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Christoph Hirnle
University of Munich

Thomas Hess
University of Munich

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Christoph Hirnle
University of Munich
Institute for IS and New Media
hirnle@bwl.uni-muenchen.de

Thomas Hess
University of Munich
Institute for IS and New Media
thess@bwl.uni-muenchen.de

Abstract

Frameworks for IT evaluation have been extensively discussed in the past. Until recently, research had concentrated on advancing classic approaches such as monetary cost/benefit considerations or strategic management matrices, but that constriction to known methods has considerably softened. More researchers now use economic models in IT evaluation. Their contributions open exciting new perspectives but unfortunately the models put forward cannot reach wide in practice as they are highly formalized. Addressing the use of economic theory in IS research, this paper attempts to fully operationalize an economic theory into a framework apt for management. Exemplarily, in a "research method case study", we operationalize Principal-Agent theory for a specific organizational setting. The particular situation we develop the framework for is collective investment into Information Technology (such as collaborative Supply Chain Management systems or collective reservation systems for airline networks). The four steps we conduct in our operationalization are translation, scenario building, structured qualitative analysis and aggregation. Along with presenting the complete operationalization process, the final framework demonstrates that a complex Principal-Agent problem can be transcribed into an easy to use IS management framework.

Keywords: IT evaluation, methodology, new institutional economics, Principal-Agent theory, management framework

1. Introduction: towards an economic approach to IT evaluation

Ways of measuring the business value of information systems have been hotly debated in IS research ever since the discipline was founded (Banker and Kaufmann 2004). In general, two streams of evaluation methods can be identified. One uses financial measures such as anticipated costs and benefits, the other tries to grasp strategic implications of IS. Evaluation frameworks have been refined extensively in the past years; other approaches try to bring relevant perspectives together (see, for example, Melville et al. 2004). Economic theory has long found its way into IT evaluation (e.g. Gold 1964, Kriebel and Raviv 1980 or Thatcher and Pingry 2004, Kumar 2004, Han et al. 2004), but as these models are highly formalized, their application in management is made difficult if not impossible.

In the course of researching IT evaluation methods for a particular setting (collective IT investments), we find that not a refinement of existing management tools but a novel one based on economic theory is needed. To Williamson (1985, p. 121-122), drawing on an economic analysis of the Japanese way of cooperating, opportunism is the major inhibitor for investing collectively. So if no collective governance structures exist which can handle opportunistic behaviour (such as in cooperations between independent partners which can be found e.g. in supply chains or the airline industry), the risk for opportunism intrinsic to

investment options must be measured. As Principal-Agent (PA) theory is primarily concerned with the analysis of contracting parties behaving opportunistically, we choose to operationalize this part of the new institutional economics. In essence, we derive a management framework for comparing the relative advantageousness of collective investment scenarios in regard to the risk for opportunism associated to them.

This paper can be regarded as an exploratory methodological case study. Exploratory case studies constitute a prelude to other methods of social science research and are generally conducted when a phenomenon requires a first access. "Such a phenomenon may be a *project* or *program* in an evaluation study" (Yin 2003, p. 4). In this paper, the project/phenomenon is our research effort in the field of operationalizing economic theory for IS research. So what is new is that we do not classically describe a practical business phenomenon but a practical research case. **The paper's primary contribution is to demonstrate a practical example of economic theory operationalization in IS research.** Hence, the results of the case itself are not as important as the case's structured description which follows our research process.

The paper's structure reflects this objective. Besides supplying the reader with background on the investigation's setting (cooperations between independent companies, also known as inter-firm networks) and relevant elements of the investigation's model (Principal-Agent theory), section 2 draws analogies to other attempts at operationalizing economic theory (investigation method). Section 3 is arranged along the lines of our own operationalization efforts: translation, scenario building, structured qualitative analysis and aggregation. In addition to stating shortcomings of our operationalization attempt, section 4 provides a short summary and a brief outlook.

2. Relevant Background

2.1. Investigation setting: collective IT investments in inter-firm networks

Cooperations between companies exist in manifold varieties such as joint ventures, strategic alliances and inter-firm networks. Definitions of and classification criteria for these different types of cooperations are numerous, but, in general, most classifications include dimensions such as financial/legal independence of the participating partners, resource catenation, cooperation time/scope and size.

Inter-firm networks represent a type of cooperation which emphasizes the independence of the participants (Miles and Snow 1986, Davidow and Malone 1992, Haecki and Lighton 2001, Veil and Hess 2002, Sturgeon 2002; NB: in our understanding virtual organizations form a subset of inter-firm networks). In respect to the typical classification criteria stated above, inter-firm networks are special as

(1) the partners are financially and legally independent and they do not primarily pool their resources (unlike setting up a joint venture where partners incorporate resources into a new firm),

(2) inter-firm networks are not limited in cooperation time and cooperation scope (unlike strategic alliances where cooperation is limited to a specific transactional aspect, e.g. 5 year preferred supplier relationships),

(3) every time an order arrives which is to be dealt with within the network, the configuration of the participating partners might change (see figure 1) and

