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How can supply networks increase firm value? A causal framework to structure the answer

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Abstract The recent literature in the field of supply chain management emphasizes the role of inter-organizational networks and the integration of vertical reproduction networks (supply chains) in particular as a key factor for value creation. However, the literature includes little empirical evidence. This situation suggests the need to appraise investments in such networks or supply chains carefully. How can a decision maker reliably assess the effect of investing in inter-organizational network arrangements on firm value? This article takes up this issue and suggests a framework consisting of five components to help answer the question. The task of the framework is to support the structuring and revelation of the causal chain between investments in the network on the one hand and the effect of these investments on firm value on the other hand. The article develops and explains the framework in detail and later on relates extant literature to its components. A finding of this article is that potential causal chains from changes in a supply chain or supply network to firm value can be quite long and hypothetical.

Keywords Supply chain integration · Interfirm relationships · Networks · Causal framework · Cause-and-effect-relationships · Value creation · Value-based management

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1 Introduction

During the last two decades, scholars of organizational theory, marketing, industrial organization, and, with increasing passion, also logistics and supply chain management suggest that companies should extend their focus beyond the realm of their own organization into the environment in order to increase a firm's performance, see e.g. [38, 59, 80]. A major topic is the integration of business activities across firm boundaries in order to reduce costs. A related issue is closer cooperation with customers and suppliers resulting in tighter coordination of business activities aimed at fuelling the race for profit, not only on a bilateral but also multilateral basis, e.g. [12, 64]. In particular supply chain integration activities have been receiving growing academic attention since the mid 1990 s [18, 41, 46, 73, 115, 118, 120, 128].

Researchers commonly use three different theoretical approaches to explain this phenomenon of increasing networking of firms. With reference to transaction cost theory, firm networks describe a dynamic equilibrium between internalizing and externalizing economic activities. The firm that has a better command of a certain activity than other firms will observe this activity in the network to achieve an allocation of functions within a network at minimum transaction costs [135]. Proponents of a resource-based view argue that "resource owners increase productivity through cooperative specialization and this leads to the demand for economic organizations which facilitate cooperation" [3]. Dyer and Singh explicitly add inter-organizational relations as a discrete class of objects to the resource-based view: "Productivity gains in the value chain are possible when trading partners are willing to make relation-specific investments and combine resources in unique ways. … Thus, idiosyncratic

interfirm linkages may be a source of relational rents and competitive advantage." [38] (p. 661) This extension is also commonly taken up under the term "relational view" [80] (p. 638). The "Industrial Marketing and Purchasing" (IMP) group follows a somewhat different research tradition. Exploiting case studies, business exchange is described as a dynamic phenomenon, asking how companies are doing business and what is created when businesses and other organizations interact. IMP research offers some descriptive frameworks; e.g., the "interaction model", which rests on the assumption that economic resources are heterogeneous and that their economic benefits are created within buyer–seller interaction, or the "ARA model", which analyzes connected business relationships [45, 95, 124].

A lot of success stories surround the topic. For example, [136] relate the early success of Japanese car manufacturers in part to their distinct form of cooperating with suppliers (tiered, hierarchical supplier networks). Bovet and Sheffi [13] attribute the success—measured according to the decrease in logistics costs or the increase of share price respectively—of companies like Dell or Procter & Gamble to their supply chain excellence due to close inter-organizational relationships. Slone et al. [114] report on a global chemical company which substantially increased ROA by better supply chain management. D'Avanzo et al. [30] show that the cumulative average growth rates of shareholder value (market capitalization) are 7–26% points higher in companies with best supply chain management practices ("supply chain leaders") compared to the industry average growth rate.

After the "dotcom crisis", Singhal and Hendricks [113] (p. 19) note that "in the recent past, it was quite easy to make the case for supply chain management. All one had to do was to point at the skyrocketing share price, high price-earnings ratio, and soaring market capitalization of the supply chain solution providers and of companies considered to be supply chain management role models (Dell, Procter & Gamble, Intel, Sun Microsystems, and Cisco, to name a few). Now, it is more difficult to make that same case as most of these companies have experienced a significant drop in their market value." This situation suggests the need to appraise investments in interfirm relationships in terms of supply chains or supply networks carefully and therefore to go beyond anecdotal evidence.

Hence, this article attempts to help decision makers to reliably assess the effect of investing in inter-organizational network arrangements on firm value by using a conceptual framework. The task of this framework is to support the structuring and revelation of the causal chain between investments in supply networks and the effect of these investments on firm value.

Ford [44], Brennan and Turnbull [15] and Brennan et al. [17] discussed extensively the concept of adaption (i.e., to meet the needs of the partner either by incurring costs or by management involvement) during the development of long-term buyer–seller relationships.[1] Accordingly, this article defines network investments as efforts to establish, adapt, or change a firm's surrounding network in order to improve its performance. For example, network investments could be initiatives such as collaborative planning, forecasting and replenishment processes or automatic replenishment programs (ARP), of which vendor managed inventory (VMI) is quite popular. Our understanding of network investments is in line with the general perception of investments: expending resources today in order to receive greater expected returns in the future. Limited to the financial sphere investments are characterized by an initial cash outflow in the present and a sequence of net cash flows in the future. Hence, the decision maker has to discount the future cash flows and proceed (reject) if the net present value is greater (less) than 0.

The article is organized as follows: in Sects. 2 and 3 we explain main terms, propose the research question and our methodology. In Sect. 4 we review the existing body of literature and summarize major findings. In Sect. 5, we develop and explain a conceptual framework consisting of five components to help answer the research question in detail and later on relate extant literature to its components. After a discussion of our results in Sect. 6 we conclude identifying further research opportunities.

2 Supply chains and supply networks as research objects

Recent literature makes a particularly strong argument for the vertical environment, see e.g. [78], often called the "supply chain", resembling an organizational arrangement which Thompson [121] coined as the "long linked technology". Thus, a supply chain is "a set of sequentially inter-dependent order-linked actors who pass products in a uniform direction from the stages of raw material production along several steps of manufacturing and assembling through various stages of moving, storing and selling to the final customer in order to satisfy customer demand, thereby optimizing choice, service, speed, and cost" [74] (p. 337). Stabell and Fjeldstad [117] point out that the sequential supply chain is but one of three generic types of interdependencies within and between organizations, Thompson [121] identified. The supply chain view models the activities of a serial interdependent

[1] See also Williamson's [135] concept of investments in transaction-specific (idiosyncratic) assets.

long-linked technology, i.e., where the output of one activity is the input of another activity. Pooled interdependence between two activities means that they are sharing a common resource. Reciprocal interdependence means that there is a mutual exchange of inputs and outputs between two organizations. Accordingly, some authors agree that serial interdependence is characterized well in the supply chain metaphor, while the term "supply network" should be used for organizational arrangements between buyers and sellers with pooled and reciprocal interdependence [47, 56, 66]. Nevertheless, other researchers use the term "network" in a variety of disciplines; including business research. But also limiting the study to the field of business research, the term "network" still refers to a huge amount of inter-organizational relations where different interpretations become apparent. Literature offers schemas to organize these approaches [2, 127]. Accordingly, the following distinguishes four meanings of the term network but used a different terminology to denote the meanings.

2.1 Model view

Network as a result of a modeling process: Primarily, the model view is dispassionate by claiming the possibility to model organizational reality by using the network notation, namely arcs and nodes. Nohria [98] (p. 3) calls this a "mode of enquiry." Thus, initially a network is nothing more than a model. Strictly speaking an artifact which is created in the course of modeling reality using network language, whereas the network model is deemed to be a powerful way to access reality [93] (p. 46), [51] (p. 604). As Nohria [98] (p. 3) is phrasing metaphorically: "… a network perspective is a particularly sturdy walking stick that is likely to hold up well in our intellectual inquiry of organizations." Much literature embarks upon the model view [32, 122], although much of this literature continues on to more substantial views (see below).

2.2 Organizational view

Network as a distinct organizational arrangement: the organizational view sees networks as distinct, generic types of organizational arrangements [127], which come into existence because of specific environmental conditions, namely "… cases in which the environment of the organization is of a concentrated and structured kind …" [57] (p. 190). Networks gradually evolve over time and are rather a consequence of an environment than a result of deliberate structuring. Along with this view, researchers suggest connotations like mutual trust, stability, long-term orientation, intimacy, commitment, closeness [2].

2.3 Management view

Network as a superior organizational arrangement: the management view sees networks as innovative, superior forms of organizing economic activity, as business systems [2]. Networks are created deliberately by concerned managers in response to changing economic environments [98]. They are built up and maintained for profit making purposes [2]. As Jarillo [68] (p. 32) is putting into words: "I see strategic networks as long-term, purposeful arrangements among distinct but related for profit organizations that allow those firms in them to gain or sustain competitive advantage vis-à-vis their competitors outside the network."

2.4 Functional view

Network as a functional organizational arrangement: this view has been triggered by Thompson [121]. Thompson distinguished long-linked, intensive, and mediating technologies. Companies employing the mediating technology, because of its task to link their customers, produce network structures (e.g., telephone, transportation, banking, insurance).

This article uses a model view of the term "network." In line with the model view, researchers define a network simply as a set of nodes which are connected by a spanning set of arcs [1, 55, 79]. Strictly speaking, a network is nothing more than an artifact which is created in the course of modeling reality using network language, whereas researchers deem the network model to be a powerful way to access reality [51, 91]. Thus, by using the term "network," research implies neither any particular form of organization, closeness, mutual trust, superiority, nor any other connotation. Accordingly, modeling a broad spectrum of organizational arrangements as a network is possible. This article focuses mainly on reproduction networks. Reproduction networks are vertical networks, according to Thompson's [121] "long linked technology", that differ from other network types in regard to their function (see Fig. 1).[2]

Reproduction networks are the most frequently used in industrial production. They mass produce fully designed material or non-material products using standardized routines. Repeating pre-designed standard operating procedures creates economic benefits. A major challenge for the management of such supply chains is coordinating the sequence of these procedures within and between companies, primarily via plans. The architecture of the network as

[2] For a brief description of the reproduction network and the other network types, see e.g. Otto [102]. For an alternative classification see e.g., Möller et al. [93].

