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Antti Ylä-Kujala

**INTER-ORGANIZATIONAL MEDIUMS:
CURRENT STATE AND UNDERLYING POTENTIAL**



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Thesis for the degree of Doctor of Science (Technology) to be presented with due permission for public examination and criticism in the auditorium 2303 of the main building at Lappeenranta University of Technology, Lappeenranta, Finland on the 22nd of November, 2018, at noon.

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Abstract

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The rise of outsourcing has revised inter-organizational relationships in conventional manufacturing industries. Transaction-oriented exchanges have been superseded by relational purchasing, where customers transfer production activities and related competencies to selected key suppliers. There are also customers who see industrial maintenance as a non-core competency that can be outsourced to external service providers. When suppliers and service providers adopt these new responsibilities, customers lose control in two managerial domains, cost management and asset management. One way for managing costs and assets is using inter-organizational mediums, which are tools, models, techniques, approaches, methods, technologies, and systems that intermediate relationships between and among organizations.

The inter-organizational medium is a completely new concept created for the purposes of this thesis, as the literature where these mediums have been discussed previously is unclear and fragmented at best. The research objective is therefore to map the current state and underlying potential of inter-organizational mediums in cost management and asset management contexts. The thesis consists of four individual publications that apply different research methods, including cluster analysis, factor analysis, (qualitative) content analysis, case studies, and design science research.

The findings suggest that inter-organizational mediums in the cost management context are currently utilized by 7 % of companies. The underlying potential is significantly higher, as the joint cost management orientation was recognized in nearly 40 % of companies belonging to two groups, 'the trustful' and 'the trailblazers'. Empirical examples of inter-organizational mediums in the asset management context are few in number. To address this shortcoming, it is demonstrated in the thesis how organizations can attain benefits with these kinds of mediums on both operational and strategic levels of asset management, granted that there is willingness to disclose information across organizational boundaries. The intermediating role of asset technologies, the Internet of Things in particular, which improves organizations' ability to disclose information, is highlighted. An implementation framework for different kinds of inter-organizational mediums is proposed. The thesis provides also novel insights into the conceptual and contextual foundations of the emerging research field of inter-organizational relations.

Keywords: inter-organizational relationships; cost management; asset management; information disclosure; inter-organizational mediums; state; potential; implementation

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Please, enjoy the read!

Antti Ylä-Kujala

Antti Ylä-Kujala

October 2018

Lappeenranta, Finland

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Abstract

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Publications

List of publications

This thesis is based on the following publications; nominated as (P)1, (P)2, (P)3 and (P)4. The rights have been granted by the publishers to include the publications in the thesis.

1. Ylä-Kujala, A., Marttonen-Arola, S. & Kärri, T. (2018). Finnish “state of mind” on inter-organizational integration: a cost accounting and cost management perspective. *IMP Journal*, Vol. 12, No. 1, pp. 171-191.

Contribution: The author was solely responsible for conducting the research and writing the article. The co-authors were involved in the design of the research and commented on all versions of the manuscript.
2. Ylä-Kujala, A., Marttonen, S., Kärri, T., Sinkkonen, T. & Baglee, D. (2016). Inter-organisational asset management: linking an operational and a strategic view. *International Journal of Process Management and Benchmarking*, Vol. 6, No. 3, pp. 366-385.

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3. Ylä-Kujala, A., Marttonen-Arola, S., Kärri, T. & Liyanage, J.P. (2018). From networks to ecosystems: redefining inter-organizational transparency. *Proceedings of Maintenance Performance Measurement and Management (MPMM) 2018*, pp. 24-31. June 21st – 22nd, 2018. Coimbra, Portugal.

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4. Ylä-Kujala, A., Marttonen-Arola, S., Sinkkonen, T. & Kärri, T. (20XX). Implementation of inter-organisational mediums: synthesising framework as a design exemplar. *International Journal of Networking and Virtual Organisations*, Vol. X, No. Y. Article in press.

Contribution: The author was solely responsible for conducting the research and writing the article. The co-authors were involved in the design of the research and commented on all versions of the manuscript.

