkingsverbanden. Vervolgens hebben we een discriminantanalyse uitgevoerd over de variabelen die we in de vorige stap hadden geïdentificeerd. Wanneer variabelen het succes van inkoopsamenwerkingsverbanden significant beïnvloeden, verwijzen we naar deze variabelen alszijnde kritische succesfactoren. We gebruikten een soortgelijke procedure voor het vergelijken van verschillen tussen organisaties die wel of niet betrokken zijn in een inkoopsamenwerkingsverband.

In hoofdstuk 7 beschrijven we een generieke kwantumkortingfunctie (KKF) gedefinieerd door een klein aantal parameters. Er wordt getest hoe goed de KKF 66 kwantum-kortingschema's kan beschrijven. Voor elk kortingschema worden de parameterwaarden van de KKF geschat met verscheidene non-lineaire kleinste kwadraten algoritmen welke vaak gebruikt worden voor het fitten van een kromme. De R^2 gebruikt in de kwaliteits-meting van de fit is berekend door de KKF prijzen te vergelijken met de daadwerkelijke prijzen van de kwantumkortingschema's.

In hoofdstuk 8 onderzoeken we hoe en onder welke omstandigheden de Gelijke Prijs (GP) opbrengstenallocatiemethode leidt tot oneerlijke uitkomsten gegeven de KKF. Hiertoe modelleren we een inkoopsamenwerkingsverband en nemen aan dat er inkoopprijs-besparingen ontstaan door schaalvoordelen. We noemen dit model een inkoopsamen-werkingspel (IS-spel) zonder kosten. Gegeven de GP-allocatiemethode analyseren we de effecten op theoretische eerlijkheid van KKF parameters, het aantal leden van een inkoopsamenwerkingsverband en de hoeveelheden die de leden inkopen.

In hoofdstuk 9 onderzoeken we hoe een inkoopsamenwerkingsverband haar opbrengsten en kosten eerlijk kan verdelen onder de leden van een inkoopsamenwerkingsverband gegeven de KKF. We breiden het model van hoofdstuk 8 uit door het introduceren van managementkosten van een inkoopsamenwerkingsverband en compensatiekosten voor leden die aanpassingen dienen aan te brengen in onder meer productspecificaties en leveranciersvoorkeuren. We noemen dit model een IS-spel met kosten. Voor verschillende allocatiemethoden gaan we vervolgens na of de methoden voldoen aan verscheidene algemene eigenschappen van eerlijkheid.

In hoofdstuk 10 proberen we meer inzicht te verkrijgen in het effectief omgaan met allocatieproblemen door theoretische eerlijkheid en realisatie te vergelijken met gepercipieerde eerlijkheid en begrip. Hiertoe voerden we twee studies uit naar allocatieproblemen. In de eerste studie waren de negen inkoophoofden van een inkoopsamenwerkingsverband betrokken. In de tweede studie waren 48 individuen betrokken welke allen reeds praktische ervaring hadden met het concept van inkoopsamenwerking. Voor beide studies hebben we soortgelijke kleinschalige onderzoeken uitgevoerd met vragen over de effecten van allocatiemethoden en verschillen betreffende gepercipieerde eerlijkheid, gepercipieerd begrip en theoretische eerlijkheid.

Conclusies

In deze paragraaf vatten we de belangrijkste conclusies van dit proefschrift samen. De conclusies worden per hoofdstuk gegeven.

Hoofdstuk 2 Onderzoekshypotheses
In het exploratieve hoofdstuk 2 is het onze belangrijkste doelstelling om een onderzoeksbasis te leggen voor dit proefschrift. We bouwen voort op de bestaande literatuur middels het ontwikkelen van verscheidene hypotheses gerelateerd aan het opzetten en managen van inkoopsamenwerkingsverbanden. Deze hypotheses zijn gebaseerd op kwalitatieve empirische data verzameld binnen de Verenigde Naties, de literatuur en theorie. De hypotheses zijn voornamelijk gerelateerd aan verschillende inkoopsamenwerkingsverbandtypes, negatieve motieven en kritische succesfactoren voor het managen van inkoopsamenwerkingsverbanden. Negatieve motieven zijn gedefinieerd als organisationele motieven om niet gezamenlijk in te kopen.

