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PROFIT SHARING IN COLLABORATIVE NETWORKS

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EXECUTIVE SUMMARY

Profit sharing means that profits are divided in a fair and equitable way between the members of an alliance. This arrangement is negotiated and written in a form of contract. Hence, profit sharing can be seen also as a transfer pricing contract between the members. The goal of profit sharing is to achieve an equilibrium state in which all the actors are satisfied.

In profit sharing context the term 'profit' is not unanimously described. First, some scholars consider profits as utilities in case of process innovations. Utility sharing is a way to encourage partners to innovate and share the gains of innovations. Whereas others relate profit sharing to risk sharing. They see that risks and profits are strictly related and thus risk should be a major driver in profit sharing contracts. Also benefit sharing is another term that arises from the literature. It means that both financial and non-financial aspects of collaborative gains should matter when sharing the gains.

Game theory, which can be described as *"the study of mathematical models of conflicts and cooperation between intelligent rational decision-makers"*, is strongly related to profit sharing research. That is because in profit sharing negotiations the actors are individuals who basically negotiate and cooperate to maximize their profit. Therefore game theory and various game theoretic concepts are widely used within profit sharing modeling.

Profit sharing rules should be based on three criteria. The first is stability of the group. It means that the result of the process has to end up to equilibrium. The second is justifiability. Hence, the benefits and the costs have to be consistent and justified by the members of an alliance. The last requirement is computational ease. Therefore, profit sharing rules should not be too complicated. This review identified and introduced a wide range of profit sharing rules that somehow fit to those criteria. Some are simple and easy to use whereas others require some attention to understand.

The last discussed tool regarding profit sharing is open-book accounting. Open-book accounting is described as *"the disclosure of product/activity/process cost information in a customer-supplier relationship"*. Even though open-book accounting is strongly related to cost reductions, it is also used as a tool to share profits. Thus, once the network's costs are known, thanks to opening the books, the firms can reallocate the network profits. This is an open and fair way to share the gains of cooperation. Open-book accounting aims to show commitment, to strengthen its position among competing firms, to learn about the other firm's operations, and to conduct joint cost-reduction efforts. Open-book accounting is most likely to work in a stabilized relationship where there is an authorized leader.

If profit sharing is applied to SGEM, one has to be careful with the balance of equilibrium and simplicity. Both, fair share and simplicity of the formula may be hard to achieve at the same time because of the complex environment and numerous variables. As a recommendation, the simplest way to share the profits would be using open-book accounting and agree the sharing rules in advance.

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1. INTRODUCTION

This paper was written in Smart Grids and Energy Markets research program and this is a follow-up paper for an earlier review (Kuparinen 2011), which considered incentives and revenue sharing in networks. This review is a literature glance to profit sharing. The purpose of this paper is to shed some light for the concept of profit sharing in collaborative networks. The review introduces some basic ideas of profit sharing, but it will not represent any extensive mathematical proof of profit sharing. That is because those proofs are done with specific premises and therefore they are not generally suitable. Moreover, those proofs are quite complex and some mathematical background is required to understand them.

The terms network, partnership, alliance, supply chain and other terms meaning firms collaborating are used interchangeably and thus this paper does not generally distinct them. Though, there are some situations where the distinction is made. Profit sharing is needed when collaborative companies want to share the gains of collaboration. The sharing is done because it works as an incentive to the networking companies and it is seen as a tool to strengthen the collaboration. Also the term 'profit allocation' is used in the literature.

First though, this review considers different aspects of profit sharing and the collaborative factors of profit sharing. Then, game theory is introduced in the chapter 2.3. In the chapter 2.4 bargaining power considering negotiations is discussed. Profit sharing disruptors and rules are discussed in chapters 2.5 and 2.6 accordingly. Finally, open-book accounting is introduced in chapter 2.7 as a tool to share profits and reduce network's costs.

2. SHARING THE PROFITS

Essentially profit sharing means that profits are divided in a fair and equitable way between the members of an alliance. This arrangement is negotiated and written in a form of a contract. Profit sharing can be seen as a transfer pricing contract between the members. The members can be inter-firm or intra-firm members. The goal of profit sharing is to achieve an equilibrium state in which all the actors are satisfied.