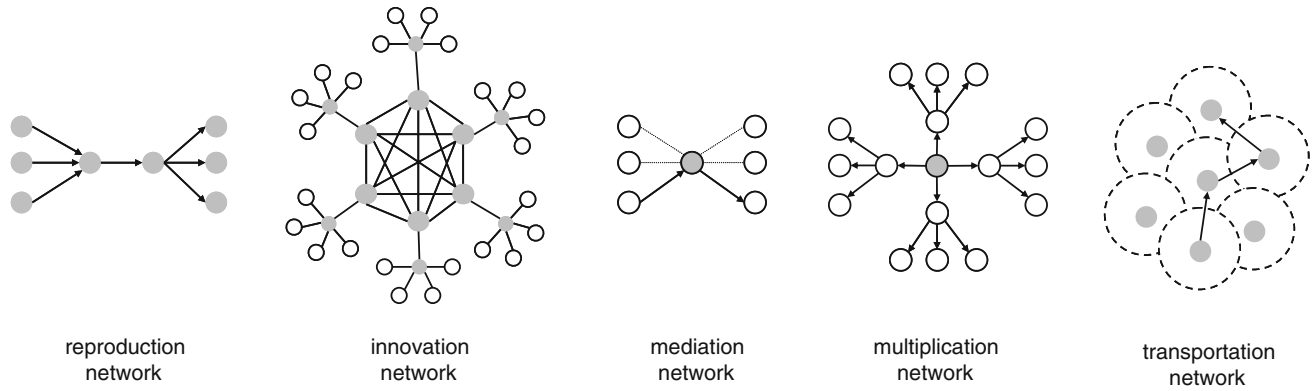

Fig. 1 Functional network typology

well as the flow of objects within the network is the result of a management process. Hence, it is a major issue to integrate business activities across firm boundaries and to cooperate closely with customers and suppliers as the major assumption behind the management of supply chains is that there is an economic rationale related to close cooperation and the integration of activities.[3]

3 Research question and methodological aspects

Decision makers face some problems when deciding on network investments. The existing research is situation-specific and in part contradictory. Furthermore, network investments are tough to justify due to their cross-organizational scope. Rules of thumb and intuitive reasoning may easily lead to poor decisions. Thus, decision makers need to process the available research results. Finally, decision makers are well advised to build up a situation-specific decision calculus that connects network investments to financial results. This calculus needs to be able to represent and organize the relevant research results mentioned above. Following the corporate finance and value-based management literature [27, 107], a firm's performance should be measured by its increase of shareholder value (i.e., changes in firm value). Hence, the research question is: how can a decision maker reliably assess the effect of network investments on firm value?

In order to answer this general question we suggest offering a framework to decision makers to link network investments to shareholder value. The principal research methodology in deriving this framework is based on sociometric network analysis [79, 91, 131]. From this point of departure we proceed with logical deduction of networking mechanisms from a model view of supply networks. Furthermore, this study partially tries to fill the framework with empirical content. Therefore, we employ empirical studies from several fields of research; e.g., sociometric network analysis, applied network theory, but also supply chain management and related fields. In addition we illustrate the framework applying it to VMI, a popular supply chain management practice. In order to link network investments to shareholder value we have to arrive at a calculus which is based on findings from corporate finance and capital budgeting offering value-based performance measures.

A framework to explain the link between network investments and firm value is lacking despite the multitude of existing references. (1) The investment and finance literature does not treat the issues of network investment appraisal. (2) The sociometric network analysis (see [131] for a comprehensive introduction) in particular only elaborates on how to modify a network generically, and develops helpful language to describe networks, but (for good reasons) does not extend the focus to the management-related questions, like whether modifying a network in a particular way is paying off. (3) The applied network theory picks up the terminological environment of the sociometric network research, and proceeds by explicitly trying to build prescriptions. In most cases, however, their causal models remain on a non-financial level. (4) This finding also holds for the majority of research in supply chain management. Conceptual articles and also case study based research primarily remain on the non-financial level. This corresponds with two other circumstances: First, in practice many companies realize the power of network investments on a limited scale and do not fully recognize their effects on financial performance. Second, supply chain managers often do not speak the language of "value-based management", and remain in non-financial terms such as inventory levels, lead times, service levels, or

[3] New [97] (p. 20) coined the term "supply chain hypothesis": "Organizations will reap commercial benefits from understanding the supply chain and (somehow) managing it. Effective firms will increasingly focus their efforts on strategies which seek to enhance the performance of the whole chain".

on-time performance. (5) Recently, researchers criticize network research-related scholars for disregarding the issue of the relevance of their outcomes to management practice [16]. Gemünden [49] (p. 9) particularly criticizes the IMP research program for not turning its attention to relevant questions like "… how, why, when, and to what extent relationships and networks really do influence the performance of a firm." He finds fault with the fact that "researchers have mostly taken this impact for granted. However, the development of a network is a costly investment, and there are different options as to how to do this." (6) Linking network investments to shareholder value is hard. For example, researchers and practitioners may put forward that there are too many time lags between network investments and their impact on shareholder value. This certainly is true. However, especially such time lags call for an accurate analysis and forecast of the effects.

4 Literature review

There are mainly two research streams, where recent supply chain management literature offers some support to link network investments to financial outcomes or firm value: empirical studies and normative statements.

4.1 Empirical studies

Decision makers can obtain empirical evidence that other companies made successful investments in networks; i.e., there is some evidence of positive relations between supply chain or network activities and performance. Both case studies and surveys provide such evidence. Assuming proper usage of the techniques to conduct empirical studies and leaving aside the idiosyncrasies of "best practice" studies, the basic argument is that a network investment will pay off since it did in other companies. Li et al. [82] present survey-based research proving a positive relation between the implementation of particular supply chain management practices (which change the inter-organizational links between customer and supplier) and organizational performance and competitive advantage. Wicht et al. [133] reveal that companies engaging in collaborative planning, forecasting, and replenishment projects should not put too much emphasis on the collaboration, as primarily the automation of the process creates the advantages. Magnus et al. [85] report empirical results from the European retail market, showing that investments in more cooperative joint processes actually reduce performance, whereas investments in social bonding between manufacturers and retailers and in open exchange of data between these partners pay off well. However, all of these do not cover financial effects remaining at connecting network investments with some non-financial effects, see also [46, 95, 96, 129]. Fabbe-Costes and Jahre [41] even question whether supply chain integration activities and its positive effects on firm performance are more rhetoric than reality. Another problem adherent to such studies is the dazzling use of the term "performance", which researchers rarely map to the financial bottom line. Using survey-based research designs results are often gathered from a Likert scale, which may cause problems regarding the constructs, measurement, and items. For further critique of recent research in supply chain integration based on surveys, see [128]. In contrast, the empirical work of Hendricks and Singhal [61, 62] explicitly concerns the financial impact, measured by shareholder value lost, of supply chain glitches. To estimate this effect, they use event study methodology to compute abnormal returns around the date when information about glitches becomes public. They find out that announcements of supply chain glitches cause a mean abnormal decrease in shareholder value of 10% in the short term [61] (p. 509), and 41% in the long run [62] (p. 42). By inverting these findings, one can estimate a significant value creation potential of more reliable and responsive supply chains. Mitra and Singhal [90] discover that participation in consortium-based industry exchange causes positive abnormal market reactions. In contrast to the vast array of work in this field, these findings are beneficial since they empirically prove the existence of a network investment effect by using capital market data. However, a general approach for a causal analysis of this effect is not their goal and is not given.

4.2 Normative statements

A further type of support is from the literature on how to build a decision or valuation calculus. The basic structure of an economic calculus compares cost and benefits of a decision, suggesting that decision makers should make the decision if benefits exceed cost. If decision makers know both for all investment alternatives, formal decision theory supports their decision making well. The more difficult task is to locate, identify, collect, quantify, and verify cost and benefits. In the area of supply chain management (as a vertical form of networking) value driver trees may explain the link between operational changes and financial outcomes via arithmetic relationships. Lambert and Pohlen [77] use value driver trees to analyze the value effects of different forms of inter-organizational management (Customer Relationship Management, Supplier Relationship Management, Supply Chain Management). They build up causal chains; e.g., between an increase in sales volume and an increase in gross margin, which later on increases the firm value, measured in economic value added (EVA). Another example would be an increase in inventory turn

from six to eight turns per year will ceteris paribus increase the return on equity by 0.3%. Thus, value driver trees are helpful since they direct managerial attention toward effective value drivers. However, in many cases managers cannot connect the focal investment to the value drivers immediately. As the example demonstrates, you cannot "buy" an increase in inventory turn. You can buy better software, hire better inventory managers, or work more closely with suppliers, but researchers have not yet proved whether this will finally increase inventory turn. So the problem is not to connect the cause metric with the effect metric (inventory turn with return on equity), but to estimate the likelihood of changing the cause metric by certain activities. Hence, Lambert and Pohlen [77] only present the formal and therefore "easy" link of the chain: obviously an increase in sales volume increases gross margin, since this increase is a defined formal linkage. Explaining how to achieve this increase in sales is more difficult. Horváth and Moeller [65] present another piece of research. They look for value creation capabilities which supply chain management impacts in any way, and make suggestions concerning what supply chain management needs to do to modify this impact. However, this article rejects one aspect of their argumentation: Horváth and Moeller [65] also suggest a value tree that differentiates on the top level between "tangible value creation" and "intangible value creation." Most of the phenomena which networks drive will end up in the category "intangible value creation." This is neither helpful nor necessary. If investments in the network only relate to increases in intangible value or intangible assets, legitimistic concerns will grow. If decision makers cannot explain how an intangible asset can improve firm value, they should reject investments in this intangible. So, if one heads toward a causal explanation of the network investment effect, measured in firm value, she/he has to relate the network investment to the bottom line, at least at the end of a (probably long) causal chain; that is, to a driver that directly affects firm value. Where Lambert and Pohlen [77] fail to explain the chain from the investment to the increase in sales (material aspect), Horváth and Moeller [65] fail to explain how the investment in the network can reach the realm of the direct, formally linked drivers of firm value (formal aspect).