We verwachten dat belangrijke negatieve motieven ‘een gebrek aan interne ondersteuning’ en ‘een gebrek aan samenwerkingsmogelijkheden’ zijn. Een ‘gebrek aan welwillendheidsvertrouwen’ lijkt geen belangrijk negatief motief te zijn voor samenwerking tussen publieke organisaties. Om de levensvatbaarheid van samenwerkingsverbanden te kunnen verbeteren bestuderen we vervolgens kritische succesfactoren en aanverwante zaken, zoals het kiezen van geschikte producten en/of diensten. We verwachten dat de belangrijkste eigenschappen van producten en diensten betreffende geschiktheid voor inkoopsamenwerking als volgt zijn: ‘gelijke inkoopbehoeften van de samenwerkende organisaties’, ‘standaardisatie’ en/of ‘geen maatwerk’. Andere belangrijke (succes)factoren die we bespreken zijn onder meer ‘inzet en interne ondersteuning’, ‘het competentieniveau van inkoopfuncties’, ‘communicatie’, ‘vrijblijvende deelname’, ‘uniformiteit van de leden’ en ‘controle over het inkoopproces’.

In het hoofdstuk bediscussiëren we verder dat kleine organisaties kwetsbaarder kunnen zijn voor het verliezen van controle door inkoopsamenwerking dan grote organisaties. Dit zou kunnen leiden tot minder inkoopsamenwerkingsverbanden die bestaan uit organisaties die sterk van elkaar verschillen in grootte. Een gelimiteerd aantal kleine organisaties met een voldoende ontwikkelde inkoopfunctie kan leiden tot minder inkoopsamenwerkingsverbanden die bestaan uit enkel kleine organisaties. In dergelijke gevallen kan een derde partij helpen met het initiëren van nieuwe inkoopsamenwerkingsverbanden.

Betreffende verschillende inkoopsamenwerkingsverbandtypes merken we op dat kleine organisaties kunnen profiteren van het meeliften op contracten van grote organisaties. Voor grote organisaties is er doorgaans echter geen (financiële) stimulans om andere organisaties te laten meeliften. Een adequate besparingsallocatiemethode kan dit meeliftprobleem verminderen en meer samenwerkingsmogelijkheden creëren voor heterogene samenwerkingsverbanden.

Hoofdstuk 3 Een typologie van inkoopsamenwerkingsverbanden
In hoofdstuk 2 merkten we op dat meer onderzoek naar verschillende inkoopsamenwerkingsverbandtypes waardevol kan zijn. In het exploratieve hoofdstuk 3 is het onze doelstelling om de belangrijkste inkoopsamenwerkingsverbandtypes te beschrijven, een typologie van inkoopsamenwerkingsverbandtypes te ontwikkelen en de samenwerkingsverbandtypes ten opzichtte van elkaar te positioneren. Hoofdstuk 3 heeft een kwalitatieve empirische aanpak.

In de typologie onderscheiden we vijf inkoopsamenwerkingsverbandtypes gebaseerd op zeven dimensies (e.g., 'levensduur van het samenwerkingsverband', 'grootte van het samenwerkingsverband', etc.). De samenwerkingsverbandtypes zijn geïdentificeerd en beschreven aan de hand van de literatuur, theorie en interviews met verschillende experts in inkoopsamenwerking. De typologie omvat relatief niet-intensieve samenwerkingsverbandtypes als meeliften en busritsamenwerkingsverbanden en intensieve types als carpoolen, konvooien en F1-teams. Hierbij definiëren we intensief als de mate waarin een organisatie 'verplicht' is om een actieve rol te vervullen in een samenwerkingsverband.