2.1. Aspects of profit sharing

In the academic literature profit sharing has several meanings. First of all, Jarimo et al. (2005) describe profit sharing as utility sharing in case of process innovations. They see profit sharing as a way to encourage partners to innovate and share the gains of innovations. Innovating is mainly related as process innovation, because those kinds of innovations have the most beneficial effect on the network's costs. Thus, utility and profits are seen as means to reduce costs and the gains are shared.

Whereas others (Lo Nigro & Addate 2011; Chauhan & Proth 2005; Mitra & Wang 2003; Chen & Chen 2005; Karjalainen et al. 2005) relate profit sharing to risk sharing. They see that risk and profit are just flipsides of a coin. Therefore risk and profit and strictly related and risk should be a major driver in profit sharing mechanisms.

Also benefit sharing (Stein & Ginevicius 2010) arises from the literature. It means that both financial and non-financial aspects of collaborative gains are taken into account. Stein and Ginevicius see non-financial benefit as intangible benefit because that kind of benefit is difficult to measure. Their main source of intangible benefit is technology spillover, which is described later in the chapter 2.6.3.

In addition, revenue sharing and other incentive pricing mechanisms, like quantity flexibility contracts (Tsay 1999), can be seen as sharing the profits. That is because for example in revenue sharing revenue and therefore also profits are reallocated. The allocation of profits in revenue sharing may not be as intentional as in 'profit sharing' regarding this review, but it is undeniable that these mechanisms redistribute the profits. On the other hand these mechanisms can be seen also as parallel systems. Therefore the classification is only a question of point of view.

2.2. Cooperation and profit sharing

The depth of organizational cooperation also affects to how the profit sharing can be arranged. Thus, Stein and Ginevicius (2010) have studied how different business collaboration forms and profit sharing come along. They recognized four kinds of business collaboration forms: a multinational company, a franchise system, a joint venture and a cluster. The classification is based on equity sharing. In this review a cluster form of collaboration is described more closely because it is the most suitable term depicting the SGEM–environment. The forms concerning profit sharing are described in the Table 1.

Table 1. Profit sharing in different collaboration structures (Stein and Ginevicius 2010)

Business form	Profit sharing characteristics
Multinational company	Profit remains in company; decisions are made in the central business unit
Franchise system	Franchiser receives a contractual fee. Franchisee receives profit after the fee is paid to franchiser
Joint venture	Profits are shared according to the contractual proportion
Cluster	Every member is responsible for his own profit. No standard mode of profit sharing exists.

As the Table 1 says, there is no standard mode for profit sharing in a cluster. Thus, there is a wide diversity of schemes, which share the profits. Every scheme, as noticed later on in the chapter 2.6, attempts to distribute the profits in a fair way, but the basis on, which the profits are shared, is different in every scheme.

Profit sharing is also affecting whether the alliance is horizontally or vertically arranged. A vertical alliance means that the alliance works like a supply chain and the value of a good or a service increases as it flows through the chain. Whereas in a horizontal alliance partners are competing directly or indirectly and they have formed an alliance for a certain purpose. The purpose might be for example to entry into new markets or to form an R&D alliance. For instance Krajewska et al. (2008) have reviewed horizontal cooperation and profit sharing among freight carriers, whereas most of the other papers considering profit sharing deal with vertically arranged supply chains.

Jarimo (2008) argue that profits can be shared in three ways. The ways are not exclusionary and therefore they can be mixed. Moreover, this classification considers mostly utility sharing but it has some relevancy regarding profits. First, the sharing can affect the subcontractor's profit by increasing or decreasing the subcontractors transfer pricing. Second, it can affect the principal's profit in similar way. In addition to these mechanisms, the partners can agree on decreasing (or increasing) end-product price. (Jarimo 2008, p. 9.) Figure 1 explains more.