List of abbreviations

ABC	Activity-based costing
CCC	Cash conversion cycle
CNPV	Cumulative net present value
COO	Cost of ownership
CSA	Customer – Supplier A
CSB	Customer – Supplier B
DOO	Director of operations
EBITDA	Earnings before interest, tax, depreciation and amortization
EBITDA%	Earnings before interest, tax, depreciation and amortization / total sales
FA	Fixed assets
FA%	Fixed assets / total sales
FAM	Flexible asset management
IFFIM	Implementation framework for inter-organizational mediums
IOA	Integrated operations advisor
IOCM	Inter-organizational cost management
IOM	Inter-organizational medium
IoT	Internet of Things
LCM	Life-cycle model
MCS	Management control system
NDA	Non-disclosure agreement
OBA	Open-book accounting
ROI	Return on investment
SASB	Supplier A – Supplier B
SME	Small / medium-sized enterprise
SOIL	Secure oil information link
TCAA	Total cost achieving activity
TCE	Transaction cost economics
TCM	Total cost management
TCO	Total cost of ownership
VCA	Value chain analysis

1 Introduction

1.1 Research context, key concepts and motivation

Within the last couple of decades, customer-supplier relationships in conventional manufacturing industries have undergone a major paradigm shift. Transactional arm's length purchasing is making way for a new strategy known as relational purchasing, where customer-supplier relationships are characterized by repeated exchanges that generate deep relational ties (see e.g. Axelsson & Wynstra 2002; Axelsson et al. 2002; Svahn & Westerlund 2009; Agndal & Nilsson 2010). The relational purchasing strategy reduces customers' supply-side resource independence as portions of production activities, and related competencies are outsourced to selected key suppliers, which establishes prominent supplier interfaces that have to be actively managed (see e.g. Araujo et al. 1999; Cousins & Spekman 2003; Baraldi et al. 2012; Araujo et al. 2016).

Another avenue where outsourcing has received increased attention is asset maintenance (and asset management). Industrial maintenance in particular is seen as a non-core competency that can be transferred – partly or completely – to equipment manufacturers and specialized maintenance service providers (see e.g. Campbell 1995; Martin 1997; Levery 1998; Persona et al. 2007). As a phenomenon, maintenance outsourcing is comparable to relational purchasing, as also the former establishes relational ties, i.e. customer-provider relationships. The main difference is that rather than goods (e.g. materials, components, assemblies etc.), the customer obtains a service or services.

Outsourcing, including the new kind of purchasing and maintenance approaches, is associated with many benefits. According to Duening and Click (2005), outsourcing provides organizations with the opportunity to save costs, acquire third-party expertise, increase market flexibility, improve scalability, and reduce the time to market. However, it can be argued that each outsourcing resolve is also a decision to externalize parts of decision-making and connected managerial domains. When relationship is prioritized over transaction, full control of 'cost management' and 'asset management' is lost.

In order to understand what cost management is, the definition of 'cost accounting' and its role within the accounting function has to be determined first.

Cost accounting (Horngren et al. 2015, p. 26):

“The process of measuring, analyzing, and reporting financial and nonfinancial information related to the costs of acquiring or using resources in an organization.”

The measurement, analysis and reporting of costs forms a foundation for all accounting and provides information for its main processes; ‘financial accounting’ and ‘management accounting’. Financial accounting is responsible for communicating the financial position to external stakeholders (e.g. investors, banks and regulatory bodies), whereas management accounting supports internal decision-making and steers the organization towards its goals (Horngren et al. 2015). Product costing, for instance, has the dual role of cost accounting by providing information for both financial accountants who value the inventories and management accountants who price the products. That being said, cost accounting is also an important premise for the above-mentioned cost management that deals with the incurring of costs. It is defined as follows:

Cost management (Bhimani et al. 2012, p. 4):

“The actions that managers undertake in the short-run and long-run planning and control of costs that increase value for customers and lower the costs of products and services.”