(4) the number of participants in inter-firm networks can easily exceed 10 partners.
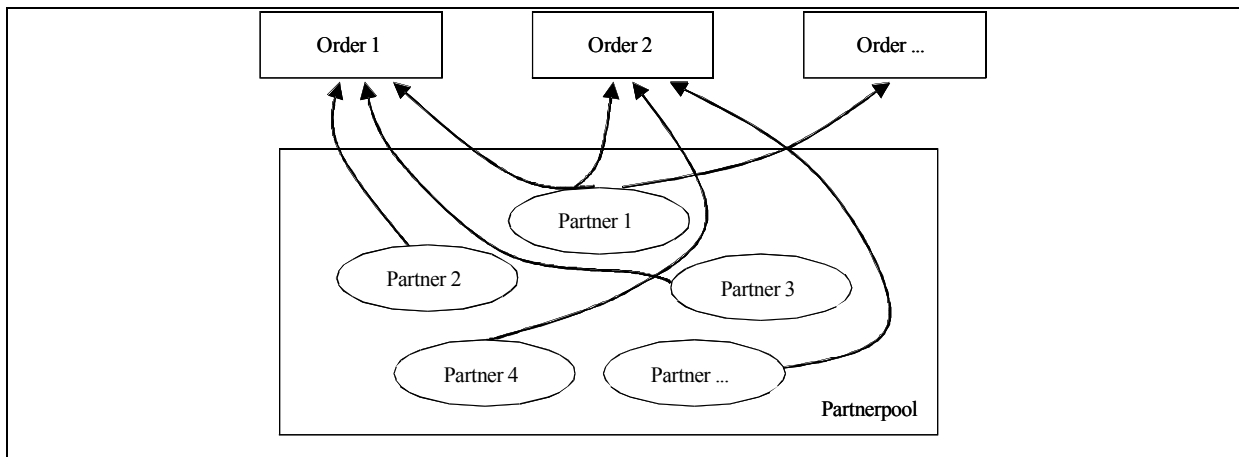
Figure 1: Order-based partner configuration (Veil and Hess 2002, p. 274)

An example of an international inter-firm network is the airline network Star Alliance. Here, 15 financially and legally independent national carriers align their operations to jointly provide services to end customers. For example, passengers can travel across the entire Star Alliance Network using one single e-ticket. This was made possible by linking the individual carriers' IT systems via Star Alliance's collective IT infrastructure, StarNet. Benefits include reduced complexity, improved customer service and lower costs for member carriers.

As indicated in the Star Alliance example collective IT infrastructures, which form the basis of interorganizational systems (IOS), will typically not be set up in Greenfield projects. Rather, the individual partners' systems will be integrated in one form or another as Eom (2005, p. 4) defines: "An interorganizational system is an information and management system that transcendents organizational boundaries via electronic linkages." Methods and standards for integrating IT systems are hotly debated in practice and research and include Electronic Data Interchange (EDI), eXtended Markup Language (XML), decentralized Enterprise Application Integration (EAI), hub-and-spoke EAI, web services and central databases. Within these technologies and methods, two architectural approaches can be differentiated: centralization and decentralization. For instance, hub-and-spoke EAI (a middleware including adaptors, transformation services and process management tools) and collective databases represent centralized architectures while changing to a common standard counts towards the other option. Still, they all constitute investments into relationship-specific IT. The IT options' common characteristic is that they all serve as a common infrastructure set between enterprise-wide and public infrastructures (for a categorization see Weill et al. 2002).

2.2. Investigation model: Principal-Agent theory

Principal-Agent (PA) theory is part of the new institutional economics and has several early contributors including Spence and Zeckhauser (1971), Ross (1973) and Jensen and Meckling (1976). A PA relationship is defined "as a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority" (Jensen and Meckling 1976, p. 308). Today, in essence, PA theory deals with problems which arise whenever the principal cannot perfectly and costlessly assess the agent's action and information ("which is almost always the case", Pratt and Zeckhauser 1985, p. 2) and the agent derives scope for opportunistic behavior from this information asymmetry.

In the tradition of new institutional economics, PA theory assumes bounded rationality and individual utility maximization. The information asymmetry (→ bounded rationality) between principal and agent leads to a discretionary scope for autonomous and therefore opportunistic behavior on the agent's side (→ utility maximization). Such situations typically exist in buyer-supplier, owner-manager and venture capitalist-investee but also in landlord-tenant or doctor-patient relationships (Wigand et al. 1997). As PA is a basic economic theory, it can explicitly be applied to any social situation (Ross 1973). Naturally, one person can find himself in numerous PA relationships, acting as principal in one, as agent in another context or even as principal *and* agent in reciprocal relationships (Pratt and Zeckhauser 1985).

When trying to reduce the uncertainties the information asymmetry poses, principals incur monitoring expenditures while agents have to commit resources to bonding. In addition, certain transactions do not take place which would have been beneficial to overall welfare (residual loss). These three items add up to Agency-costs which differ among organizational arrangements (Jensen and Meckling 1976).

In detail, three problems emerge from the underlying information asymmetry: (1) hidden action (2) hidden intention and (3) hidden characteristics (Wigand et al.1997).

(1) After the contract has been signed the principal cannot observe or judge the agent's efforts (hidden action) and the agent can maximize his utility at the expense of the principal. This phenomenon is known also known as "moral hazard".

(2) In addition, the post-contractual intentions of the agent remain hidden. As the principal ex-ante advances resources (constituting sunk costs) to enter a *specific* relationship, he is then dependent upon the agent. Ex-post, he can observe the agent's actions but cannot change them. The resulting scope for opportunistically exploiting this dependency is categorized as "hold up".

(3) Hidden characteristics are based on the assumption that the principal cannot accurately judge the quality of the agent's offer before the contract is signed. The key problem with hidden characteristics is not primarily opportunistic behavior itself but the information asymmetry's final consequence: it results in adverse selection, where unfavorable agents chosen which will, in extreme cases, lead to the closing of markets. By now, numerous tested strategies for reducing pre-contractual information asymmetries exist. Still, the problem's focus is not on opportunism itself. Therefore hidden characteristics will not be pursued further in this analysis.

In general, Principal-Agent theory can be used to explain (positive analysis) or to design (normative analysis) such relationships. In normative analyses, recommendations are put forward as to which institutional arrangement is to be chosen (depending on agency-costs). In our case, a positive analysis is conducted as institutional arrangements seem to be very hard to establish (see introduction / see also Casciaro 2003 or Ahmadjian and Lincoln 2001) and hence the degree of opportunistic scope of different options is to be measured.