Meeliften houdt doorgaans in dat een grote organisatie een contract afsluit op basis van haar eigen specificaties. Dit contract mag gebruikt worden door andere organisaties onder (vrijwel) dezelfde contractcondities. Een busrit betreft doorgaans meeliften op een grote schaal en lange termijn, wat mogelijk gemaakt wordt door een derde partij. Carpoolen betreft het uitbesteden van inkoopactiviteiten aan een van de leden van een inkoopsamenwerkingsverband: elk product wordt ingekocht door het geschiktste lid. Een konvooi is meestal een klein eenmalig inkoopsamenwerkingsverband voor een overeenkomend inkoopproject. Voor een overeenkomend eenmalig probleem bundelen de leden van het samenwerkingsverband hun krachten en gezamenlijk worden de inkoopactiviteiten uitgevoerd. Een F1-team is doorgaans een klein inkoopsamenwerkingsverband dat voor een langere periode actief is. Gezamenlijke projecten worden meestal uitgevoerd door vertegenwoordigers van alle samenwerkende organisaties.

De vijf inkoopsamenwerkingsverbandtypes zijn gepositioneerd in een matrix (i.e., de snelwegmatrix) aan de hand van twee onderscheidene dimensies (zie ook figuur 4.1). Deze twee dimensies zijn gedefinieerd als de 'invloed van alle leden op de gezamenlijke activi-

teiten' en het 'aantal verschillende gezamenlijke activiteiten'. De vijf andere dimensies zijn niet onderscheidend voor alle samenwerkingsverbandtypes, maar kleuren de types nader in.

Dit hoofdstuk bouwt voort op de literatuur middels het verschaffen van meer inzicht in verschillende dimensies van verschillende samenwerkingsverbandtypes. Dit is van belang om beter te kunnen begrijpen waarom sommige samenwerkingsverbandtypes beter passen bij bepaalde situaties dan andere types. De typologie kan verder gebruikt worden als een geschikt samenwerkingsverbandtype opgezet dient te worden. In een geschikt samenwerkingsverband hebben de dimensies van een samenwerkingsverband bepaalde typische scores. Sommige inkoopsamenwerkingsverbandtypes presteren bijvoorbeeld het beste als samenwerkingsverbanden die voor een langere termijn actief zijn (dimensie 'levensduur van het samenwerkingsverband') met weinig leden (dimensie 'grootte'). Andere inkoopsamenwerkingsverbandtypes presteren juist het beste als lange-termijn samenwerkingsverbanden met veel leden. Tot slot observeren we dat verschillende samenwerkingsverbandtypes verschillende onderzoeksmodellen impliceren en verschillende voordelen, nadelen en kritische succesfactoren kunnen hebben.

Hoofdstuk 4 Een symbiotische uitbreiding van de typologie
In het exploratieve hoofdstuk 4 is het onze doelstelling om na te gaan hoe een extensie van hoofdstuk 3 het nut van dat hoofdstuk kan vergroten. De extensie verschaft informatie over de noodzakelijkheid van een formele methode voor het alloceren van gezamenlijke besparingen (zie ook figuur 4.1). Hoofdstuk 4 heeft een kwalitatieve empirische aanpak en breidt de typologie van hoofdstuk 3 uit door de relaties tussen samenwerkende leden mee te nemen. In andere woorden, we breiden de typologie uit met een zogeheten symbiosedimensie. Aan de hand van 51 geanalyseerde cases vinden we een empirische onderbouwing voor de dimensie.

De symbiosedimensie is van belang omdat gezamenlijke besparingen niet altijd eerlijk worden gealloceerd onder de leden van een inkoopsamenwerkingsverband (zie hoofdstuk 2). Dit kan spanningen creëren binnen sommige inkoopsamenwerkingsverbandtypes. Hoofdstuk 4 bouwt voort op de literatuur door initiële ondersteuning te bieden voor een nieuwe symbiosedimensie voor de typologie.

Tot slot bespreken we dat er voor meelift- en busritsamenwerkingsverbanden een relatief hoge noodzakelijkheid is betreffende het hebben van een speciale methode voor het alloceren van gezamenlijke besparingen. Carpoolsamenwerkingsverbanden en F1-teams hebben doorgaans een relatief lage noodzakelijkheid voor een speciale allocatiemethode om het samenwerkingsverband succesvol te kunnen laten zijn. Echter, als enkele leden van bijvoorbeeld een F1-team veel meer waarde toevoegen aan een samenwerkingsverband dan de andere leden, dan neemt de noodzakelijkheid voor een formele allocatiemethode ook toe voor een F1-team. De daadwerkelijke toepassingen van allocatiemethoden voor inkoopsamenwerkingsverbanden worden in nader detail bediscussieerd in hoofdstuk 8 tot en met hoofdstuk 10.