Cost planning and cost control are keywords in the definition. The purpose of cost management is not – by any means – to reduce costs despite consequences. As Horngren et al. (2015) emphasize, an organization may choose to improve its financial position also by incurring costs to satisfy customers. Quintessential to the idea of cost management is therefore the recognition of the fact that each managerial decision commits to certain costs (Bhimani et al. 2012). It also has to be pointed out that management accounting and cost management should not be applied interchangeably. Unlike the former that meets a number of predefined needs in the accounting function, the latter, i.e. cost management, is a holistic management approach, or a managerial mindset, which helps organizations to deploy resources appropriately based on cost accounting and other sources of information. When the costs of products and services, as well as the value experienced by customers depend increasingly on suppliers’ ability to incur costs, cost management transforms from an internal activity to a partly external one.

Prior to conceptualizing asset management, the meaning of an ‘asset’ should be clarified. The international asset management standard ISO 55000 defines an asset as:

Asset (ISO 55000 2014, p. 13):

“Item, thing or entity that has potential or actual value to an organization.”

Within this general definition, there are multiple ways to classify assets. By taking an accountant's view to assets, Hastings (2015) observes the balance sheet that comprises two types; 'fixed assets' and 'current assets'. Fixed assets are physical items (e.g. land, plant, buildings, and equipment), the value of which is retained over a financial year. Current assets, on the other hand, consist of faster moving items (e.g. raw materials, finished goods, other inventories, and accounts receivable) that can be easily liquidated, i.e. converted into cash in a relatively short period of time. Another classification is proposed by Amadi-Echendu et al. (2010), who make a distinction between 'engineering assets' and 'financial assets'. While the latter type exists as contracts between organizations (e.g. stocks, intangible rights and accounts receivable), engineering assets possess also a tangible dimension independent of contractual terms (e.g. equipment and inventories), which means that a great deal of their value stems from a capability e.g. to produce a specific amount of goods in a specific unit of time.

Furthermore, asset management is defined in the ISO 55000 standard as follows:

Asset management (ISO 55000 2014, p. 14):

“Coordinated activity of an organization to realize value from assets.”

Hence, the interpretation of asset management is dependent on the definition of asset. In this thesis, asset management is understood mainly as those activities that organizations take to realize value from engineering assets, e.g. servicing an equipment in order to maintain its above-mentioned capability. This approach is sometimes referred to as 'engineering asset management' (Amadi-Echendu et al. 2010). In the wake of maintenance outsourcing as a form of relational purchasing, the accountant's view to asset management is becoming more pronounced. Closer ties to (maintenance) service providers is an enabling factor for 'flexible asset management' (Marttonen 2013), which aims at improving profitability in organizations through designated and collaborative management of fixed assets and working capital (i.e. inventories + accounts receivable – accounts payable). Although accounts receivable is not an engineering asset per se, it is certainly linked to fixed assets and the process that converts raw materials into finished goods. In this respect, flexible asset management is an extension of engineering asset management in the contemporary industrial landscape.

The traditional outlook to cost management and asset management has been that they are exceedingly intra-organizational activities, which means that any piece of information related to either costs or assets has been kept within organizational boundaries. The rise of boundary-spanning phenomena, e.g. relational purchasing, has, however, created two parallel managerial domains, intra-organizational and inter-organizational ones. As far as

the latter is concerned, it is essential to make a distinction between ‘inter-organizational relations’ and ‘inter-organizational relationships’.

Inter-organizational relations and relationships (Cropper et al. 2008, p. 4):

“Inter-organizational relations is concerned with relationships between and among organizations. [...] we’ll use the acronym, ‘IOR’, to refer to the name of the field – i.e. inter-organizational relations – and ‘IORS’ to refer to these inter-organizational relationships.”

Inter-organizational relations is the name of the field that studies inter-organizational relationships, i.e. relationships between and among organizations. As inter-organizational relationships is a generic term for a heterogeneous group of situations, different ‘inter-organizational entities’ are typically particularized in the conduct of research. Such entities are described with illustrative terms, such as partnership, alliance, joint venture, or network (Cropper et al. 2008). There are also constructs that refer to ‘inter-organizational acts’, the consequence of which are new inter-organizational entities. Outsourcing, for instance, may establish a partnership between a customer and its supplier/provider. In this thesis, the plural form – inter-organizational relationships – is the expression for organizations’ relationships to other organizations, whereas the singular form – inter-organizational relationship – is an organization’s specific relationship to another organization. Throughout the thesis, also inter-organizational entities such as networks are mentioned.