The recent supply chain management literature offers some support to link network investments to financial outcomes or firm value. However, the financial impact of supply chain integration activities has been widely neglected. Hence, this article attempts to make a contribution where the literature falls short. In order to establish linkages between network investments and changes in metrics, we are searching for available explanations that establish a linkage between an investment in the inter-organizational network and the firm value in integrate them into a conceptual framework. The importance of that linkage has prominent protagonists. Singhal and Hendricks argue that a major challenge for supply chain executives is "to convince senior management, Wall Street, customers, and various supply chain partners that supply chain performance matters. … If they are to make the case that there is money on the table to be grabbed through better SCM, they will need to support it using bottom-line measures and objective evidence. There is no better way to do this than by establishing the link between supply chain performance and shareholder value" [113] (p. 19). Mouzas [94] points out that firms' endeavors need a framework that enables them to be effective, that is, to create sources of value inherent in business networks to be measured using the present value of all future earnings, and be efficient at the same time, in other words, to create superior levels of sustainable productivity. To be meaningful for decision makers these linkages must address the idiosyncrasies of a focal company.

5 A conceptual framework for a causal explanation of the network investment effect

Obviously, research on financial effects of network investments is nascent, however, lacking both the agreed-upon constructs and theoretical frameworks necessary to move forward. Hence, Fig. 2 shows the proposed analytic framework for a causal explanation of the hypothesized linkage between supply chain integration activities (i.e., making investments in the vertical network) and their effect on financial performance, finally measured as an increase in firm value, which the authors call the network investment effect.

If network investments (left-hand side of the framework) are to increase firm value (its components on the right-hand side of the framework respectively), the decision makers need to establish a logically plausible causal chain, departing from the left-hand side of the focal network investment (networking dimension, networking mechanism), touching expected networking effects in the middle section of the framework, and finally reaching non-financial and financial indicators on the right-hand side.

The heuristic benefit of the proposed framework is twofold: first, the framework explicitly names the steps one needs to cover in the pursuit of explaining the network investment effect ("what to do") with material effects and connect these effects with accepted indicators of financial success. Second, the framework draws attention to the vast array of existing theory to support decision makers in building their causal chain in terms of an adequate business model.

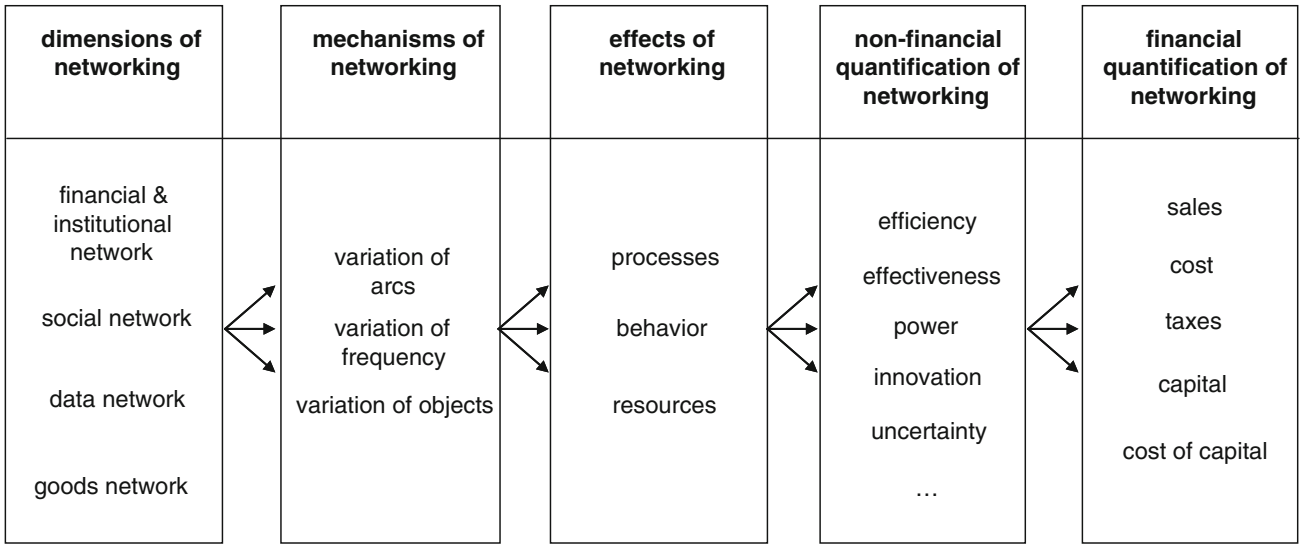

Fig. 2 Framework for a causal explanation of the network effect

On the left-hand side the framework guides the decision maker as to how and on which dimensions networking can take place. The middle section calls for a review of the huge reservoir of existing research linking selected network mechanisms (changes in the structure of arcs and nodes) to indicators of organizational performance. The right-hand side urges the decision maker to be explicit: which financial indicator can I improve? The above review reveals that the literature often leaves out this final step.

The right-hand side of the analytical framework uses two steps to document the effects of network investments: financial and non-financial indicators. Financial indicators are relevant to decision makers. But the introduction of non-financial indicators allows the linking of existing knowledge to the causal chain more easily; that is, re-use existing knowledge in order to build one's own sound theory of how a network investment will increase firm value. Empirical findings, for example, provide evidence that vendor transaction specific investments have (a) a direct impact on trust in a relationship between manufacturer and retailer, and (b) an indirect impact on the long-term orientation of a relational exchange [48]. More existing knowledge, especially from structuralistic approaches to network theory [26, 32], could be activated in a similar fashion. Cook and Whitmeyer [26] (p. 114) link this research to the structuralistic view in sociology, suggesting that "all important social phenomena can be explained primarily, if not completely, by social structure." Researchers can integrate such empirically tested truths into the framework to help build a "theory in use." But the task for the decision maker is not finished, since the "long-term orientation" in itself, for example, is only a non-financial indicator. To close the gap, one has to continue by arguing whether long-term orientation affects financial indicators of firm value, and if so, how. The following overview explains the framework in a sequential manner from left to right. Nevertheless, this display format should not suggest that no interdependencies can occur between different steps in the framework, but should merely help to reduce complexity.

5.1 Dimensions of supply networks

Asking whether networking creates value is senseless in so far, as economic actors are always connected via goods, information, and financial flows. Thus, the question is not whether one networks, but how: a firm's performance is not only the result of its own individual efforts but depends necessarily on its relations to the surrounding network, e.g. [134]. Thus, network configuration analysis helps to explore the options for networking by modeling transactional organizational arrangements. A transactional network connects actors which maintain exchange relationships [43, 122, 132]. The arcs may represent any exchange objects. Such a multiple network is, to rephrase Nohria [98], a specific mode of inquiry. The notion of multiple networks implies, for the sake of analysis and management, that an organizational arrangement should be treated conceptually as a set of multiple, layered partial networks. The partial networks are unique in that their constitutive characteristic is the object that flows within the layer. As stated above, basic flows in business networks are goods, information, and cash flows. Furthermore, institutional and behavioral economics suggest considering institutional as well as social aspects of relationships which also play a major role in business networking. Based on these theoretical insights, the following suggests

differentiating four network layers: the financial and institutional network, the social network, the data network, and the goods network (Fig. 3)

For a better understanding of the suggested network layer's basic properties, which may be interdependent, see Table 1.

In order to illustrate these dimensions we use VMI as an example. Many companies have applied ARPs over the last few years, among which VMI enjoys great popularity, to improve inventory performance, see e.g. [22, 39, 103, 111, 130]. VMI changes the traditional replenishment process from distributor generated purchase orders to manufacturers' recommended replenishment quantities and typically involves the use of information technology. In VMI systems the vendor has to establish reorder points for each item. On reaching the reorder point level in the customer's inventory, the vendor generates the replenishment order based on actual sales data, and delivers a batch size ensuring availability without excess inventories on hand. The vendor makes replenishment decisions in accordance with pre-defined service level agreements between VMI partners. The vendor's upstream network node contains this process, observing outward stock movement at the retail outlet and replenishing based on the vendor's inventory plan.

Considering the dimensions of networking, VMI represents at first a change in the data network. In order to enable the supplier to generate meaningful replenishment quantities the buyer needs to communicate additional data, like demand projections and inventory status data. This data exchange is regularly based on a contractual agreement, which is represented in the institutional networking dimension, determining service levels, or delivery frequencies. The goods network will also be affected, since the frequency and quantities of products moved now represent the supplier's planning and may substantially differ from the buyer induced flows being witnessed before. Finally, this situation will also have an effect on the social network, since the traditional linking pin structure between the companies will be extended from only one pair (procurement—sales) to multiple pairs (procurement—sales, inbound logistics—outbound logistics).