Hoofdstuk 5 Micro-evoluties van inkoopsamenwerkingsverbanden
In hoofdstukken 3 en 4 merkten we op dat er verscheidene inkoopsamenwerkingsverbandtypes bestaan. Sommige van deze samenwerkingsverbandtypes hebben doorgaans

een lange levensduur en kunnen zich ontwikkelen op meerdere dimensies door de tijd heen. In het exploratieve hoofdstuk 5 bouwen we voort op de resultaten van de eerdere hoofdstukken en is het onze doelstelling om de zogeheten micro-evoluties te beschrijven welke plaatsvinden binnen de zogeheten macro-fases in intensieve inkoopsamenwerkingsverbandtypes, zoals F1-teams. We bestuderen dus interorganisationele managementdynamieken van inkoopsamenwerkingsverbanden op een gedetailleerd niveau en we bouwen voort op de bestaande literatuur betreffende macro-evolutionaire modellen.

We hebben vijf interorganisationele managementdimensies van micro-evoluties geïdentificeerd waarop een inkoopsamenwerkingsverband zich kan ontwikkelen: 'relaties tussen de leden', 'doelstellingen', 'activiteiten', 'organisatie' en 'hulpmiddelen'. Aan de hand van drie case studies, evolutietheorie en organisatieleertheorie hebben we vijf tabellen ontwikkeld welke een overzicht geven van micro-evoluties (zie tabel 5.3 tot en met tabel 5.7). Deze tabellen kunnen gebruikt worden als een leidraad bij het stap voor stap ontwikkelen van de dimensies van een inkoopsamenwerkingsverband. Ook vergroten de tabellen het inzicht in micro-evoluties. Zodoende kan beter begrepen worden hoe inkoopsamenwerkingsverbanden zich (kunnen) ontwikkelen en gemanaged dienen te worden door de tijd heen. De tabellen hanteren een soortelijk formaat als het zogenaamde Monczka-model.

Tot slot laten we enkele oplossingen voor verschillende inkoopsamenwerkingsproblemen zien. Niettemin blijken sommige gezamenlijke problemen lastig oplosbaar. Dit betreft onder andere het berekenen (zie hoofdstuk 7) en alloceren van de besparingen van een inkoopsamenwerkingsverband onder haar leden (zie hoofdstuk 8 tot en met hoofdstuk 10).

Hoofdstuk 6 Een grootschalige enquête
In hoofdstuk 2 stelden we dat meer onderzoek noodzakelijk is voor het verifiëren van verscheidene hypotheses betreffende inkoopsamenwerking. In hoofdstuk 6 testen we daarom enkele hypotheses in een grootschalige enquête onder 224 organisaties. Specifieke doelstellingen zijn het identificeren van verschillen tussen organisaties die wel of niet betrokken zijn in een inkoopsamenwerkingsverband betreffende motieven voor inkoopsamenwerking en het identificeren van kritische succesfactoren voor het managen van carpoolsamenwerkingsverbanden en F1-teams. Hoofdstuk 6 bouwt voort op de literatuur door kwantitatief empirisch bewijs te leveren voor (delen van) verscheidene hypotheses.

De motieven die we in hoofdstuk 6 analyseren helpen in het verkrijgen van meer inzicht in de redenen waarom organisaties ervoor kiezen om wel/niet lid te worden van een inkoopsamenwerkingsverband of een samenwerkingsverband op te zetten. Belangrijke motieven voor organisaties om niet in een inkoopsamenwerkingsverband betrokken te zijn zijn 'een gebrek aan samenwerkingsmogelijkheden', 'onthulling van gevoelige informatie (van toepassing voor de private sector)', 'weerstand van leveranciers', 'angst voor meeliftende leden' en 'weinig prioriteiten voor inkoopsamenwerking'. Onze resultaten suggereren ook dat het lastiger is dan verwacht om om te gaan met 'gereduceerde doorlooptijden' in een inkoopsamenwerkingsverband.