2.3. *Investigation method: operationalizing economic theory*

To our knowledge, evaluation frameworks for measuring the risk for opportunism associated to a specific investment have not yet been developed. In general, the aim of economic investigations is relative, not absolute comparison (Williamson 1991). But while economic comparisons are typically used with the purpose of (formally) explaining the dynamics of reality (in our case: governance of, structure of and investment behaviour in inter-firm

networks / see Han et al. 2004, Beckman et al. 2004, Solf 2004, Casciaro, 2004, Wohlgemuth and Hess 2003 for recent examples), our study sets out to develop a management framework for collective investments.

Numerous Principal-Agent analysis were conducted for real life cases (see Reid 1977, Rubin 1978, Block and MacMillan 1993, Bhattacharyya and Lafontaine 1995 or Casamatta 2003 on complex PA-analysis examples). Still, they have not been operationalized to a management framework. Generally, research has rather attended to operationalizing transaction cost theory. In this respect, we scanned transaction cost attempts in order to obtain a general idea for approaching the operationalization of PA theory. For our case, we tried to focus on works set in an atmosphere where our object of analysis, the risk for opportunism, is considered as a major influence on decision making: IT sourcing. Our analysis harvested three approaches: (1) quantifying transaction costs in order to use the figures in cost accounting (e.g. Albach 1988), (2) quantifying the level of perceived transaction cost (e.g. Ang and Straub 1998) and (3) breaking down transaction cost into qualitatively assessable variables (e.g. Dibbern et al. 2003 who explain the correlation between transaction and production cost in outsourcing by discerning qualitative context variables such as specific process knowledge, trust and location specificity).

Option (1) has been widely discussed, but contradicts the idea of relative economic comparison and has not yielded substantial results so far (Burr 2003). While the results of option (2) would foster the individual reflection of the personal decision making situation of a cooperation partner, option (3) additionally yields a basis for discussion and negotiation within the inter-firm network, as the composition of the risk levels is transparently developed in a structured manner. Therefore, option 3 will be pursued for operationalizing PA theory in our case.

3. Operationalization case study

As discussed in section 2.3, breaking down the decision making situation at hand into qualitatively assessable variables seems to be the most promising approach for categorical operationalization in our setting. Following scientific method, we have to distinguish between exogenous (independent) and endogenous (dependent) variables. In our case, the endogenous variable (the one we wish to measure for different types of collective IT investment) is the risk level as induced by hidden action and hidden intention respectively. The independent variables make up types of collective IT investments.

While the endogenous variable is clear, it is imperative to define adequate independent variables. Hence we first **translate** the setting of investing collectively into PA-theory: who can – abstracted away from a real case – take on the roles of Principal and Agent? Then, we **build scenarios** which are made up of all realistically possible combinations of PA-roles and participants in the real world. These scenarios constitute aggregations of independent variables. Then we **analyse** all information asymmetries (➔ qualitatively assessable dependent variables) in those scenarios and record the results **in a structured, comparable manner**. Finally, we **aggregate** these results to arrive at a comprehensive risk assessment framework. Figure 2 summarizes this process.

Translation
Who is Principal, who is Agent?
What is the Agent's task?

Scenario building
Which different types of collective IT investment are possible?

Structured qualitative analysis
Analyzing the relevant risks in all scenarios.

Result aggregation
Pulling the individual risk analyses together.

Figure 2: Operationalization process

3.1. Translation

As indicated in section 2.2, Principal-Agent relations can be quite complex as they might encompass multiple agents and multiple principals and even be reciprocal (Grossmann and Hart 1983, Pratt and Zeckhauser, Arrow 1985, Wigand et al. 1997). Therefore, when analysing relationships in terms of Principal-Agent theory, it is imperative that all relevant roles of the participating players are clearly stated from the beginning. In order to supply a starting point for the following positive analysis and a quick-reference for readers, this section will first give an overview of the relevant roles.

In the case of collective IT investment, three roles can be identified. One company might take on several roles; one role can be taken on by many companies.

- **Beneficiary:** Any network member who links up to the collective IS in order to benefit from using it. Beneficiaries do not necessarily have to invest into the collective IS.

- **Investor:** Any network member who actively designs and pays for setting up and running the system and benefits from using it himself and/or others using it. Investors hold most property rights to the system (system owners). If there are multiple investors, the total cost of the system is shared; if only one partner invests, he carries the total cost himself.

- **Supplier:** The institution which sets up and runs the system. Depending on the architecture/sourcing option chosen, suppliers can either be all investors, one/a small group of investors or an external supplier.

Relevant players can be clearly identified in all collective IT investments, an interesting example being the papiNet integration project. papiNet set out as a global transaction standard initiative and can now be regarded as an inter-firm network in our terminology (due to flexible production configuration, legal and financial independence of the partners, high number of partners and unlimited cooperation scope; see section 2.1). In June 2001, all major papiNet partners (a group of 80 print-media companies including publishers, printing shops, logistics companies and paper manufacturers) introduced ebXML-based communication software: Ponton X/P. This software (legacy system adaptors + messenger) is based on

open-source products, but had to be customized to match industry processes. Development costs were completely covered by the paper manufactures, whilst customization itself was outsourced to Ponton Consulting. Cleary, all network members who introduce this decentralized collective information system gain benefits from it in terms of process and resource economies (beneficiaries). At first, the paper manufacturers designed and paid the system (investors) but also benefit from the linking up to it (beneficiaries). Ponton Consulting, which developed the system, was the supplier of the collective IS at this stage of the project.