The title of the thesis, “Inter-organizational mediums: current state and underlying potential”, suggests that some kind of ‘mediums’ are utilized in inter-organizational relationships. According to Oxford English Dictionary (2017), there are numerous definitions for the word medium. The following distinction is adopted here with the emphasis on “thing” rather than “person”, without downplaying the role that individuals may have on the functionality of relationships (see e.g. Free 2008; Jakobsen 2012). It should also be noted that the following conceptualization of (inter-organizational) medium is unique to the thesis, and cannot thus be found in prior scientific literature.

Medium (Oxford English Dictionary 2017):

“A person or thing which acts as an intermediary. An intermediate agency, instrument, or channel; a means; esp. a means or channel of communication or expression.”

By building on the concept of inter-organizational relationships and the definition of medium, it can be concluded that an **inter-organizational medium** is a...

- *tool,*
- *model,*
- *technique,*
- *approach,*
- *method,*
- *technology, or*
- *system that intermediates relationship(s) between and/or among organizations.*

In the crossroads of cost management and inter-organizational relationships, an inter-organizational medium is a thing (e.g. a cost accounting technique) that enables collaborative planning and control of costs, which increases value for customers and lowers the costs of products/services. In the crossroads of asset management and inter-organizational relationships, an inter-organizational medium is a thing (e.g. a decision-making tool) that enables organizations to realize value from assets in collaboration.

In conjunction with increasing industrial interdependencies, the inter-organizational phenomenon has been gaining popularity in the academia as well (see **Table 1.1**). As circa 30 years have passed since inter-organizational relationships were recognized as something more than a necessity resulting from organizations' reciprocal exchange (Håkansson 1982; Thorelli 1986), three decades of research can be distinguished; the first (1987 – 1996), the second (1997 – 2006), and the third (2007 – 2016). The data concerning this was retrieved from SCOPUS (2018), which is the largest abstract and citation database of peer-reviewed scientific literature. The query strings were searched from the titles, abstracts and keywords of all available document types including, but not limited to, journal articles, conference papers and book chapters within the following subject areas; business, management and accounting, engineering, and decision sciences.

The transition from the first decade to the second entails a substantial multiplication in the quantity of publications dealing with anything and everything “inter-organizational”. The largest growth numbers are displayed in the second and third query strings, which indicates that different relationship types and the ways to manage them have been puzzling scholars. When ‘management’ is further coupled with ‘cost’ and ‘accounting’ (i.e. the fourth query string) as well as ‘asset’ and ‘maintenance’ (i.e. the fifth query string), it becomes evident that the former combination has been studied significantly more. It is also worth noting that despite the smaller multipliers in the third decade, the interest towards the inter-organizational phenomenon has not abated. The publication quantities are greater, across the queries, than those of the preceding decades combined.

Table 1.1 The evolution of “inter-organizational” in scientific research (SCOPUS 2018).

Query string ↓ Years (X–Y) →	1987 – 1996	1997 – 2006	2007 – 2016
Inter-organizational ¹	3 764 →	16 112 (4.3x)	26 890 (1.7x)
Inter-organizational ² AND relationship	1 300 →	6 609 (5.1x)	12 297 (1.9x)
Inter-organizational ³ AND management	1 198 →	6 051 (5.1x)	10 396 (1.7x)
Inter-organizational ⁴ AND management AND cost OR accounting	394 →	1 899 (4.8x)	2 787 (1.5x)
Inter-organizational ⁵ AND management AND asset OR maintenance	82 →	378 (4.6x)	628 (1.7x)
Inter-organizational ⁶ AND cost management OR asset management AND medium (i.e. tool OR...)	21 →	80 (3.8x)	179 (2.2x)