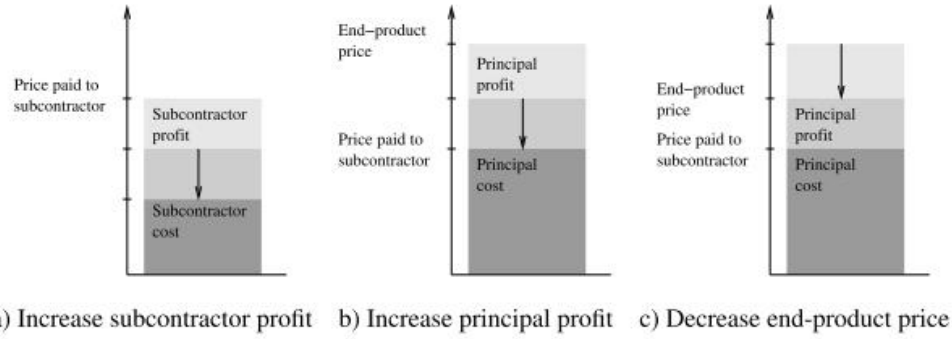

Figure 1. Utility sharing possibilities. (Jarimo 2008, p. 9)

It is feasible to decrease the price of a product or a service, if it is uncompetitively priced. Otherwise utilities should be shared between the partners with respect of equilibrium principle (Jarimo & Kulmala 2008, pp. 6–7)

2.3. Game theory

Game theory can be defined *as "the study of mathematical models of conflicts and co-operation between intelligent rational decision-makers"* (Myerson 1997, p. 1). Thus, it is a tool to analyze situations in which two or more individuals affect each other's welfare by making decisions. (Myerson 1997, p. 1). Game theory is strongly related to profit sharing, because, as discussed earlier, in profit sharing the actors are individuals, who basically negotiate and cooperate to maximize their profit. Therefore game theory is widely used within profit sharing modeling.

Game theory is divided into two branches: non-cooperative and cooperative game theory. Those branches differ in how they formalize interdependence among the players. (Brandenburger 2007, p. 1). Most of the articles, which deal with profit sharing, use cooperative game theory as their point of view. According to cooperative game theory companies can make binding agreements that maximizes the network's utility. Cooperative game theory aims to improve total profits and welfare. (Guardiola 2007.) Thus, cooperative game theory is very useful tool to depict the gains of profit sharing.

Nash equilibrium is another basic concept in game theory. In Nash equilibrium the players (two or more) make the best decisions they can while taking into account the decisions of the others. The choices are made simultaneously. The payoff may not be the best for all the players and they could improve their payoffs by negotiating. Nash equilibrium is a non-cooperative game theory. (Myerson 1997, p. 91)

Another game theoretic concept that is related to profit sharing is Shapley value. Shapley value is a form of coalition game like cooperative game theory, but unlike cooperative game theory, the Shapley value takes the contribution of the players into account. Thus, the Shapley value measures the bargaining power of the players in negotiations. (Winter 2002, pp. 1–2.) The value is based on four axioms; efficiency, symmetry, dummy and additivity. First, the players' resources, that are available, are to be shared precisely among themselves. Second, symmetric players are to be paid equal shares. Third, a dummy player gets zero payoff. Finally fourth, the payoffs are additivity. Additivity is a mathematical term that describes that value can be added to the game. As a result there is one payoff function that satisfies all four axioms. (Winter 2002, pp. 3–4)

2.4. Bargaining power

Bargaining power is one of the main influencer in profit sharing arrangements. Thus, a powerful negotiator can demand a larger share of profits. Bargaining power consists of wide range of factors that influence the relationship of the partners. There can be internal factors like competency of a company and external factors like competition status. In other words competition status means that a subcontractor's bargaining power is high if a principal has no other alternatives. (Jarimo & Kulmala 2008, p. 14).

Also intangible assets have an impact on bargaining power. Thus, the partner with superior technology, marketing, management or other skills has more bargaining power. (Stein 2010, p. 432) More about bargaining power and its sources can be read from Michael Porter's (2008) paper "The five competitive forces that shape strategy".

2.5. Factors disrupting the equilibrium state

As said, the aim of a profit sharing contract is to achieve an equilibrium state, where all the actors are satisfied. Though, there are several disrupting factors that have to be dealt with in order to reach a new equilibrium after a disruption. A profit sharing contract has a set of parameters, which determine how the profits are shared (see the chapter 2.6). The parameters have to be changed or adjusted after a disruption or if the disruptions are well known, then they have to be dealt in the contract already.

One of recognized disruptions is an unexpected demand. Demand can fluctuate quite dramatically and therefore it affects the profit sharing. Yang and Zhao (2010) have discussed and developed a mathematical profit sharing model for a supply chain whose demand fluctuates. Jarimo et al. (2005) discussed process innovations that reduce costs. If the balance of the cost structure in a network changes, then the profit sharing contract has to be revised. So, cost changes are a major disruptor as well.