Figure 3 depicts an overview of the Principal-Agent relationships players can find themselves in. While the problems within these relations will be discussed in more detail later, this first classification is needed for describing important scenarios.
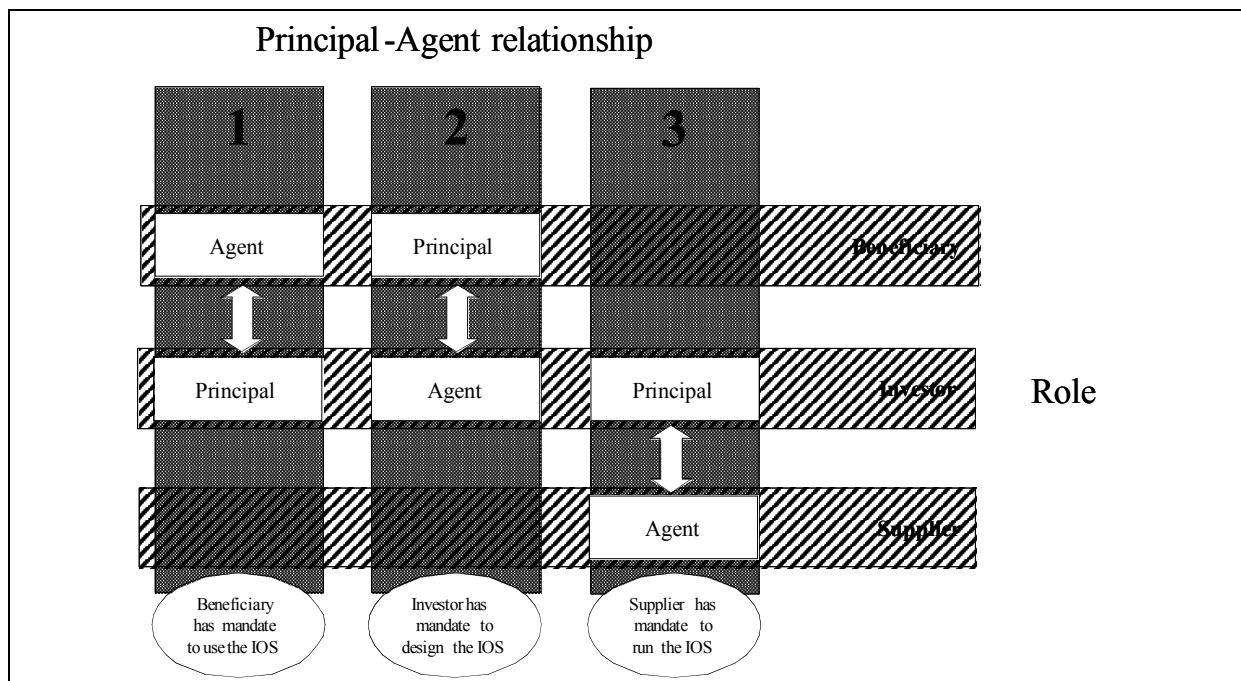

Figure 3: Generic Principal-Agent map for collective IS investment (Hirnle 2005, p. 10)

- **PA-relationship 1:** A collective IS generates value only if enough network partners (beneficiaries) participate. So, once the investors have committed their resources to the investment (and have hence incurred *sunk costs*), they are dependent on the other network members to take part in the collective IS. If all investors are also beneficiaries, all network members are principals and agents to each other in this respect.

- **PA-relationship 2:** At the same time, in order to secure participation of enough beneficiaries, the investor must build an IS the partners agree with. In other words, the investor is commissioned to design and build an IOS on behalf of the participating partners. If all beneficiaries are also investors, all network members are principals and agents to each other in this respect.

- **PA-relationship 3:** The investor-supplier relationship is PA-classic. The investors select a supplier (network partner or external institution) to set up and run the collective IS. During the selection phase, investors incur transaction costs. Once the

supplier (agent) is selected, the investors (principals) pay the supplier for setting up and running the IS.

3.2. Scenario building

The PA-relationships modelled here bear great potential for opportunistic behaviour. However, the degree of discretionary scope for opportunistic action varies depending on how the investment atmosphere is shaped. The optimal shape of that atmosphere for a company depends on its individual position within the network, or, in other words, the role it takes on (Baker et al. 2002). When considering information asymmetries between the parties, the question is to what extent the participants take on all roles or to what extent the roles are divided amongst individual parties. The differentiating criterion between beneficiary and investor is optional investing (beneficiaries can, but do not necessarily have to invest). If suppliers are external to the network, they are separate entities with own information levels. If suppliers are internal, roles are combined. Hence, four possible scenarios can be identified (graphically depicted in Figure 4) which differ by the amount of partners who incur expenditures for designing, setting up and running the IOS (all partners or only a fraction of the partners) and how the IOS is sourced.
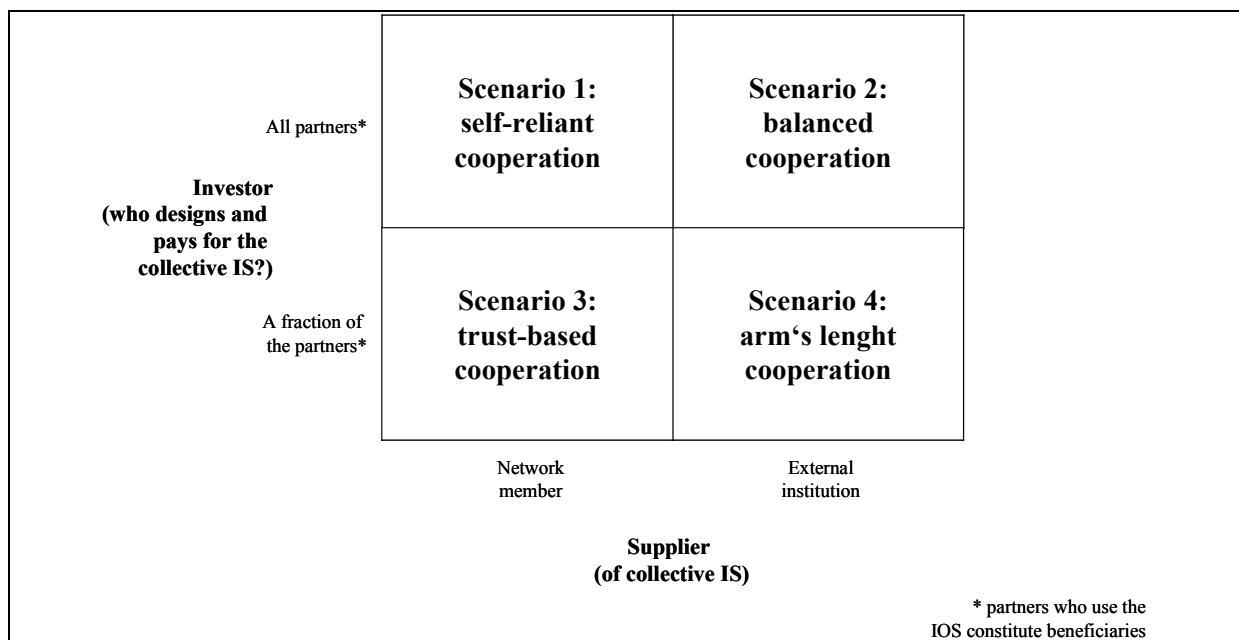
<table>
<tr><td rowspan="2">All partners*