1 TITLE-ABS-KEY ("inter-organizational" OR "inter-organisational" OR "inter-firm" OR "interorganizational" OR "interorganisationsal" OR "interfirm" OR (("customer" OR "client" OR "buyer" OR "purchaser") AND ("supplier" OR "provider" OR "contractor" OR "manufacturer" OR "producer"))) AND PUBYEAR > X-1 AND PUBYEAR < Y+1 AND (LIMIT-TO (SUBJAREA, "BUSI ") OR LIMIT-TO (SUBJAREA, "ENGI ") OR LIMIT-TO (SUBJAREA, "DECI "))

2 TITLE-ABS-KEY ("inter-organizational" OR "inter-organisational" OR "inter-firm" OR "interorganizational" OR "interorganisationsal" OR "interfirm" OR (("customer" OR "client" OR "buyer" OR "purchaser") AND ("supplier" OR "provider" OR "contractor" OR "manufacturer" OR "producer"))) AND ("relationship" OR "partnership" OR "alliance" OR "joint venture" OR "collaboration" OR "cooperation" OR "network")) AND PUBYEAR > X-1 AND PUBYEAR < Y+1 AND (LIMIT-TO (SUBJAREA, "BUSI ") OR LIMIT-TO (SUBJAREA, "ENGI ") OR LIMIT-TO (SUBJAREA, "DECI "))

3 TITLE-ABS-KEY ("inter-organizational" OR "inter-organisational" OR "inter-firm" OR "interorganizational" OR "interorganisationsal" OR "interfirm" OR (("customer" OR "client" OR "buyer" OR "purchaser") AND ("supplier" OR "provider" OR "contractor" OR "manufacturer" OR "producer"))) AND ("management" AND PUBYEAR > X-1 AND PUBYEAR < Y+1 AND (LIMIT-TO (SUBJAREA, "BUSI ") OR LIMIT-TO (SUBJAREA, "ENGI ") OR LIMIT-TO (SUBJAREA, "DECI "))

4 TITLE-ABS-KEY ("inter-organizational" OR "inter-organisational" OR "inter-firm" OR "interorganizational" OR "interorganisationsal" OR "interfirm" OR (("customer" OR "client" OR "buyer" OR "purchaser") AND ("supplier" OR "provider" OR "contractor" OR "manufacturer" OR "producer"))) AND ("management" AND ("cost" OR "accounting")) AND PUBYEAR > X-1 AND PUBYEAR < Y+1 AND (LIMIT-TO (SUBJAREA, "BUSI ") OR LIMIT-TO (SUBJAREA, "ENGI ") OR LIMIT-TO (SUBJAREA, "DECI "))

5 TITLE-ABS-KEY ("inter-organizational" OR "inter-organisational" OR "inter-firm" OR "interorganizational" OR "interorganisationsal" OR "interfirm" OR (("customer" OR "client" OR "buyer" OR "purchaser") AND ("supplier" OR "provider" OR "contractor" OR "manufacturer" OR "producer"))) AND ("management" AND ("asset" OR "maintenance")) AND PUBYEAR > X-1 AND PUBYEAR < Y+1 AND (LIMIT-TO (SUBJAREA, "BUSI ") OR LIMIT-TO (SUBJAREA, "ENGI ") OR LIMIT-TO (SUBJAREA, "DECI "))

6 TITLE-ABS-KEY ("inter-organizational" OR "inter-organisational" OR "inter-firm" OR "interorganizational" OR "interorganisationsal" OR "interfirm" OR (("customer" OR "client" OR "buyer" OR "purchaser") AND ("supplier" OR "provider" OR "contractor" OR "manufacturer" OR "producer"))) AND ("cost management" OR "management accounting" OR "asset management" OR "maintenance management") AND ("tool" OR "model" OR "technique" OR "approach" OR "method" OR "technology" OR "system")) AND PUBYEAR > X-1 AND PUBYEAR < Y+1 AND (LIMIT-TO (SUBJAREA, "BUSI ") OR LIMIT-TO (SUBJAREA, "ENGI ") OR LIMIT-TO (SUBJAREA, "DECI "))