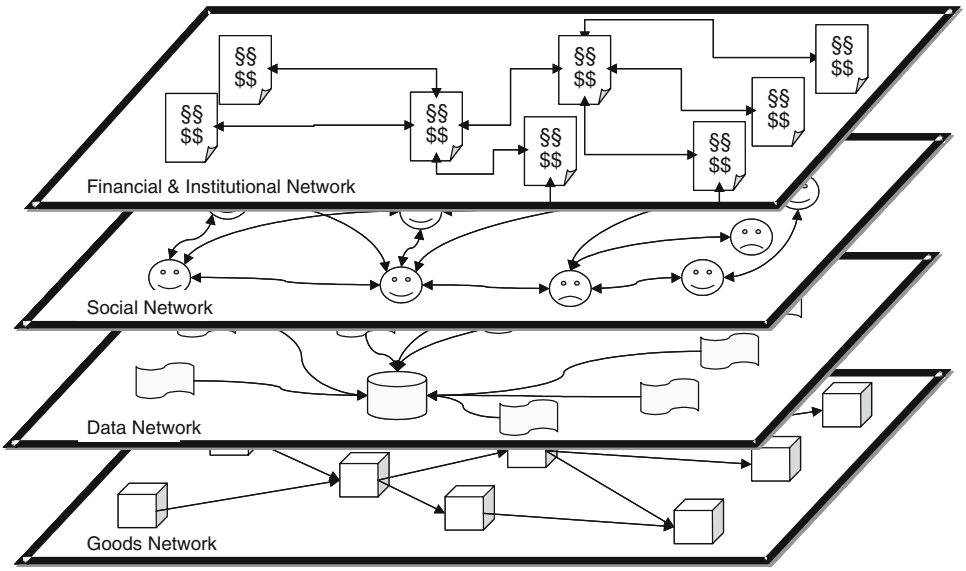

Fig. 3 Dimensions of networking: four relevant network layers

Table 1 Properties of network layers

Partial network	Node	Arcs, objects
Financial and institutional network	Supply and demand side ordered firms, inter-organizational planning authorities, investors, governments	Investments (capital), payments, indentures (rights, duties, cash flows), director interlock (interests), laws (taxes)
Social network	Decision maker	Relationships (interests)
Goods network	Transfer mechanisms (transportation, handling, warehousing), transformation mechanisms (production)	Transport systems (goods and services)
Data network	IT systems (man or machine)	Communication channels (data)

5.2 Mechanisms of supply networks

In line with the model view of supply networks, we defined a network simply as a set of nodes which are connected by arcs. Accordingly, three generic mechanisms are logically derivable from the network model at each dimension to modify a network:

5.2.1 Variation of arcs

Links between actors (nodes) are called arcs. Arcs can be established, maintained or eliminated. A variation changes the network structure. Adding a new supplier means adding an extra arc, for example.

5.2.2 Variation of frequency

The frequency of the exchange (i.e., any exchange pattern) between the actors can also be modified. Suppliers deliver more often, or sales agents visit customers more often, for example. However, this frequency does not affect the network structure.

5.2.3 Variation of objects

Finally, researchers can modify a network by adding, varying or eliminating the exchange objects. Mitchell [89] (p. 23) differentiates the exchange categories "communication", "products/services", and "norms".

Implementing a VMI program would require adding objects to the existing arcs in the network between manufacturer and buyer, requiring an exchange between inventory status and demand data. VMI changes the frequency of network exchange from a periodic transfer of purchase orders to a more frequent, probably even daily exchange of inventory and demand/sales data. In some cases VMI may also require additional arcs, if, for example, multiple points of sale and multiple warehouses communicate updates to the manufacturer, where previously only a central procurement body of the buyer issued purchase orders.

5.3 Generic effects of network investments

Dimensions and mechanisms of networking are instruments to describe the field of possible supply network investments. The question remains what kinds of effects the corresponding variations cause. Furthermore, we have to avoid the risk of interpreting the single network layers as independent from each other, which would hinder a full understanding of the value creation process of supply networks. Therefore, we have to consider interrelationships between different network layers. For a better understanding of business relationships Håkansson and Snehota [58] distinguish activity links, resource ties, and actor bonds (ARA-model) as three different effect parameters that can be taken as determinants of a relationship's outcomes. Correspondingly, the following integrates possible effects of network investments in generic classes. These generic effects concern processes, behavior, and resources. Treating these effects separately is helpful in reducing complexity. Nevertheless, we have to keep in mind the interplay between these generic networking effects: processes depend on resources and actor's behaviors, and resources limit the range of possible behavior an actor can pursue for example.

5.3.1 Network investments affect processes

A process effect results from closer activities between two partners, which furthermore—as a reaction to a variation in networking (arc, frequency, and object)—leads to a (direct) change in the efficiency or effectiveness of a process. For example, a variation of the networking in the supply chain context, can stimulate the following process effects (ordered by integration intensity): inter-organizational exchange of information, coordination of the order flow, coordination of capacity, or inter-organizational reorganization (i.e., modification of the process structure to eliminate redundant value creation processes, standardize processes, or swap value creation activities between institutional actors to reap comparative cost advantages).[4] The information systems and supply chain integration literature generally accepts that information technology plays a major role in realizing process effects, as stated above [54, 86]. But researchers in general must analyze whether a variation changes the process efficiency or effectiveness accordingly in order to link it to financial measures, see e.g. [94].

Proceeding with the VMI example, from the manufacturer's point of view, VMI affects the efficiency of the replenishment process, since the manufacturer can decide autonomously on the replenishment quantity and time, thereby increasing the truck utilization, and reducing the transit time of products from the factory to the inbound stock of the buyer.

5.3.2 Network investments affect behavior

According to the network model presented above, arcs not only connect processes but also actors. Accordingly, network investments also affect the behavior of actors in a

[4] Kambil and Van Heck [70] provide a generalizable framework of basic exchange processes, identifying ten distinct processes operating in interfirm exchange relationships, which also can be helpful to analyze generic process effects of supply chain integration activities.

network; i.e., "how actors perceive, evaluate, and treat each other" [57]. A positive behavioral effect may exist if a variation in networking influences the propensity of actors to act cooperatively. Actors can exert influence directly (actor connected to varied arc) or indirectly (actor linked to a directly influenced actor).

The definition of cooperative action in this article is a distinct behavior of a decision maker who voluntarily and deliberately accepts the concerns of his exchange partners as restrictions on his decision making situation. The behavioral effect can affect firm value directly or indirectly. An indirect effect means that the modified willingness to cooperate only affects the execution of processes. For example, a network investment may spur the sharing of point-of-sale data between manufacturer and retailer or joint consideration of replenishment, which in turn may influence firm value. A direct influence emerges if an actor immediately hands over benefits to a network which are directly relevant to firm value (e.g., increased sales volume within the exchange category).

In our example, VMI constitutes links between partners and therefore affects the propensity of manufacturers and buyers to cooperate. Buyers assign control to suppliers and rely completely on their ability to provide proper material right on time. Suppliers, on the other hand, accept high levels of commitment from the customer. Besides these more strategic effects VMI also has operative behavioral effects: coordinated activities become possible due to technical investments, but also require cooperative behavior if firms are to execute them.

5.3.3 *Network investments affect resources*

Networking also links resources and therefore supports the build-up of tangible or intangible resources which allow for an improved execution of future tasks. This is what we call the resource effect. A direct resource effect occurs when those resources which are tied together become beneficial relationship-specific "resource constellations" [57]. Besides a direct impact on firm value, the resource effect can indirectly impact behavior and processes via trust, knowledge, competitive position, or real options, for example.[5]

5.3.3.1 Trust Networking can increase the "trust" resource, which in turn may impact the behavior and duration of the network relationships [48, 110], and can reduce risk. Trust can particularly reduce behavioral uncertainty and asymmetric information, and thereby help to overcome opportunistic behavior [8, 31]. However, trust need not be fruitful per se. Instead, empirical findings suggest the establishment of management control systems with trust saving mechanisms [92]. Also, in a trustful context, cooperative action becomes possible, which in turn may trigger process effects, for example the exchange of confident data.

5.3.3.2 Knowledge A further potential effect is the access to and accumulation of knowledge; that is, learning, information, know-how and capabilities, which in turn impact behavior and processes [63] (p. 738). The transfer of knowledge to partners creates economies of scope. Furthermore, learning from experiences in networking facilitates interfirm know-how transfer [40].

5.3.3.3 Competitive position In addition, networking can improve the competitive position of a firm, e.g. [29, 38, 68]. Competitive position is a resource that directly impacts firm value. Loosely networked actors find themselves confronted with an institutional arrangement of tightly networked firms enjoying a comparatively strong competitive position.

5.3.3.4 Real options Furthermore, networking may create other resources, namely real options. Real options represent future courses of action which would otherwise have been impossible. A growth option may serve as an example: In the course of a global strategy, a network partner opens up the option of taking part in this endeavor, and thus extending the footprint of the company into new markets as well. Another example is managerial flexibility in terms of production capacities over different suppliers considering demand uncertainty, e.g. [116].

Carrying forward the VMI example, such programs support trust-building by close and successful collaboration, which in turn may impact behavior and/or the duration of the network relationships. Furthermore, the manufacturer especially will build up knowledge on how to forecast demand accurately, manage inventories, and meet customer service goals. Moreover, learning from experience in networking facilitates behavioral and process changes in turn. In addition, as the case of Shell Chemical Co. shows, VMI can help to differentiate from its rivals, particularly in industries often viewed as commodity businesses [105]. Finally, initiating and providing ARPs can contain the real option of enhancement to embrace consignment inventory arrangements.