Investor
(who designs and
pays for the
collective IS?)</td><td>Scenario 1:
self-reliant
cooperation</td><td>Scenario 2:
balanced
cooperation</td></tr>
<tr><td>Scenario 3:
trust-based
cooperation</td><td>Scenario 4:
arm's lenght
cooperation</td></tr>
<tr><td>A fraction of
the partners*</td><td></td><td></td></tr>
<tr><td></td><td>Network
member</td><td>External
institution</td></tr>
<tr><td></td><td colspan="2">Supplier
(of collective IS)</td></tr>
<tr><td></td><td colspan="2">* partners who use the
IOS constitute beneficiaries</td></tr>
</table>

Figure 4: Principal-Agent scenarios in collective IS investment (Hirnle 2005, p. 12)

Certainly, a PA-relationship also exists between beneficiaries and suppliers. However, we chose to refrain from a detailed analysis of this relationship as the relationship between investing beneficiaries and suppliers is already modelled in PA-relationship 3 and we believe that a central difference between scenarios 2 and 4 lies in cutting off non-investing beneficiaries from suppliers.

3.3. Structured qualitative analysis

In this section, the two potential information asymmetries (hidden action, hidden intention) ought to be discussed in regard to the three Principal-Agent relationships in all four scenarios, the central measure being the risk for opportunism. As this paper's objective is to demonstrate the process of operationalization, merely one sample scenario will be discussed here. We choose to go into investment scenario 2 (balanced cooperation) as this scenario represents the most advantageous approach in comparison to the other scenarios. It has to be said that when displaying one scenario only, the transparency of the risk ratings is diminished as the reader cannot place the derivation of the rating into relation to the other scenarios' discussions. Still, the operationalization step "structured qualitative analysis" is made clear. A detailed analysis of all scenarios can be found in Hirnle (2005).

Scenario classification

In the balanced cooperation scenario, all network members ex-ante agree to bear their share of the costs of the collective IS (unlike scenarios 3 & 4). All beneficiaries are also investors. Unlike scenario 1, however, the supplier is a company *external* to the network. In other words, the collective IS is sourced "in-network" in scenario 1 and is now being "outsourced" in scenario 2. One central difference for our analysis is that external providers allow usage-based fees (such as application service providers - ASPs). An example for this scenario would be a collaborative supply chain management system which is run by a third party vendor.

Risk 1: Hidden action/moral hazard

Relationship 1: Grave hidden action information asymmetries exist in this investor (principal) - beneficiary (agent) relationship. The central moral hazard feature here is known as **free riding**, was first focused by Holmstrom (1982) and has been attributed to inter-firm networks by Rokkan and Buvik (2003). In our context, free riding denotes a situation where network members enjoy the benefits of the common good (here: IOS usage rights) without having to bear the full costs: either an investor understates his benefit derived from the IOS and pays less or the ex-ante investor changes his mind and refuses to pay at all. The free riding partner can do so as a) partners cannot adequately judge the utility to the free rider and hence cannot know that he is free riding and b) the utility of the IOS depends on all partners participating, and hence the network members will not always exclude the free rider from using it. However, investors will only invest if they expect an individual positive return and that return is in a fair relation to the returns the other investors receive (Wohlgemuth and Hess 2003). Fundamentally, investors find themselves in catch 22: while they are basically willing to pay for a collective service, they could potentially have higher returns if they engaged in free riding.

Free riding is particularly important topic in this scenario and can, in extreme cases, lead to an inadequate IOS or even inhibit its installation. When entering an outsourcing relationship, both the provider and the investor incur information and communication costs during the initiation, negotiation, settlement, adaptation and control of the exchange (commonly known as transaction costs, Williamson 1975). The provider will add his transaction costs to the price he charges. The investors have to add their transaction costs to their net expenditure for the IOS. When an ex-ante investor deflects and chooses to free ride, he can examine the negotiated contracts after the process has ended. If he favors the contract, he can realise it without incurring as high transaction costs. If he considers the conditions to be inappropriate,

he can either not introduce the IOS at all or negotiate his own contract. He defers his decision to participate into the future without taking extra risks. The **reduced transaction costs** and his **real option to defer the investment** both constitute potential extra utility to the agent. In addition, typical outsourced IT is highly standardised. As the outsourcing contracts themselves reflect this feature, network partners can more easily deflect from the group of original investors. Hence, sourcing an IOS externally when all beneficiaries ex-ante agree to be investors even **increases the danger of free riding** due to standardised contracts. Therefore, the **risk for opportunistic behaviour** due to moral hazard is considered to be very **high**.

Relationship 2: As all beneficiaries invest and hence take part in system/outsourcing contract design, information asymmetries can be ruled out. When an ex-ante investor chooses to **free ride** and become a beneficiary only, he can still be quite sure to obtain access to an appropriate IOS due to the high degree of standardization. The same goes for the remaining investors, if, of course, enough network partners participate in the design. Hence, only a **low risk** can be identified.