We bediscussiëren dat het 'gebrek aan samenwerkingsmogelijkheden' impliceert dat meer inspanningen betreffende het aanmoedigen van inkoopsamenwerking waardevol kunnen zijn in zowel de private als de publieke sector. De literatuur suggereert een onafhankelijke derde partij te gebruiken in het geval van potentiële 'onthulling van gevoelige informatie'.

In het geval van 'leveranciersweerstand' kunnen inkoopsamenwerkingsverbanden een deel van de besparingen op de transactiekosten delen met de leverancier. In hoofdstukken 8 en 9 bediscussiëren we dat eerlijke allocatiemethoden onder meer de 'angst voor meeliftende leden' kunnen reduceren.

Betreffende de verschillen tussen de leden van een samenwerkingsverband laten we zien dat intensieve inkoopsamenwerkingsverbandtypes minder goed functioneren wanneer de leden veel van elkaar verschillen. We hebben in de dataset namelijk significante verschillen kunnen aantonen tussen succesvolle en niet-succesvolle inkoopsamenwerkingsverbanden betreffende overeenkomende 'doelstellingen', 'invloed', 'kennisbijdragen', 'inzet' en 'interne ondersteuning'. We hebben echter geen significante verschillen kunnen aantonen betreffende 'overeenkomende organisationele culturen'. Betreffende producten die geschikt zijn voor inkoopsamenwerking concluderen we dat dit generieke, overeenkomende, bulk, gestandaardiseerde, routine en hefboomproducten betreft. Maatwerk, strategische, lokale en knelpuntproducten zijn minder geschikt voor inkoopsamenwerking. Tot slot, betreffende verschillen tussen kleine en grote organisaties concluderen we dat kleine organisaties die niet betrokken zijn in een inkoopsamenwerkingsverband het 'verliezen van controle over het inkoopproces' hoger scoren dan grote organisaties die niet betrokken zijn in een inkoopsamenwerkingsverband. Kleine organisaties verwachten waarschijnlijk dat zij door hun kleinere grootte minder controle hebben in inkoopsamenwerkingsverbanden waaraan ook grote organisaties deelnemen. Desalniettemin kunnen we middels het vergelijken van organisaties die wel of niet betrokken zijn in een samenwerkingsverband aantonen dat dit motief in de praktijk minder negatief uit lijkt te vallen dan verwacht.

De belangrijkste kritische succesfactoren zijn 'vrijblijvende deelname', 'er in totaal voldoende tijd in steken', 'alle leden dragen unieke kennis bij', 'alle leden hebben weinig te maken met personele wisselingen betreffende het samenwerkingsverband', 'eerlijke allocatie van opbrengsten en kosten' en 'communicatie'. Middels deze succesfactoren kunnen we in 89,3% van de gevallen correct voorspellen of een inkoopsamenwerkingsverband als succesvol of niet-succesvol wordt gepercipieerd.

In tegenstelling tot in hoofdstuk 2 tonen we aan dat de bestudeerde factoren die gerelateerd zijn aan de 'formaliteit van een samenwerkingsverband' en 'interorganisationeel vertrouwen' geen kritische succesfactoren zijn voor het managen van inkoopsamenwerkingsverbanden. Deze factoren zijn met name van belang wanneer een inkoopsamenwerkingsverband wordt opgericht. De verschillen tussen hoofdstuk 2 en hoofdstuk 6 kunnen verklaard worden door de verschillen in de gebruikte onderzoeksmethoden. In hoofdstuk 2 bestudeerden we het gepercipieerde belang van succesfactoren. In hoofdstuk 6 stelden we de succesfactoren vast door succesvolle en niet-succesvolle samenwerkingsverbanden te vergelijken.

Hoofdstuk 7 Ontrafelen van kwantumkortingen

In hoofdstuk 7 trachten we een generieke kwantumkortingfunctie (KKF) gedefinieerd door een klein aantal parameters te beschrijven, te testen hoe goed de KKF verschillende kwantumkortingtypes beschrijft en verscheidene praktische KKF-indicatoren te ontwikkelen. We bestuderen hiertoe de situatie waarin een inkopende organisatie om dient te gaan met een kwantumkortingschema. We gaan ervan uit dat de inkopende organisatie kan

onderhandelen met een leverancier over de inkoopprijs en de staffel voor alle mogelijke hoeveelheden, maar niet weet wat de onderliggende functie is die de leverancier heeft gebruikt om het kwantumkortingschema op te stellen.