5.4 Non-financial effects of network investments

As a next step the framework suggests analyzing the impact of modified processes, resources or different behavior on non-financials, like inventories, innovation

[5] The indirect impact only emerges after the resource itself has emerged. For example, trust is treated not as precondition of networking (which it surely is) but as a potential effect networking can affect.

rate, time to serve, access to markets or resources, or productivity. Since the dominant approach in the network literature is to analyze the goals or the functions of networking respectively, the explanation of non-financial effects here can refer to a huge amount of existing literature, see e.g. [9, 10, 42, 60, 115, 123]. However, the focus of this article is not on the goals but on the effects of networking. For literature reviews embracing recent findings in supply chain integration research, see e.g., Fabbe-Costes and Jahre [41] or Van der Vaart and Van Donk [128]. Ritter and Gemünden [108] (p. 692) argue that "the problem with today's network literature is that it is fragmented and—at least sometimes—different pieces do not seem to fit together." The proposed framework may also be a help in structuring the existing findings in an explicit way "from left to right"; that is, from specific changes in current networks to the value of the firm.

Continuing with our VMI example, there are multiple non-financial measures which are affected. For the sake of our framework, we will only mention the most important: VMI increases truck utilization, since the system can adjust replenishment quantities to meet truck dispatching needs, and achieve fully utilized trucks. VMI increases inventory turns. In a retail survey analysis, Clark and Lee [23] find that retailers which had implemented an ARP with manufacturers increased inventory turns by around 60% and stock-outs decreased by 1.7% on average. Inventory turn is also improved, since unsteady orders (or order sizes resp.) from buyers no longer force manufacturers to maintain surplus capacity or excess on-hand inventory. According to a study by Sabath et al. [111], VMI reduces out-of-stock situations, since manufacturers are given the responsibility to re-stock according to their own expectations. They report that managers believe that running ARP like VMI helps their firms to achieve goals such as improved customer service, fewer stock-outs, improved reliability of deliveries, and faster inventory turnover. Furthermore, ARP helps managers to be effective in reducing inventory, overstocks, returns and refusals, handling, costs, and product damage.[6] VMI reduces the administrative burden, since the manufacturer does not have to process incoming purchase orders, and the retailer does not have to create and issue purchase orders. In practice, the process actually requires the creation of a purchase order on the part of the buyer, since the buyer's ERP system can only process the inbound delivery if a matching purchase order exists. However, a fully automated process creates the purchase order, which will not reduce administrative efficiency. VMI increases the production efficiency of the manufacturer, since the manufacturer can plan and run batch sizes autonomously without having to build up outbound stock. Manufacturers can ship the production output to the buyer at their own discretion. They must of course consider maximum stock levels at the buyer's site. Finally, VMI will reduce the magnitude of the bullwhip effect, since the system will transfer the demand information more often. The reduced bullwhip effect in turn helps reduce manufacturer inventory levels [21, 33]. Lee et al. [81] show that manufacturers reap inventory and cost reductions by sharing information, especially when demands are significantly correlated over time. Croson and Donohue [28] show in an experimental study that sharing POS data helps reduce the bullwhip effect by smoothing order oscillation of upstream partners.

[6] Although Sabath et al. [111] reap these results from a 7-point scale using a survey-based research design, which may cause concern regarding the constructs, measurement, and items (see [128]), other studies also confirm the findings.

5.5 Financial quantification of the network investment effect

5.5.1 Firm value as primary objective

The last and probably most crucial step of the framework is to estimate and calculate the value contribution of the non-financial effects which networking investments cause. According to our research question, we assume that a decision maker wants to measure the network investment effect by its impact on firm value. Thus, building a valuation calculus to link network investments to shareholder value is the main purpose of this article.

Following the corporate finance and value-based management literature [27, 107], it is common sense that the long-term financial performance of corporations, and especially joint stock companies, should be measured by their increase in firm value, that is, shareholder value. Ex post, market capitalization might be one possible measure. However, share price is not an adequate performance indicator for ex ante planning purposes. Therefore, an analytical valuation calculus is necessary. Furthermore, the application of shareholder value analysis accounts for the long term orientation of network investments. Network investments are often expected to have a time lag until an impact on firm value will occur. Hence, short term accounting measures would not be able to report the network investment effect properly. Instead, explicitly long term oriented shareholder value analysis is far better suited and should help avoiding short term thinking in business planning.

Before describing the valuation calculus, we have to consider two questions: what is the subject and what is the object of valuation? In general, subjects of valuation can be shareholders, bondholders, customers, employees, or other stakeholders. This article concentrates on the owners, i.e.,

the shareholders, due to the fact that on global stock markets shareholders expect competitive returns from their investments, and force managers to create value for the shareholders. Thus, the question is: which financial benefits can shareholders expect from a firm's investments in supply networks? In the case of the valuation object, one has the option of valuing a single company within its surrounding network, or the network itself. This article deals with the valuation of a single company. Network investments are thus seen from a firm's perspective. The reasons why this article does not provide an evaluation of network investments from a network perspective have their roots in huge problems of measurement, definition, and allocation of networks and their effects. Regularly, firms are part of multiple different networks simultaneously. Such networks often overlap, are polycentric, and are not clear-cut. Furthermore, the participating firms are economically and legally self-dependent for the most part. Subjecting them to a system of central planning in the search for a kind of inter-organizational optimum raises difficulties with respect to management and control. On the one hand, firms would have to establish competencies beyond common property rights on a network level. On the other hand, transfer price systems would become necessary as a result of the relinquishment of markets and market prices to balance costs and benefits. Finally, managers from every single firm have to give an account to the firm's shareholders in regard to whether the decisions were beneficial or not regarding the firm's shareholder value.

5.5.2 *Value-based valuation calculus*

The valuation calculus applying the present value formula is methodically based on findings from corporate finance and capital budgeting. Focusing on financial goals, the value of any asset equals the present value of its future cash flows. Hence, the value of a firm is determined by two economic factors: the future earnings and the opportunity cost of capital. Firms engage in exchange activities within their networks in order to generate sales revenues; these activities produce costs (operating expenses). Moreover, (current and fixed) assets that firms utilize are not cost-free. They bear opportunity cost of capital, predominantly measured as weighted average cost of capital (WACC).

Considering future earnings, the following valuation methods are available: (1) discounted cash flow valuation (DCF) based on expected free cash flows, or (2) residual income valuation (RI) based on expected residual earnings. Both valuation principles can be transformed into each other by considering cost of capital [84, 104], as indicated in Fig. 4.

The widely known DCF method discounts expected free cash flows with the WACC. The firm value results as DCF (see [14] for details). The RI method also discounts all RIs with the WACC until the end of the forecasting period. After that, a terminal value usually adds up to the value of an infinite lifetime. The periodic RIs are the result of the difference in expected earnings in terms of net operating profit after tax minus a capital charge. Researchers also refer to this difference as EVA. They often call the sum of the discounted residual earnings market value added (MVA). By adding the (book value of) initially invested capital to MVA, this valuation result of the RI method equals the DCF method.

For periodic performance evaluation, firms can use monthly, quarterly, or annual EVA statements. If the EVA is positive, the business can cover total costs including the cost of capital employed. If the EVA is negative, value is being destroyed. By interpreting periodic EVAs, one must be aware that several positive or negative performance signals do not allow a non-ambiguous statement concerning the overall performance of the network investment.

Furthermore, network investments may create options (see Sect. 5.3.3). Options could be to raise (or reduce) the level of inter-organizational networking, or to use the raised networking level as a platform for a later take-over of selected network partners. Besides the focal network investment, these options are relevant for the valuation, and researchers must integrate them into the valuation calculus using the real options approach (Binomial or Black-Scholes model) or via decision tree analysis. With the real options approach, the option value has to be added to the DCF value. If the DCF valuation is based on a decision tree analysis, real options need not be calculated separately [14, 27].

All relevant figures or financial quantities for running the valuation calculus (sales growth, operating expenses, cost of capital) have to be estimated. According to our framework this could be based on the financial effects which Table 2 shows.

Table 2 lists a number of relevant non-financial phenomena from network theory in an explanatory approach, and reproduces research results explaining how variations in networking influence these phenomena, and which financial quantities they affect. This table therefore constitutes a central interface in the proposed framework. One must be aware that on the one hand the above table cannot contain all the relevant literature, and the presented categories might not be all-embracing. On the other hand, this means future research opportunities: The authors could include a huge number of findings from the literature in Table 2, especially from empirical supply chain management research.