Relationship 3: If an external entity sets up and runs the IOS, a hidden action information asymmetry arises between the investors and the supplier. While the supplier's performance can be measured and managed through Service-Level-Agreements, the inter-firm network looses control over *how* the IOS is run (e.g. what happens to externally saved data). Overall, however, as external suppliers typically handle several clients, all these clients undertake *monitoring* to some extent. **So the more standardized and the more centralized** an outsourced IOS is, **the lower monitoring costs** to the individual partners are. Therefore, moral hazard is unlikely which leads to a **low risk** for opportunistic behavior.

Risk 2: Hidden intention/hold up

Relationship 1: When all beneficiaries invest, no hold up problems occur. Only if moral hazard sets in (in the shape of free riding), investors will have **sunk costs** and will then be dependent on the participants. Unlike scenario 1, where an internal supplier has to shoulder the IT investment sum, the external supplier carries the biggest part of the original investment in this scenario. The **sunk costs** investors (inter-firm network partners) incur are transaction costs which are far lower than the costs of the original IT investment. While the risk by itself is medium, the relatively low sunk costs the investors incur lead to a **low level of risk** in this relationship.

Relationship 2: No risk can be identified when all beneficiaries invest. In **free riding** situations, the reduced functionality due to free riders not taking part in the design process of the IOS can be considered minimal. That is, of course, if enough partners do actively invest. In all, the **risk** is **very low**.

Relationship 3: The key factor determining hold up problems in investor-supplier relationships is **transaction specificity**. Typically, inter-firm network IT is considered to by highly specific (e.g. common standards, common databases, etc.). From an ex-ante hidden intention perspective, however, this is not necessarily the case: as there can be an intense market-based competition for the contract, the economic specificity of the transaction is relatively low. Once the supplier is chosen, however, a **fundamental transformation** occurs (Williamson 1985): with the supplier building up idiosyncratic knowledge about the network he gains advantages over competitors which they cannot catch up. This way, an ex-ante starting position with low specificity can, over time, lead to a monopoly-like exchange situation.

In scenario 1 (all partners invest, IOS is sourced in-network) hold up is very strong as the system's specificity helps the internal supplier to hide his intentions to a very high degree. When sourcing externally, however, **specificity is likely to be reduced** for two reasons: a) investors have an interest in standardized systems as they want to be able to source the IOS from another supplier and hence **reduce the risk for fundamental transformation** and b) suppliers have an interest in standardized systems as they want to be able to sell the same resource to other customers. Even if suppliers do not agree to/cannot offer a standardized system, hold up is low due to reputation effects. As a supplier's key business is IT provision, reputation loss would directly affect his business. In other words, the supplier incurs signaling costs by not behaving opportunistically and, this way, builds up his reputation. So even when taking into consideration that the externally sourced system can have different levels of specificity, the **risk for hold up** is regarded to be rather **low**.

Summary of scenario 2

Relative to scenario 1 (all beneficiaries invest, IOS is sourced in-network), the risk for opportunistic behavior is notably reduced. This is particularly true for a reduced risk for sunk costs and a lower probability of opportunistic behavior on the supplier's side. However, the potential free riding of ex-ante investors is facilitated. Table 1 summarizes the evaluation carried out.

Relationship	Risk for opportunistic behavior due to		Risk summary
	Hidden action	Hidden intention	
1 Principal: **Investor** Agent: Beneficiary	High	Low	➔
2 Principal: **Beneficiary** Agent: Investor	Low	Low	⬇
3 Principal: **Investor** Agent: Supplier	Low	Low	⬇

Table 1: Summary of analysis for scenario 2
(Reading example: in relationship 2 of this scenario,
the principals (beneficiaries) face an overall low risk for opportunism)

3.4. Aggregation

In the original study, all scenarios are discussed in the same structured manner and the discussions' results are all recorded in a risk summary table for the individual relationships. The tables now have to be restructured to reflect management structures aggregated to reduce complexity. In short: while the discussions lead to scenario summaries, a management framework must take on a stakeholder-based view. The risk levels assessments have to be carried over into risk assessment frameworks for investors and beneficiaries respectively. Restructuring the tables to reflect the stakeholder structure leads to the final risk assessment framework which is depicted in Figure 5.

The risk levels shown can easily be reconstructed from the summary of analysis for scenario 2 (table 1). For example, when all partners invest and the IOS is outsourced (scenario 2), the