We bouwen voort op de literatuur door een analytische en kwantitatieve empirische basis te geven voor een generieke KKF welke gebruikt kan worden om de onderliggende functie van vrijwel alle verschillende kwantumkortingtypes te benaderen. We laten namelijk zien dat de KKF zeer goed in staat is om 66 verschillende kwantumkortingschema's te benaderen. Onze dataset laat ook zien dat kwantumkortingen een grote impact kunnen hebben op de totale inkoopkosten. De grootst gevonden kwantumkorting bedroeg 90,1% en de gemiddelde korting bedroeg 31,3%.

We bediscussiëren dat de KKF en verwante indicatoren nuttige gereedschappen kunnen zijn in leveranciersselectie- en onderhandelingsprocessen. De KKF stelt inkopende organisaties onder meer in staat om specifieke prijzen voor een grote verscheidenheid aan inkoophoeveelheden te berekenen gegeven een simpel kwantumkortingschema. De KKF kan ook gebruikt worden voor concurrentieanalyses, multiple sourcing beslissingen en voor het berekenen van prijsbesparingen voor inkoopsamenwerkingsverbanden. Samenvattend stellen we dat de KKF prijsinformatiedeficiënties vermindert voor inkopende organisaties betreffende kwantumkortingschema's welke door leveranciers worden verstrekt. Deze gereduceerde informatiedeficiëntie kan leiden tot lagere inkoopprijzen en/of een betere productkwaliteit voor inkopende organisaties. Tot slot, de KKF kan gebruikt worden in verder onderzoek naar de karakterisatie van markten bezien vanuit een vraagelasticiteits-oogpunt en in onderzoeksmodellen die gebruik maken van kwantumkortingen, zoals we doen in de volgende hoofdstukken.

Hoofdstuk 8 Theoretisch oneerlijke verdeling van opbrengsten
Zoals aangeduid in hoofdstuk 2 tot en met hoofdstuk 6 is de eerlijke allocatie van opbrengsten en kosten belangrijk voor inkoopsamenwerkingsverbanden. Één aangegeven reden voor het feit dat het sommige inkoopsamenwerkingsverbanden niet voor de wind gaat is een toenemende ontevredenheid onder de leden van een samenwerkingsverband betreffende de allocatie van de gezamenlijke opbrengsten en kosten. In hoofdstuk 6 toonden we aan dat de Gelijke Prijs (GP) opbrengstenallocatiemethode een veelgebruikte methode is in intensieve inkoopsamenwerkingsverbanden. In het analytische hoofdstuk 8 bouwen we voort op de literatuur door na te gaan hoe en onder welke omstandigheden de GP-methode leidt tot theoretisch oneerlijke uitkomsten gegeven de KKF.

Om GP te kunnen analyseren gebruiken we een inkoopsamenwerkingspel (IS-spel). We analyseren oneerlijkheid dat ontstaat door het gebruik maken van GP voor het alloceren van gezamenlijke opbrengsten. We demonstreren dat oneerlijkheid wordt veroorzaakt door het negeren van een specifieke component van de toegevoegde waarde van individuele leden voor een samenwerkingsverband.

We hebben twee eerlijkheidratio's ontwikkeld en hebben deze gekoppeld aan algemene eigenschappen van eerlijkheid uit de coöperatieve speltheorie. Gegeven onze aannames bewijzen we dat organisaties welke hun inkoopvolume groter laten worden dan 38% (eerste eerlijkheidsratio) van het totale inkoopvolume van een GP gebruikend inkoopsamen-werkingsverband minder opbrengsten gaan ontvangen, ondanks dat hun toegevoegde

waarde voor het inkoopsamenwerkingsverband toeneemt en ook de totale opbrengsten van het samenwerkingsverband toenemen. Gegeven onze aannames bewijzen we vervolgens dat een organisatie in een GP gebruikend inkoopsamenwerkingsverband een maximale opbrengst verkrijgt wanneer het 25% van het totale inkoopvolume inkoopt (tweede eerlijkheidsratio). De eerlijkheidratio's tonen dus onder meer aan dat een grote speler in een inkoopsamenwerkingsverband relatief weinig directe opbrengsten krijgt. De ratio's kunnen gebruikt worden om te beoordelen in welke situaties GP een oneerlijke methode is.