In general, any market disruption requires a revision to the contract. Market disruptions, in spite of whether they are short term or long term disruptions, will always change the balance of network. That is because the companies in a network have different capabilities and their capacities differ as well. Therefore the disruptions will affect them differently. Moreover, not only external but also internal disruptions have to be considered as seen in the previous paragraph. As a final notice, if the circumstances vary, a general rule for profit sharing would not be appropriate (Kajüter & Kulmala 2005, p. 189).

2.6. Profit sharing rules

As discussed earlier, practically every study concerning profit sharing tries to prove their profit sharing rules with a game theoretic approach. That means that those are somewhat complex mathematical proofs under certain circumstances. In this review those models or rules are generally described without complex mathematics.

Gerchak and Gupta (1991) argue that allocations should be based on three criteria. The first is stability of the group. It means that the result of the process has to end up to equilibrium as mentioned earlier. The second is justifiability. So, the benefits and the costs have to be consistent and justified by the members of an alliance. The last requirement is computational ease. Therefore the rules should be understood without mathematical background or at least they should be computed easily. If managers understand the rule factors, then it is more likely that they act to maximize their profit and thus act for a common welfare.

Rese (2006) argues that there are two possibilities for profit sharing. The first possibility is that profit sharing should be based on partners' costs. Cost based models have a serious threat to opportunistic and dishonest behavior because the partners want to include as much costs as possible to maximize their own share of profits. The second possibility is based on partners' contribution in delivering value to the customer. Value can be seen as the degree of effort the partner has in an alliance. Despite Rese's classification, this review divides profit sharing in risk-based and in cost-based mechanisms, because the profit sharing literature considers more risks than value. Though, some mechanisms considering value are introduced in the 'combined mechanisms' –section. This chapter introduces also a profit sharing categorization in the subchapter 2.6.4.

2.6.1. Costs based mechanisms

Fractional rule is a somewhat simple profit sharing rule. In fractional ruling each player's allocation is proportional to the expected costs that the player would incur. So, a certain fraction of the profits is paid to a partner and that fraction is based on the costs that the partner is responsible in the supply chain. (Nagarajan & Sosic 2008, p. 731)

A fixed price or a fixed fee is another simple mechanism to determine prices and profits as well. In a fixed price contract the price is usually negotiated before the actual selling starts and thus profits may not be intentionally shared. (Karjalainen et al. 2004). On the other hand this kind of deal is able to share profits if demand and channel costs are known. Thus, some profit sharing schemes may end up to a fixed price contract. Though, typically cost-based schemes are usually determined in advance, so that the channel's profit is not yet known.

2.6.2. Risk based mechanisms

Risk is definitely a major factor in profit sharing agreements, because risks and profits go hand in hand. When equity is shared, like in joint-ventures, one of the bases is naturally the percentage of the shares owned by a company. In addition to equity there may be some other sharing mechanisms as well. Chauhan and Proth (2005) proposed an approach to share the profits according to relative risk of a company. In this case risk is considered as an investment in the cooperation, though no specific definition for the 'investment' is given.

Lo Nigro and Abbate (2011) have also proposed a profit sharing model, which is related to risks. They considered risks as variability in the expected results. In other words, a higher rate of return of capital is required when there is higher variability in expected cash flows. Thus, the authors use β from Capital Asset Pricing Model (CAPM) to indicate the variability. In this case beta consists of relational and performance risks. Relational risk can be calculated by assessing opportunism, uncertainty and trust while performance risk is calculated by assessing the possibility of network arrangement to improve product, information, supply or demand management. This beta value is then used in basis of Shapley value to share the profits.

Risk-reward contracts are one way of allocating risks between the actors. The idea is to create a formula which indicates how costs are divided if a target cost is not achieved. Most risk-reward contracts are focused on costs, but other criteria, such as safety or quality, are feasible as well. Therefore it is important to tailor criteria according to the key performance indicators. (Bresnen & Marshall 2000.) This is a basic contract type in project alliances.