investors' risk is aggregated to ↘. This rating is averaged from to the investors' opportunism risks for relationship 1 (➔) and relationship 3 (↓).
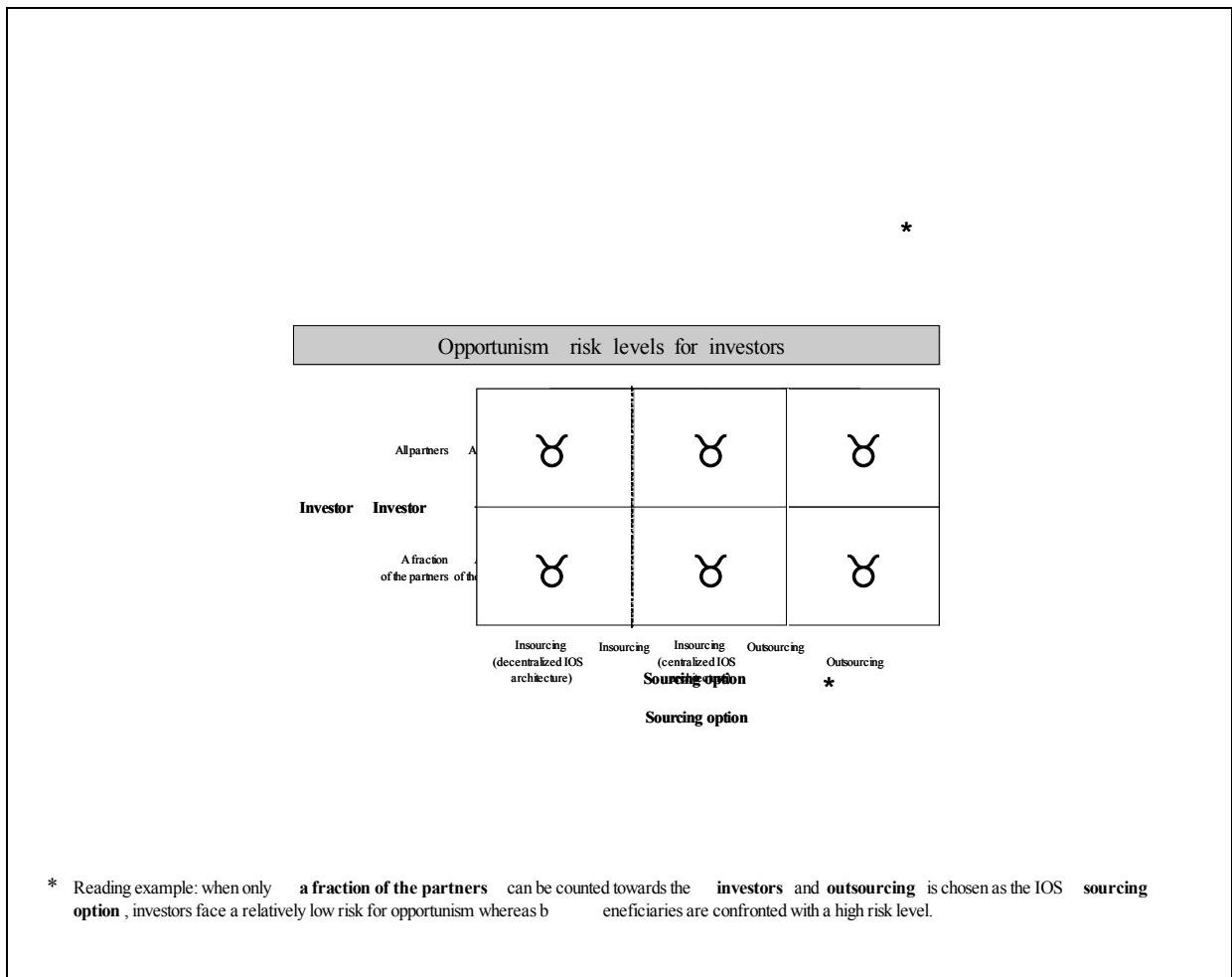

Figure 5: Risk assessment framework (Hirnle 2005, p. 24)

The framework can easily be put to practice (for an example see Hirnle 2005). After gathering a few basic facts on the setting (e.g. all network members/a fraction of the network members invest), every company must become clear about which position they take on (am I an investor or a beneficiary only?). With those easily accessible facts, any IOS investment can be positioned within the risk assessment framework and the risk level can be read off. Once the risk levels for the individual companies are identified, they can be discussed within the network and, if risk is unequally distributed, a different IOS option could be chosen.

Naturally, the outcome of such discussions depends on factors such as strategies, negotiating power and risk aversions of the participants involved. Nevertheless, the framework can be useful for creating transparency in collective investments. So even if one partner insisted on keeping his opportunistic scope for action, his intentions would become clearer *before* the IOS was introduced which also constitutes a reduction of information asymmetries.

4. Summary, limitations and outlook

This paper set out to demonstrate the operationalization of an economic theory for use in IS management. First, we quickly introduced the investigation's setting (collective IT investment in inter-firm networks), model (Principal-Agent theory) and method (operationalization of economic theory). In section 3, our exemplary investigation was structured along four steps: translation, scenario building, structured qualitative analysis and aggregation. Our methodological case concluded with the application of the newly developed framework.

Several points of critique must find a mention. First and foremost, a qualitative analysis lacks the apparent rigor of a formal economic model. Second, by aggregating risk levels, complexity might be reduced to strongly. Third, the framework is rather a basis for negotiation that a strict evaluation instrument in the sense of a net present value calculation. However, we believe that the framework represents a realistic management approach to the problem.

In all, the paper presented an exploratory, methodological case study of economic theory operationalization for Information Systems research. In next steps, it would be interesting to either conduct more operationalization case studies with the structure presented here (using other theories and others settings) or with different approaches. In the future, a standardised and process model, harmonised amongst the researchers in the community, would be very helpful for taking advantage of the economic theories' power in IS management.

References

Ahmadjian, C.L., and Lincoln, J.R. "Keiretsu, Governance, and Learning: Case Studies in Change from the Japanese Automotive Industry," *Organization science* (12:6) 2001, pp 683-701.

Albach, H. "Kosten, Transaktionen und externe Effekte im betrieblichen Rechnungswesen," *ZfB - Zeitschrift für Betriebswirtschaft* (58:11) 1988, pp 1143-1170.

Ang, S., and Straub, D.W. "Production and transaction economies and IS outsourcing: a study of the U.S. banking industry," *MIS Quarterly* (22:4) 1998, pp 535-552.

Arrow, K.J. "The economics of agency," in: *Principals and Agent: The structure of business,* M. Spence and R.J. Zeckhauser (eds.), Harvard Business School Press, Boston, 1985, pp. 37-54.

Baker, G., Gibbons, R., and Murphy, K.J. "Relational Contracts in Strategic Alliances," National bureau of economic research conference on strategic alliances, Cheeca Lodge, Islamorada, FL, 2002.

Banker, R.D., and Kaufmann, R.J. "The evolution of research on information systems: a fiftieth-year survey of the literature in Management Science," *Management Science* (50:3) 2004, pp 281-298.

Beckman, C.M., Haunschild, P.R., and Phillips, D. "Friends or strangers? Firm-specific uncertainty, market uncertainty and network partner selection," *Organization Science* (15:3) 2004, pp 259-275.

Bhattacharyya, S., and Lafontaine, F. "Double-sided moral hazard and the nature of share contracts," *RAND Journal of Economics* (26:4) 1995, pp 761-781.

Block, Z., and MacMillan, I.C. *Corporate Venturing,* Harvard Business School Press, Boston, 1993.