Picking up our VMI example, if the specified improvements in the non-financial indicators of performance actually set in, VMI can also increase the value-based performance. A reduced out-of-stock quota will reduce lost sales, improving both the buyer's and seller's

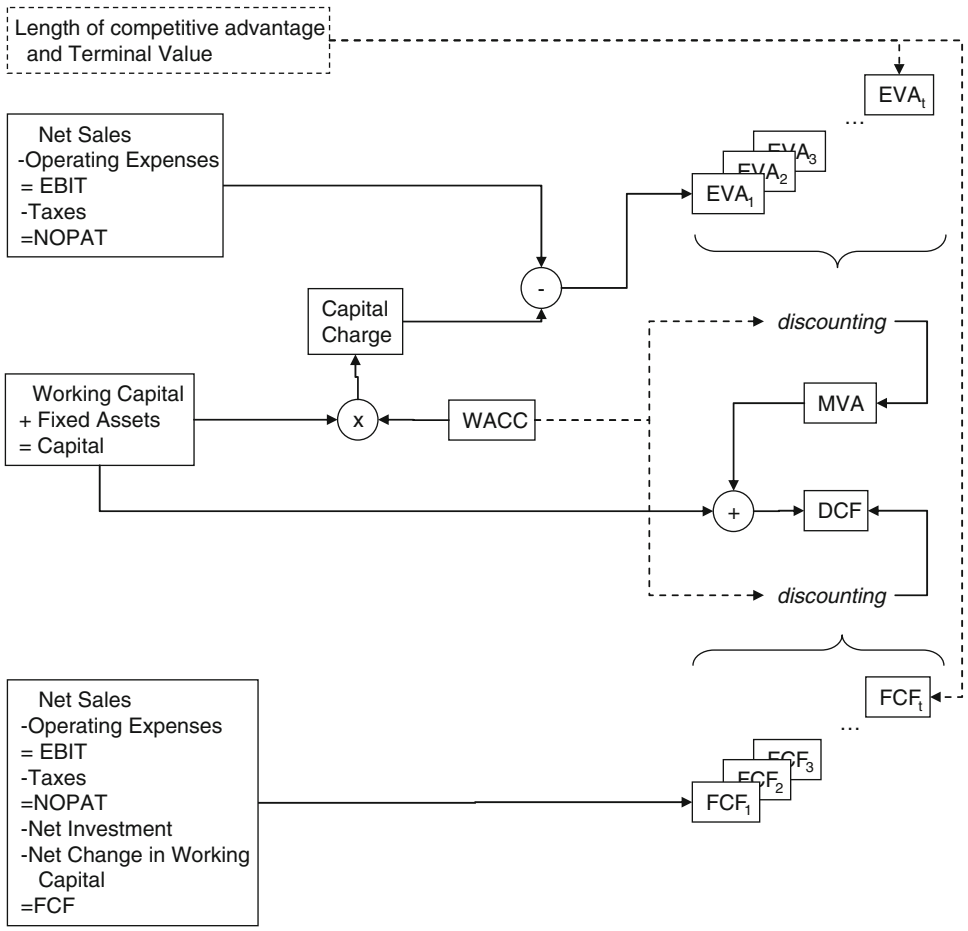

Fig. 4 Valuation calculus

performance. Automated administrative handling of purchase and sales orders, improved truck utilization, and improved operations productivity due to mitigating uncertainty of demand reduces operating costs. Improved inventory turn will reduce the volume of capital employed.

Nevertheless, translating qualitative effects into hard numbers means a hard job for executives. From the viewpoint of management control this procedure is also helpful as it reveals assumptions and responsibilities of planning and controlling a network investment. Of course, decision makers still have to deal with the problem of future prospects. However, this problem is not specific to the proposed framework here, but holds for all valuation and capital budgeting methods based on future earnings. Finally, researchers can assess the network investment effect by comparing the expected firm value with and without the focal network investment. This effect may certainly also be negative.

6 Discussion

In the remaining of this article we will discuss some characteristics that make the framework particularly beneficial for practitioners and researchers but we will also discuss some limitations.

6.1 Compatibility of documentation

Kaplan and Norton [71, 72] suggest that firms should explicitly document the process and the result of the strategic decision making in a structured form in order to ease strategy building, communication, monitoring, and revision. They suggest using strategy maps and balanced scorecards for documentation. The strategy maps are especially compatible with the line of thought this article advocates, since they resemble a cause and effect model. Thus, decision makers using the proposed framework to structure their theory toward the network investment at hand will organize and document their thoughts in a fashion basically compatible with strategy maps.

6.2 Compatibility of language

Supply chain managers often do not speak the language of financial and management accountants and remain in non-financial terms such as inventory levels, lead times, service levels, or on-time performance, while top management has

Table 2 Impact of networking on central non-financial and financial indicators

Networking influences …	This affects …	Examples, relevant research
Innovation	Sales	Network competence has a strong positive influence on a firm's product and process innovation success [109]
		Networking, especially connecting heterogeneous actors' impacts creativity [67]
		Networking impacts the innovation rate and thereby the financial performance of start-ups [112, 119]
		Networking affects know-how acquisition, which depends on strong and weak ties [53]
		Networking affects the velocity of the diffusion of innovations [24]
		Networking impacts the possibilities for companies to bundle their research and development abilities [59]
		Networking impacts the possibilities for companies to combine complementary competencies (technology leader, market leader) to reduce time to market and to reap first-mover advantages [11, 34, 42, 126]
Quality	Sales, cost	Networking through interfirm asset co-specialization is positively associated with quality [35]
Time to serve	Sales	Networking impacts the inter-organizational coordination of the order flow to reduce the "time to serve" [75]
		Networking through interfirm asset co-specialization is positively associated with new model cycle time [35]
Access markets	Sales	Networking impacts access to markets [34, 60]
Power, lobbying	Sales, cost	Networking impacts the possibilities for collective action as a means to enforce group interests [3, 100, 101]
		Networking influences the power (weight and domain) of single actors in networks [19]
Access to resources	Sales, cost	Networking impacts the access to resources like capital, personnel, or equipment [11]
		Networking improves access to information that would not effectively be available through conventional market mechanisms [52]
		Networking increases economic effectiveness through organizational learning and knowledge sharing [5, 37, 69, 126]
		Networking provides access to knowledge that is not available within a firm [36, 137]
Efficiency, economies of scale	Cost	Networking reduces each member firm's variable cost of production [83, 88]
		Networking reduces each member firm's investment cost [83, 88]
		Networking impacts the ease of extending the production volume [11, 25]
Fluctuation	Cost	Networking impacts the possibilities of reducing the amplitude of order size swings via coordination of local dispatching systems [7, 87]
Uncertainty	Cost of capital	Networking impacts the actor's propensity and tolerance toward defects [106]
		Networking impacts the possibilities of sharing the risks and costs of organizational action between organizations [11, 25, 42, 59, 83, 99, 126]
		Networking reduces uncertainty [38] (p. 669), [50] (p. 113), [6, 83]; in particular through cross-shareholding and director interlocks [125]
Inventory	Needed capital	Specialized supplier networks are positively associated with lower inventory costs [35]
		Networking impacts the possibilities of reducing inventory levels via coordination of local dispatching systems [87]
		Sharing inventory risk in the supply chain improves the system efficiency [20, 76]

to report the financial impact of their strategies to shareholder. In order to achieve a better understanding and more convincing arguments, the framework links the non-financial sphere of networking with "value-based management".

6.3 Explicit explanation

Explaining and forecasting network investment effects seems to be one of the most crucial steps planning or executing supply chain integration activities, which requires the construction of long chains of cause and effect relationships. For practitioners, who are unaware of the fundamental but complex dynamics of supply networks, the framework suggests explicitly listing the non-financial value drivers to support learning in regard to whether and how these drivers affect firm value. This approach can also be beneficial identifying the weak and therefore critical links of the cause and effect relationships.

6.4 Access to network theory

The structuralistic approach to network theory provides a huge reservoir of knowledge about how variations in network structure affect central phenomena (see Table 2 for details). The framework can reveal the abovementioned phenomena, and therefore provide access to this research. For example Uzzi's findings suggest that networking "increases economic effectiveness … that [is] crucial to competitiveness in a global economy—organizational learning, risk-sharing, and speed-to-market" [126].

6.5 Access to supply chain management research

Empirical supply chain management research also provides a huge reservoir of results in regard to how supply chain management practices affect central phenomena. The framework can also provide access to these findings, as the mentioned phenomena can appear in the framework. Future research in the form of literature reviews using the proposed framework could also help to bushwhack through the vast array of SCM literature [41, 128].

6.6 Research tool

Researchers may use the framework to generate, describe, classify, or evaluate supply networking strategies. Because research on supply networks does not agree yet on how to capture networking or supply chain integration activities, or how to measure the resulting effects on performance or firm value, future research in the form of literature reviews using the proposed framework could help to provide a useful survey of the huge amount of literature on networks and supply chain integration. Such research may also help to gain fruitful insights, and identify research gaps where the missing links in the causal chains are or where empirical proof is still necessary.

6.7 Limitations

Nevertheless, the framework does not claim to present a comprehensive list of dedicated causal chains, which are immediately prescriptive for decision makers. Hence, practitioners may not be totally satisfied. Although the article contains a framework that shows how to argue from "left to right", from network change to financial impact, no single comprehensive end-to-end causal chain appears which decision makers could use immediately. The question could be raised if such a causal chain has been explicitly established yet. In this aspect, decision makers as well as other researchers have to do the work, building a hypothetical causal chain for testing according to each case.

7 Conclusion

The findings of this study indicate that evaluation and decision-making concerning network investments are complex issues. Therefore, this article presents a causal framework to analyze network investments in terms of their expected impact on firm value. In order to actually realize the expected network investment effect the framework may also serve as a tool for controlling network investments. The framework claims to help analyze the network investment effect by structuring the analysis process by elaborating on the options for modifying networks (layers and mechanisms), systematizing effects of networking, linking effects to changes in non-financial performance indicators, and finally, linking non-financial to financial indicators of firm value. The article relates existing prescriptions, norms, and empirical research to the framework for explanatory purposes using many different research streams.

But further research is necessary. For providing a deeper understanding, case study research could capture certain cause–effect linkages for different network investments that build explicit, comprehensive end-to-end chains that link actions to qualitative as well as quantitative outcomes causally, that are logically sound, and that are empirically tested. The currently prevailing literature, especially in the area of supply chain management, which praises networks, close relationships with all actors, and other related norms generally as modern and superior forms of inter-organizational arrangements, does not promote the progress of the discipline as long as the literature leaves open how and to what extent network investments and other supply chain integration activities affect financials. What is necessary is research that explicitly connects network action to ultimate financial performance, actually measured by an increase in firm value. This article tried to pave the way for this research.