Tot slot bediscussiëren we enkele maatregelen welke een inkoopsamenwerkingsverband kan gebruiken om gepercipieerde oneerlijkheid te verminderen en zodoende haar stabiliteit en welslagen te verbeteren. De voorgestelde maatregelen betreffen het gebruik maken van een andere opbrengstenallocatiemethode dan GP en/of het compenseren van de oneerlijke effecten van GP middels een kostenallocatiemethode welke grote organisaties in een inkoopsamenwerkingsverband bevoordeeld. We bediscussiëren deze maatregelen in nader detail in hoofdstuk 9.

Hoofdstuk 9 Theoretisch eerlijke verdeling van opbrengsten en kosten
Het analytische hoofdstuk 9 bouwt verder op bestaande besparingsallocatiemethoden en past deze aan voor inkoopsamenwerkingsverbanden. Het hoofdstuk bouwt voort op de literatuur door aan te duiden hoe gezamenlijke opbrengsten en kosten op een theoretisch eerlijke wijze onder de leden van een inkoopsamenwerkingsverband gealloceerd dienen te worden gegeven de KKF. Om kostenallocatiemethoden te kunnen analyseren voegen we een kostenelement toe aan het IS-spel uit hoofdstuk 8. Daarnaast ontwikkelen we enkele nieuwe allocatiemethoden – de Aangepaste Compromiswaarde (AC) 1 en 2 – en aan de hand van verscheidende algemene eigenschappen van eerlijkheid vergelijken we deze methoden met bestaande allocatiemethoden. We laten onder meer zien dat de Gelijke Hoeveelheid (GH) methode kleine organisaties bevoordeelt en dat de Proportioneel naar Inkoopvolume (PI) methode grote organisaties bevoordeelt. Dit is een van de kwesties die we nader onderzoeken in hoofdstuk 10.

AC2 voldoet aan de meeste eigenschappen van eerlijkheid en is geacht een theoretisch eerlijke methode te zijn voor het alloceren van opbrengsten en kosten. We raden aan om de GP-opbrengstenallocatiemethode niet te combineren met een proportionele kostenallocatie-methode als de leden van een inkoopsamenwerkingsverband sterk verschillen in aspecten als de grootte van de organisaties. Voor dergelijke situaties raden we deze veelvoor-komende combinatie niet aan omdat dan niet voldaan wordt aan verscheidene algemene eigenschappen van eerlijkheid.

Het is opvallend dat in hoofdstuk 6 is aangeven dat inkoopsamenwerkingsverbanden met minder uniforme leden vaker GP combineren met een proportionele kostenallocatiemethode dan met de GH-kostenmethode. Wij adviseren juist om de GP-opbrengstenmethode te combineren met de GH-kostenmethode als (vrijwel) even grote organisaties met elkaar samenwerken en/of er een lage noodzakelijkheid is voor een formele allocatiemethode (zie hoofdstuk 4) en de financiële risico's klein zijn. Als organisaties niet even groot zijn en de noodzakelijkheid hoog of de financiële risico's groot zijn, dan adviseren we om de AC2-methode te gebruiken. Als er in dergelijke situaties gekozen wordt voor een theoretisch minder eerlijke allocatiemethode, dan benadrukken we dat het belangrijk is dat dit een

intentionele keuze is en dat de leden van het samenwerkingsverband zich ervan bewust zijn dat de allocatiemethode niet voldoet aan menige eigenschappen van eerlijkheid.

Hoofdstuk 10 Gepercipieerde eerlijkheid en begrip
In hoofdstukken 8 en 9 hebben we wiskundige oplossingen voor allocatieproblemen geanalyseerd. In hoofdstuk 10 voegen we een sociaal psychologisch perspectief toe aan onze analyse. We bouwen voort op de literatuur door het verkrijgen van meer inzichten in het omgaan met allocatieproblemen door theoretische eerlijkheid en realisatie (wiskundig perspectief) te vergelijken met gepercipieerde eerlijkheid en begrip (sociaal psychologisch perspectief) in verschillende stappen van allocatieprocessen.