Burr, W. "Fundierung von Leistungstiefenentscheidungen auf der Basis modifizierter Transaktionskostenansätze," *zfbf - Zeitschrift für betriebswirtschaftliche Forschung* (55:March) 2003, pp 112-134.

Casamatta, C. "Financing and Advising: Optimal Financial Contracts with Venture Capitalists," *The Journal of Finance* (58:5) 2003, pp 2059-2085.

Casciaro, T. "Determinants of governance structure in alliances: the role of strategic, task and partner uncertainties," *Industrial and Corporate Change* (12:6) 2003, pp 1223-1251.

Davidow, W., and Malone, M. *The virtual corporation: structuring and revitalizing the corporation for the 21st century,* Harper Business Press, New York, 1992.

Dibbern, J., Heinzl, A., and Leibbrandt, S. "Interpretation des Sourcings der Informationsverarbeitung: Hintergründe und Grenzen ökonomischer Einlussgrößen," *WIRTSCHAFTSINFORMATIK* (45:5) 2003, pp 533-540.

Eom, S.B. "An introduction to inter-organizational information systems," in: *Inter-Organizational Information Systems in the Internet Age,* S.B. Eom (ed.), Idea Group Publishing, Hershey, 2005, pp. 1-30.

Gold, B. "Economic effects of technological innovations," *Management Science* (11:1) 1964, pp 105-134.

Grossman, S.J., and Hart, O.D. "An Analysis of the Principal-Agent Problem," *Econometrica* (51:1) 1983, pp 7-45.

Haecki, R., and Lighton, J. "The future of the networked company," *The McKinsey Quarterly* (38:3) 2001, pp 26-39.

Han, K., Kauffman, R.J., and Nault, B.R. "Information Exploitation and Interorganizational Systems Ownership," *Journal of Management Information Systems* (21:2) 2004, pp 109-136.

Hirnle, C. "Assessing the risk for opportunism in collective IT investment: a Principal-Agent based framework for use in inter-firm networks," *Working paper no 1/2005 of the Institute for Information Systems and New Media of the University of Munich*, Munich, 2005.

Holmstrom, B. "Moral Hazard in Teams," *Bell Journal of Economics* (13:2) 1982, pp 324-340.

Jensen, M.C., and Meckling, W.H. "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure," *Journal of Financial Economics* (3:4) 1976, pp 305-360.

Kriebel, C.H., and Raviv, A. "An economics approach to modeling the productivity of computer systems," *Management Science* (26:3) 1980, pp 297-313.

Kumar, K. "A Framework for Assessing the Business Value of Information Technology Infrastructures," *Journal of Management Information Systems* (21:2) 2004, pp 11-32.

Melville, N., Kraemer, K., and Gurbaxani, V. "Information technology and organizational performance: an integrative model of IT business value," *MIS Quarterly* (28:2) 2004, pp 283-322.

Miles, R.E., and Snow, C.C. "Organizations: New Concepts for New Forms," *California Management Review* (28:3) 1986, pp 62-73.

Pratt, J.W., and Zeckhauser, R.J. "Principals and Agents: An overview," in: *Principals and Agents: The structure of Business,* J.W. Pratt and R.J. Zeckenhauser (eds.), Harvard Business School Press, Boston, 1985, pp. 1-35.

Reid, J.D.J. "Sharecropping as an Understandable Market Response: The Post-Bellum South," *Journal of Economic History* (33) 1973, pp 106-130.

Rokkan, A.I., and Buvik, A. "Inter-firm cooperation and the problem of free riding behaviour: an empirical study of voluntary retail chains," *Journal of Purchasing & Supply Management* (9:5-6) 2003, pp 247-256.

Ross, S.A. "The Economic Theory of Agency: The Principal´s Problem," *American Economic Review* (36:2) 1973, pp 134-139.

Rubin, P.H. "The Theory of the Firm and the Structure of the Franchise Contract," *Journal of Law and Economics* (21:1) 1978, pp 223-233.

Solf, M. "Unternehmenskooperationen als Folge von Informations- und Kommunikationstechnologieveränderungen: eine theoretische Analyse," *zfbf - Zeitschrift für betriebswirtschaftliche Forschung* (56:March) 2004, pp 146-167.

Spence, M., and Zeckhauser, R.J. "Insurance, information and individual action," *American Economic Review* (61:2) 1971, pp 380-387.

Sturgeon, T. "Modular production networks: a new American model of industrial organization," *Industrial and Corporate Change* (11:3) 2002, pp 451-496.

Thatcher, M.E., and Pingry, D.E. "An Economic Model of Product Quality and IT Value," *Information Systems Research* (15:3) 2004, pp 268-286.

Veil, T., and Hess, T. "A Basic approach towards cost accounting for virtual web organizations," in: *Managing virtual web organizations in the 21st century: issues and challenges,* U.J. Franke (ed.), Idea Group Publishing, Hershey, 2002, pp. 270-291.

Weill, P., Subramani, M., and Broadbent, M. "Building IT infrastructure for strategic agility," *MIT Sloan Management Review* (44:Fall) 2002, pp 57-65.

Wigand, R., Picot, A., and Reichwald, R. *Information, Organization and Management: Ex-panding Markets and Corporate Boundaries,* Wiley, Chichester, 1997.

Williamson, O.E. *Markets and Hierachies: Analysis and Antitrust Implications. A study in the Economics of Internal Organization.,* Free Press, New York, 1975.

Williamson, O.E. *The economic institutions of capitalism,* Free Press, New York, 1985.

Williamson, O.E. "Comparative economic organization: the analysis of discrete structural alternatives," *Administrative Science Quarterly* (36:2) 1991, pp 269-296.

Wohlgemuth, O., and Hess, T. "Strategische Projekte als Objekte kollektiver Investitionsentscheidungen in Unternehmensnetzwerken," in: *Managementforschung volume 13,* G. Schreyoegg and J. Sydow (eds.), Springer, Berlin, 2003, pp 195-223.

Yin, R.K. *Applications of case study research*, (3rd ed.) Sage, Thousand Oaks, 2003.