2.6.3. Combined mechanisms

Liu (2010) has developed a mathematical model that considers factors affecting the effort degree of a partner. These effort degree factors include total cost, core competency, innovation ability, marginal ratio and risk preference. He ends up to three conclusions considering these factors. First, the more a partner's collaboration costs are, the larger its proportion of profits should be. Second, partner's core competency (innovation contribution) should be in direct ratio to the proportion and innovation costs should be

squared and inverted. Third, partner's marginal ratio should be in direct ratio to the profit proportion. Liu also considers his model in a dynamic environment.

Jarimo et al. (2005) depicted three profit sharing rules when sharing the utility (sharing cost reductions) from process innovations. In egalitarian solution the profits or utilities are shared equally. Therefore every member receives exactly the same amount of profit no matter what the contribution to the alliance is. In Nash games each bargainer has an additional possible strategy, a threat, which alters the relative strengths of negotiating companies. With Nash equilibrium it is possible to take each player's strategy into account, which alters the game. The third sharing mechanism is modified Shapley value, which incorporates added value each player provides. (Jarimo et al. 2005, pp. 411–417)

Table 2. Jarimo et al.'s utility sharing rules. (Jarimo et al. 2005, p. 419)

Solution concept	*Principle for profit sharing*	*Note*
Egalitarian (π^{e})	$\frac{\pi_{max}}{\lvert N_v \rvert + 1}$	Profit is shared equally
Nash's relative threats (π^{T})	$\max_{\sum \pi_i \le \pi_{max}} \prod_j (\pi_i - \tau_i)$	Profit is shared proportionally to disagreement outcome
Harsanyi's modified Shapley value (π^{s})	$\frac{\pi_{max}}{\lvert N_v \rvert + 1} - \frac{\tau_{ni}(i)}{2} + \frac{\tau_i}{2}$	Profit is shared proportionally to disagreement outcome and to the added value each player provides

Technology spillover is one factor that should also take into account when determining profit sharing. Stein and Ginevicius (2010, p. 432) describe technology spillover as *"the additional benefit from sharing technological knowledge"*. The additional benefit is therefore knowledge and innovations that are feasible to use in future businesses. If a partner's technology input is high, it expects a high profit share. On the other hand smaller profit share can be compensated by bigger technology spillover. In conclusion, a partner who receives more knowledge and innovations than he transfers to others has to give more financial value to the others. The same logic goes otherwise as well. (Stein & Ginevicius 2010, p. 432)

2.6.4. Profit sharing categories

To continue the discussion of different profit sharing models a rather versatile and combined model by Karjalainen et al. (2004) is introduced. It depicts profit and risk sharing and divides them into three different categories based on how they motivate the supplier to improve their performance. See Table 3 for the classification.

Table 3. Profit sharing categories by Karjalainen et al. (2004, p. 87)

Category	Profit and risk sharing mechanisms
Category A	Fixed price
	Fixed unit price
	Costs plus fixed fees
Category B	Expectation of extra reward
	Extra reward on the supplier's performance
	Extra reward on the customer's sales
	Extra reward on the customer's profit
Category C	Supplier's entire profit at risk
	Profits and losses shared
	Supplier's compensation embedded in product price

Category A is mainly based on supplier's costs and those agreements do not give much motivation to innovate or improve performance. Category B rewards the suppliers if their performance level is better than anticipated, but they do not increase supplier's risk. Finally, category C risk-reward methods share both risks and profits. Category C methods expose the supplier to the market risk and thus profits depend on the market success. (Karjalainen et al. 2004, pp. 85-86)

A rather similar classification was proposed by Mäkinen et al. (2011). They classified profit sharing into five levels according to the risk included in the contract. See the classification from the Table 4.

Table 4. Profit sharing levels by Mäkinen et al. (2011, p. 5)

Profit sharing level	**Pricing method**
Level 1	The collaborator is paid for work done in units of working hours
Level 2	The collaborator is paid a fixed, contracted price
Level 3	The collaborator is paid a fixed, contracted price and also some extra payments for separately agreed criteria
Level 4	Part of the payment for the collaborator is tied to product sales
Level 5	The collaborator is paid a share of the profits in the same manner that he has been taking risks for the product

In their study Mäkinen et al. (2011) made a survey to software OEM's and suppliers and searched if there was a correlation between high satisfaction and high profit sharing level. Moreover, they studied if a high profit sharing level results to better than expected collaboration success. The results were somewhat unexpected. They found that OEMs are the most satisfied at the profit sharing level 3, not at level 5 as expected. Suppliers were the most satisfied at the level 4. So, there are other factors, which determine the satisfaction level and thus profit sharing level does not predict the outcome. Moreover, risk sharing may not always result to high satisfaction considering collaboration.