We beginnen het hoofdstuk door op te merken dat allocatieproblemen vaak voorkomen, maar dat theoretisch eerlijke allocatiemethoden slechts weinig worden gebruikt. Om hier meer inzicht in te verkrijgen hebben we verschillende stappen ontwikkeld voor het omgaan met allocatieproblemen. De stappen betreffen:

1. **Axiomatische eerlijkheid**
   Wordt door een methode voldaan aan bepaalde algemene eigenschappen van eerlijkheid, welke gepercipieerd worden als belangrijk?
2. **Axiomatisch begrip**
   Wordt begrepen of een methode wel/niet voldoet aan bepaalde eigenschappen van eerlijkheid, welke gepercipieerd worden als belangrijk?
3. **Procedurele eerlijkheid**
   Wordt een methode als eerlijk gepercipieerd?
4. **Procedureel begrip**
   Wordt begrepen tot welke daadwerkelijke allocatie een methode leidt?
5. **Distributieve eerlijkheid**
   Wordt de daadwerkelijke allocatie van een methode als eerlijk gepercipieerd?

Voor elke stap hebben we een vergelijkbare indicator ontwikkeld welke gebruikt kan worden om om te gaan met allocatieproblemen. De stappen hebben we gebruikt in twee kleinschalige studies (zie figuur 10.3 voor de verschillende stappen). In beide studies tonen we aan dat het nuttig kan zijn om na te gaan wat het axiomatische en procedurele begrip is in het geval van een allocatieprobleem. Ter voorbeeld, soms waren de respondenten in de veronderstelling dat de bekende GP-opbrengstenallocatiemethode aan een bepaalde eigenschap van eerlijkheid voldoet, terwijl dit in theorie niet het geval is. Zelfs een bekende allocatiemethode als GP blijkt dus niet goed begrepen te zijn door de respondenten. In de studies tonen we ook aan dat de GP-methode wordt gepercipieerd als vrij eerlijk, maar dat de daadwerkelijke allocaties van de methode over het algemeen niet als eerlijk worden gepercipieerd.

Opmerkelijk genoeg worden de daadwerkelijke allocaties van AC2 – een complexe en theoretisch eerlijke allocatiemethode – als oneerlijker gepercipieerd dan de allocaties van een goed begrepen maar theoretisch oneerlijkere proportionele allocatiemethode. Om dit te kunnen verklaren bediscussiëren we complexiteit en een pragmatisch perspectief gebaseerd op rechtvaardigheidstheorie. In termen van dit pragmatische perspectief laten we zien dat de daadwerkelijke allocaties van een inkoopsamenwerkingsallocatiemethode als eerlijk worden gepercipieerd als de allocaties neigen naar proportionaliteit middels een redelijke,

objectieve en goed begrepen indicator. Zo wordt de PI-methode als de eerlijkste opbrengstenallocatiemethode gepercipieerd voor de bestudeerde inkoopsamenwerkingsverbanden. Hierbij dient wel te worden opgemerkt dat de PI-methode door kleine organisaties als minder eerlijk wordt gepercipieerd dan door grote organisaties.

Als een inkoopsamenwerkingverband een complexe allocatiemethode gebruikt, zoals de theoretisch eerlijke AC2 methode, dan is het van belang om duidelijk uit te leggen aan de leden van het samenwerkingsverband hoe de methode werkt en wat de daadwerkelijke allocaties van de methode zijn. Anders kan het gebeuren dat de allocatiemethode niet goed begrepen wordt, wat een negatief effect kan hebben op de gepercipieerde eerlijkheid van de methode en de allocaties van de methode.

About the author

Fredo Schotanus (1978) started as a Ph.D. candidate of Purchasing Management and Management Science at the University of Twente at the end of 2002. His Ph.D. project entitled 'horizontal cooperative purchasing' resulted in this thesis. During the project, research scholarships were granted by NEVI, NWO, CAPS, and IPSERA.

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