References

1. Ahuja RK, Magnanti TL, Orlin JB (1993) Network flows: theory algorithms and applications. Prentice Hall, Englewood Cliffs
2. Alajoutsijärvi K, Eriksson P, Tikkanen H (2001) Dominant metaphors in the IMP network discourse. Int Bus Rev 10:91–107
3. Alchian AA, Demsetz H (1972) Production, information costs, and economic organization. Am Econ Rev 62(5):777–795
4. Aldrich HE, Mueller S (1982) The evolution of organizational forms: technology, coordination, and control. Res Organ Behav 4:33–37
5. Anand BN, Khanna T (2000) Do firms learn to create value? The case of alliances. Strateg Manage J 21:295–315
6. Asanuma B (1989) Manufacturer–supplier relationships in Japan and the concept of relation-specific skill. J Jpn Int Econ 3:1–30
7. Austin TA, Lee HL, Kopczak L (1997) Supply chain integration in the PC industry. Working Paper, Anderson Consulting, Stanford University

8. Axelrod RM (1984) The evolution of cooperation. Basic Books, New York
9. Bagchi PK, Byoung CH, Skjoett-Larsen T, Soerensen LB (2005) Supply chain integration: a European survey. Int J Logist Manage 16:275–294
10. Barringer BR, Harrison JS (2000) Walking a tightrope: creating value through interorganizational relationships. J Manage 26:367–403
11. Berg SV, Friedman P (1977) Joint ventures, competition, and technological complementaries: evidence from chemicals. South Econ J 43:1330–1337
12. Birkinshaw J, Morrison A, Hulland J (1995) Structural and competitive determinants of a global integration strategy. Strateg Manage J 16:637–655
13. Bovet D, Sheffi Y (1998) The brave new world of supply chain management. Supply Chain Manage Rev 2:14–22
14. Brealey RA, Myers SC (2000) Principles of corporate finance, 6th edn. McGraw Hill, Boston
15. Brennan R, Turnbull PW (1997) The process of adaption in inter-firm relationships. In: Gemünden HG, Ritter T, Walter A (eds) Relationships and networks in international markets. Elsevier, Oxford, pp 65–80
16. Brennan R, Turnbull PW (2002) Sophistry, relevance and technology transfer in management research: an IMP perspective. J Bus Res 55:595–602
17. Brennan R, Turnbull PW, Wilson DT (2003) Dyadic adaption in business-to-business markets. Eur J Mark 37:1636–1665
18. Burgess K, Singh PJ, Koroglu R (2006) Supply chain management: a structured literature review and implications for future research. Int J Oper Prod Manage 26:703–729
19. Burkhardt ME, Brass DJ (1990) Changing patterns or patterns of change. Adm Sci Q 35:102–107
20. Cachon GP (2004) The allocation of inventory risk in a supply chain: push, pull, and advance–purchase discount contracts. Manage Sci 50:222–238
21. Chen F, Drezner Z, Ryan JK, Simchi-Levi D (2000) Quantifying the bullwhip effect in a simple supply chain: the impact of forecasting, lead times, and information. Manage Sci 46:436–443
22. Cheung KL, Lee HL (2002) The inventory benefit of shipment coordination and stock rebalancing in a supply chain. Manage Sci 48:300–306
23. Clark TH, Lee HG (2000) Performance, interdependence and coordination in business-to-business electronic commerce and supply chain management. Inf Technol Manage 1:85–105
24. Coleman JS, Katz E, Menzel H (1957) The diffusion of innovation among physicians. Sociometry 20:253–270
25. Contractor FJ, Lorange P (1988) Competition vs. cooperation: a benefit/cost framework for choosing between fully-owned investments and cooperative relationships (Special Issue). Manage Int Rev 5–18
26. Cook KS, Whitmeyer JM (1992) Two approaches to social structure: exchange theory and network analysis. Annu Rev Sociol 18:109–127
27. Copeland T, Koller T, Murrin J et al (2000) Valuation—measuring and managing the value of companies, 3rd edn. Wiley, New York
28. Croson R, Donohue K (2003) Impact of POS data sharing on supply chain management: an experimental study. Prod Oper Manage 12:1–11
29. Cunningham MT, Culligan K (1990) Competitiveness through networks of relationships in information technology product markets. In: Ford D (ed) Understanding business markets: interaction relationships and networks. Academic, London, pp 508–525
30. D'Avanzo R, von Lewinski H, Van Wassenhove LN (2003) The link between supply chain and financial performance. Supply Chain Manage Rev 7:40–47
31. Das TK, Teng B-S (1998) Between trust and control: developing confidence in partner cooperation in alliances. Acad Manage Rev 23:491–512
32. Davern M (1997) Social networks and economic sociology: a proposed research agenda for a more complete social science. Am J Econ Sociol 56:287–302
33. Disney SM, Towill DR (2003) The effect of vendor managed inventory (VMI) dynamics on the Bullwhip effect in supply chains. Int J Prod Econ 85:199–215
34. Doz YL, Hamel G (1998) Alliance advantage—the art of creating value through partnering. Harvard Business School Press, Boston
35. Dyer JH (1996) Specialized supplier networks as a source of competitive advantage: evidence from the auto industry. Strateg Manage J 17:271–291
36. Dyer JH, Hatch NW (2004) Using supplier networks to learn faster. MIT Sloan Manage Rev 45:57–63
37. Dyer JH, Nobeoka K (2000) Creating and managing a high-performance knowledge sharing network: the Toyota case. Strateg Manage J 21:345–367
38. Dyer JH, Singh H (1998) The relational view: cooperative strategy and sources of interorganizational competitive advantage. Acad Manage Rev 23:660–679
39. Elvander MS, Sarpola S, Mattson S-A (2007) Framework for characterizing the design of VMI systems. Int J Phys Distrib Logist Manage 37:782–798
40. Emden Z, Yaprak A, Cavusgil ST (2005) Learning from experience in international alliances: antecedents and firm performance implications. J Bus Res 58:883–892
41. Fabbe-Costes N, Jahre M (2007) Supply chain integration improves performance: the Emperor's new suit? Int J Phys Distrib Logist Manage 37:835–855
42. Faulkner D (1995) International strategic alliances: co-operating to compete. McGraw Hill, London
43. Fombrun CJ (1982) Strategies for network research in organizations. Acad Manage Rev 7:280–291
44. Ford D (1980) The development of buyer-seller relationships in industrial markets. Eur J Mark 14:339–354
45. Ford D, Håkansson H (2006) IMP—some things achieved: much more to do. Eur J Mark 40:248–258
46. Frohlich MT, Westbrook R (2001) Arcs of integration: an international study of supply chain strategies. J Oper Manage 19:180–200
47. Gadde L-E, Håkansson H et al (2001) Supply network strategies. Wiley, Chichester
48. Ganesan S (1994) Determinants of long-term orientation in buyer-seller relationships. J Mark 58:1–19
49. Gemünden HG (1997) The development of IMP—an analysis of the conference processings 1984–1996. In: Gemünden HG, Ritter T, Walter A (eds) Relationships and networks in international markets. Elsevier, Oxford, pp 3–12
50. Gerlach ML (1992) The Japanese corporate network: a block-model approach. Adm Sci Q 37:105–139
51. Goshal S, Bartlett CA (1990) The multinational corporation as an interorganizational network. Acad Manage Rev 15:603–625
52. Goto A (1982) Business groups in a market economy. Eur Econ Rev 19:53–70
53. Granovetter MS (1973) The strength of weak ties. Am J Sociol 78:1360–1380
54. Gunasekaran A, Ngai EWT (2004) Information systems in supply chain integration and management. Eur J Oper Res 159:269–295