2.7. Open-book accounting

Open-book accounting is another useful tool when profits are shared. The current literature identifies open-book accounting as *"the disclosure of product/activity/process cost information in a customer-supplier relationship"* (Suomala et al. 2010, p. 74). This means that the actors in an alliance reveal cost information in order to recognize cost reduction possibilities or to share information. Open-book accounting aims to show commitment, to strengthen its position among competing firms, to learn about the other firm's operations, and to conduct joint cost-reduction efforts. Open-book accounting is also a necessity for profit sharing. (Kulmala et al. 2002, p. 158.) Open-book accounting plays a key role in inter-organizational cost management, which aims to coordinate the alliance's costs. (Kajüter & Kulmala 2005, p. 180)

Open-book accounting is mainly associated with costs reductions. Basically there are two sources of cost reductions: product design and production process. With cost information the partners can reveal inefficient processes or show up inconsistent practices. Moreover, they can assess how the product features suit the overall production process. (Kulmala 2002, pp. 165-166.) But cost reductions are just the other side of the story. With open book accounting the firms are also able to share profits. Thus, once the networks costs are known, thanks to opening the books, the firms can also reallocate the profits. This is an open and fair way to share the gains of cooperation.

In open-book accounting the firms have to determine to who the books are open. Openness creates trust issues and because cost information is very sensitive by nature, companies consider that it cannot be shared openly. Kulmala (2002, p.163) argues that cost information sharing is usually dyadic by nature, not a network-wide. That means that cost information is shared only between the customer and the subcontractor. Moreover, sharing might be one-way sharing meaning that only the supplier reveals the book to the customer, but not otherwise. This might lead to several mishaps: the supplier may feel pressured by the customer, the supplier may feel unequal compared with the customer, or the customer may dictate the supplier's decision-making. But when considering maximizing the network profits, the situation is in contrast to current situation. Namely, the cost information should be transparent and available to every member in order to maximize the gains of open-book accounting. (Kulmala 2002, p. 172).

Trust can be seen as a prerequisite, facilitator or consequence in inter-organizational cost management. That means that it is not exactly clear, what is the role of trust in open-book accounting. (Suomala et al. 2010, p. 74). Though, it is clear that certain amount of trust is a perquisite in order to gain success in the open-book accounting negotiations. Otherwise the negotiations may end up to partial open books or no deal at all is made. If mutual trust is not achieved during negotiations the members can accept the right to audit other members (Kulmala 2002, p. 165). After all, if a deal is made and some good results are achieved, trust is a consequence of this process.

Kajüter and Kulmala (2005, pp. 196–197) recognized six major reasons for failure of implementing open-book accounting:

1. Suppliers experience **no extra benefit** from openness and main contractors do not offer win-win solutions.
2. Suppliers think that accounting information **should be kept in-house**.
3. Network members **cannot produce accurate cost information** and see no sense in sharing poor cost data.
4. Suppliers are **afraid of being exploited** if they reveal their cost structure.
5. Suppliers do **not have capable resources** or resource support from main contractors for the development of accounting systems.
6. Network members cannot agree on **how open-book practice should be implemented**.

Some reasons may be caused by others (like 2 and 4) and some are closely related (like 3 and 5). Moreover, in other circumstances more reasons for failure may be found and those can be more interrelated. (Kajüter and Kulmala 2005, pp. 196–197.) All together, these factors should be taken into account when preparing for negotiations and do every possible action to advance the negotiations.

Open-book accounting practice is depended on firm-specific factors like degree of competition and firm size. Thus, Kajüter and Kulmala (2005, p. 201) recognized four factors that affect and specify open-book practice:

1. The type of network
2. The type of its product
3. The network infrastructure
4. The social nature of the network relationships

Therefore, there is no common practice for open-books and thus every practice is unique. In conclusion to this discussion Kajüter and Kulmala (2005, p. 202) argue that open-book accounting is most likely to work *"in long-term hierarchical networks that manufacture functional products, provide a sound infrastructure for open-book practice and comprise trust-based network relationships"*. Hence, open-book accounting should be used in a stabilized relationship, where there is a certain hierarchy and an authorized leader.

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