55. Håkansson H, Ford D (2002) How should companies interact in business networks? J Bus Res 55:133–139
56. Håkansson H, Persson G (2004) Supply chain management: the logic of supply chains and networks. Int J Logist Manage 15:11–26
57. Håkansson H, Snehota I (1989) No business is an island: the network concept of business strategy. Scand J Manage 5:187–200
58. Håkansson H, Snehota I (1995) Analysing business relationships. In: Håkansson H, Snehota I (eds) Developing relationships in business networks. Routledge, London, pp 24–49
59. Hamel G, Doz YL, Prahalad CK (1989) Collaborate with your competitors—and win. Harv Bus Rev 67:133–139
60. Harbison J, Pekar P (1998) Smart alliances. Jossey-Bass, San Francisco
61. Hendricks KB, Singhal VR (2003) The effect of supply chain glitches on shareholder wealth. J Oper Manage 21:501–522
62. Hendricks KB, Singhal VR (2005) An empirical analysis of the effect of supply chain disruptions on long-run stock price performance and equity risk of the firm. Prod Oper Manage 14:35–52
63. Hillebrand B, Biemans WG (2003) The relationship between internal and external cooperation: literature review and propositions. J Bus Res 56:735–743
64. Holtbrügge D (2005) Configuration and co-ordination of value activities in German multinational corporations. Eur Manage J 23:564–575
65. Horváth P, Moeller K (2004) Supply chain performance measurement: a transaction cost theory—and value-based approach. In: Epstein M, Mantoni JF (eds) Performance measurement and management control: superior organization performance. JAI-Elsevier Science, Oxford, pp 155–184
66. Huemer L (2006) Supply management—value creation, coordination and positioning in supply relationships. Long Range Plann 39:133–153
67. Ibarra H (1992) Structural alignments, individual strategies, and managerial action: elements toward a network theory of getting things done. In: Nohria N, Eccles RG (eds) Networks and organizations. Harvard Business School Press, Boston, pp 165–188
68. Jarillo JC (1988) On strategic networks. Strateg Manage J 9:31–41
69. Kale P, Singh H, Perlmutter H (2000) Learning and protection of proprietary assets in strategic alliances: building relational capital. Strateg Manage J 21:217–237
70. Kambil A, Van Heck E (1998) Reengineering the Dutch flower auctions: a framework for analyzing exchange organizations. Inf Syst Res 9:1–19
71. Kaplan RS, Norton DP (1996) Balanced scorecard—translating strategy into action. Harvard Business School Press, Boston
72. Kaplan RS, Norton DP (2004) Strategy maps—converting intangible assets into tangible outcomes. Harvard Business School Press, Boston
73. Klaus P (2009) Logistics research: a 50 years' march of ideas. Logist Res 1:53–65
74. Kotzab H, Otto A (2004) General process-oriented management principles to manage supply chains: theoretical identification and discussion. Bus Process Manage J 10:336–349
75. LaLonde BJ, Masters JM (1994) Emerging logistics strategies: blueprints for the next century. Int J Phys Distrib Logist Manage 24:35–47
76. Lai G, Debo LG, Sycara K (2009) Sharing inventory risk in supply chain: the implication of financial constraint. Omega 37:811–825
77. Lambert D, Pohlen T (2001) Supply chain metrics. Int J Logist Manage 12:1–19
78. Lambert DM, Cooper MC (2000) Issues in supply chain management. Ind Mark Manage 29:65–83
79. Laumann EO, Galaskiewicz J, Van Marsden P (1978) Community structure as interorganizational linkages. Annu Rev Sociol 4:455–484
80. Lavie D (2006) The competitive advantage of interconnected firms: an extension of the resource-based view. Acad Manage Rev 31:638–658
81. Lee HL, So KC, Tang CS (2000) The value of information sharing in a two-level supply chain. Manage Sci 46:626–643
82. Li S, Ragu-Nathan B, Ragu-Nathan TS, Subba Rao S (2006) The impact of supply chain management practices on competitive advantage and organizational performance. Omega 34:107–124
83. Lu D (2001) Shared network investment. J Econ 73:299–312
84. Lücke W (1955) Investitionsrechnung auf der Grundlage von Ausgaben oder Kosten? Z Handelswissenschaftliche Forsch 7:310–324 (in German)
85. Magnus K-H, Nienaber A-M, Schewe G, Thonemann U (2008) Eine Überdosis an Kooperation vermeiden! Empirische Erkenntnisse zum Erfolg der Supply-Chain-Organisation. Schmalenbachs Z Betriebswirtschaftliches Forsch 60:241–276 (in German)
86. Mahadevan B (2003) Making sense of emerging market structures in B2B E-commerce. Calif Manage Rev 46:86–100
87. Mason-Jones R, Naim MM, Towill DR (1997) The impact of pipeline control on supply chain dynamics. Int J Logist Manage 8:47–62
88. McAndrews JJ, Rob R (1996) Shared ownership and pricing in a network switch. Int J Ind Organ 14:727–745
89. Mitchell JC (1973) Networks, norms and institutions. In: Boissevain J, Mitchell JC (eds) Network analysis. Mouton, The Hague, pp 15–35
90. Mitra S, Singhal V (2008) Supply chain integration and shareholder value: evidence from consortium based industry exchanges. J Oper Manage 26:96–114
91. Mizruchi MS, Galaskiewicz J (1993) Networks of interorganizational relations. Sociol Methods Res 22:46–70
92. Möller K (2006) Unternehmensnetzwerke und Erfolg—Eine empirische Analyse von Einfluss- und Gestaltungsfaktoren. Schmalenbachs Z Betriebswirtschaftliche Forsch 58:1051–1076 (in German)
93. Möller K, Rajala A, Svahn S (2005) Strategic business nets—their type and management. J Bus Res 58:1274–1284
94. Mouzas S (2006) Efficiency versus effectiveness in business networks. J Bus Res 59:1124–1132
95. Narasimhan R, Kim SW (2002) Effect of supply chain integration on the relationship between diversification and performance: evidence from Japanese and Korean firms. J Oper Manage 20:303–323
96. Narasimhan R, Nair A (2005) The antecedent role of quality, information sharing and supply chain proximity on strategic alliance formation and performance. Int J Prod Econ 96:301–313
97. New SJ (1996) A framework for analyzing supply chain improvement. Int J Oper Prod Manage 16:19–34
98. Nohria N (1992) Is a network perspective a useful way of studying organizations? In: Nohria N, Eccles RG (eds) Networks and organizations. Harvard Business School Press, Boston, pp 1–22
99. Ohmae K (1987) The triad world view. J Bus Strategy 7:8–19
100. Olson M (1965) The logic of collective action—public goods and the theory of groups. Harvard University Press, Cambridge
101. Olson M (1982) The rise and decline of nations—economic growth stagflation and social rigidities. Yale University Press, New Haven

102. Otto A (2002) Management und controlling von supply chains. Gabler Verlag, Wiesbaden (in German)
103. Pohlen TL, Goldsby TJ (2003) VMI and SMI programs—how economic value added can help sell the change. Int J Phys Distrib Logist Manage 33:565–581
104. Preinreich GAD (1937) Valuation and amortization. Account Rev 12:209–226
105. (1997) Shell improves value through 'supplier managed inventory'. Purchasing 123:79
106. Putnam RB, Bayne N (1987) Hanging together—cooperation and conflict in the seven-power summits. Harvard University Press, Cambridge
107. Rappaport A (1981) Selecting strategies that create shareholder value. Harv Bus Rev 59:139–149
108. Ritter T, Gemünden HG (2003) Interorganizational relationships and networks: an overview. J Bus Res 56:691–697
109. Ritter T, Gemünden HG (2003) Network competence: its impact on innovation success and its antecedents. J Bus Res 56:745–755
110. Ryu S, Park JE, Min S (2007) Factors of determining long-term orientation in interfirm relationships. J Bus Res 60:1225–1233
111. Sabath RE, Autry CW, Daugherty PJ (2001) Automatic replenishment programs: the impact of organizational structure. J Bus Logist 22:91–105
112. Shan W, Walker G, Kogut B (1994) Interfirm cooperation and startup innovation in the biotechnical industry. Strateg Manage J 15:387–394
113. Singhal VR, Hendricks KB (2002) How supply chain glitches torpedo shareholder value. Supply Chain Manage Rev 6:18–24
114. Slone RE, Mentzer JT, Dittmann JP (2007) Are you the weakest link in your company's supply chain? Harv Bus Rev 85:116–127
115. Spekman RE, Kamauff JW, Myhr N (1998) An empirical investigation into supply chain management: a perspective on partnerships. Int J Phys Distrib Logist Manage 28:630–650
116. Spinler S, Huchzermeier A (2006) The valuation of options on capacity with cost and demand uncertainty. Eur J Oper Res 171:915–934
117. Stabell CB, Fjeldstad ØD (1998) Configuring value for competitive advantages: on chains, shops, and networks. Strateg Manage J 19:413–437
118. Stank TP, Keller SB, Daugherty PJ (2001) Supply chain collaboration and logistical service performance. J Bus Logist 22:29–48
119. Stuart TE (2000) Interorganizational alliances and the performance of firms: a study of growth and innovation rates in a high-technology industry. Strateg Manage J 2179:1–811
120. Thomas DJ, Griffin PM (1996) Coordinated supply chain management. Eur J Oper Res 94:1–15
121. Thompson JD (1967) Organizations in action. Social science base of administrative theory. McGraw-Hill Publishing Company, New York
122. Tichy NM, Tushman ML, Fombrun C (1979) Social network analysis. Acad Manage Rev 4:507–519
123. Töyli J, Häkkinen L, Ojala L, Naula T (2008) Logistics and financial performance: an analysis of 424 Finnish small and medium-sized enterprises. Int J Phys Distrib Logist Manage 38:57–80
124. Turnbull P, Ford D, Cunningham M (1996) Interaction relationships and networks in business markets: an evolving perspective. J Bus Ind Mark 11:44–62
125. Useem M (1984) The inner circle—large corporations and the rise of business political activity in the U.S and U.K. Oxford University Press, Oxford
126. Uzzi B (1996) The sources and consequences of embeddedness for the economic performance of organizations: the network effect. Am Sociol Rev 61:674–698
127. Van Alstyne M (1997) The state of network organization: a survey in three frameworks. J Organ Comput Electronic Commer 7:83–151
128. Van der Vaart T, Van Donk DP (2008) A critical review of survey-based research in supply chain integration. Int J Prod Econ 111:42–55
129. Vickery SK, Jayaram J, Droge C, Calantone R (2003) The effects of an integrative supply chain strategy on customer service and financial performance: an analysis of direct versus indirect relationships. J Oper Manage 21:523–539
130. Vigtil A (2007) Information exchange in vendor managed inventory. Int J Phys Distrib Logist Manage 37:131–147
131. Wasserman S, Faust K (1994) Social network analysis: methods and applications. Cambridge University Press, Cambridge
132. Whetten D (1987) Interorganizational relations. In: Lorsch J (ed) Handbook of organizational behavior. Prentice Hall, Englewood Cliffs, pp 238–253
133. Wicht J, Hopp A, Arminger G (2008) Aufbau, Durchführung und Leistungsmessung eines CPFR-Pilotprojekts im Handel. Schmalenbachs Zeitschrift für betriebswirtschaftliche Forschung 60:214–240 (in German)
134. Wilkinson I, Young L (2002) On cooperating: firms, relations and networks. J Bus Res 55:123–132
135. Williamson OE (1985) The economic institutions of capitalism. Free Press, New York
136. Womack JP, Jones JT (1994) From lean management to lean enterprise. Harv Bus Rev 72:93–103
137. Wu F, Cavusgil ST (2006) Organizational learning, commitment, and joint value creation in interfirm relationships. J Bus Res 59:81–89