Aggregate level numbers provide a general understanding of the inter-organizational phenomenon, but do not reveal what kind of contributions each stream of literature retains. In order to define the research gap explicitly, a deeper thematic analysis was conducted based on keywords and the most cited publications within the fourth, fifth and sixth query strings (see **Table 1.2**). A detailed breakdown of the most cited publications can be found in the appendices (see p. 83-85). Management topics related to cost/accounting were found in 5080 documents, whereas asset/maintenance appeared 1088 times. When the search was targeted at different mediums with emphasis on cost/asset -driven concepts rather than plain words (e.g. ‘cost management’ instead of ‘cost’ and ‘management’), 280 matches were acquired. It should be stated, however, that there are false positives, as some search parameters (e.g. tool) are common parlance.

Table 1.2 Analysis of research themes based on keywords and the most cited publications.

Query string	Keywords: <i>top 10 most common</i>	Keywords: <i>top 10 most relevant</i>	Publications: <i>top 50 most citations</i>
Inter-organizational ⁴ AND management AND cost OR accounting <i>5080 documents (1987 - 2016)</i>	1 Costs 2 Supply chain management 3 Customer satisfaction 4 Sales 5 Industrial management 6 Supply chains 7 Project management 8 Competition 9 Cost effectiveness 10 Inventory control Outsourcing 21 Cost accounting 36 Contractors 41 Cost reduction 47 Information sharing 89 Service provider 114 Suppliers 124 Trust 125 Cost management 126 Buyer-supplier relationships 154	Transactional focus (i.e. supply chains) 32 Relational focus 6 Non-industrial topic 5 Out of scope 7 = 50
Inter-organizational ⁵ AND management AND asset OR maintenance <i>1088 documents (1987 - 2016)</i>	1 Maintenance 2 Customer satisfaction 3 Industrial management 4 Sales 5 Project management 6 Costs 7 Supply chain management 8 Competition 9 Information management 10 Supply chains Outsourcing 12 Asset management 24 Investments 26 Contractors 30 Service provider 53 Intangible assets 74 Maintenance management 83 Maintenance services 102 Trust 117 Original equipment manufacturer 124	Transactional focus (i.e. supply chains) 24 Relational focus 9 Intangible assets 9 Out of scope 8 = 50
Inter-organizational ⁶ AND cost management OR asset management AND medium <i>280 documents (1987 - 2016)</i>	1 Cost management 2 Costs 3 Maintenance 4 Asset management 5 Cost accounting 6 Supply chain management 7 Customer satisfaction 8 Supply chains 9 Competition 10 Sales Maintenance management 15 Inter-organizational cost management 62 / 134 Maintenance services 64 Target costing 68 Open-book accounting 76 / 77 Trust 81 Activity-based costing 104 Channel relations 111 Collaborative network 112 Control 118	Cost management focus 27 Asset management focus 6 Supply chain focus 8 Out of scope 9 = 50

The most common keywords relative to the fourth and fifth query strings are fairly generic, both comprising e.g. 'industrial management', 'customer satisfaction' and 'sales'. Bearing in mind that these queries have an inter-organizational foundation, most context-relevant keywords are utilized rather infrequently. Examples of such words are 'outsourcing' (pos. 21), 'suppliers' (pos. 124) and 'buyer-supplier relationships' (pos. 154) in the fourth query string, and in the fifth query string, 'outsourcing' (pos. 12), 'maintenance services' (pos. 102) and 'original equipment manufacturer' (pos. 124).

Another common keyword for the fourth and fifth query string is 'supply chains' (see 'supply chain management' as well), which is typically operationalized in the literature to describe inter-organizational relationships that are transactional. When looking at the most cited publications, it can be noticed that – in contrast to relational focus – the above-mentioned supply chain perspective dominates the scientific discussion on this level of analysis. Further, characteristic to the fifth query string in particular, is a considerable amount of search results related to intangible, "non-engineering" assets, such as intellectual rights and human capital. As a keyword, 'intangible assets' (pos. 74) is more prevalent than e.g. 'maintenance services'.

In the sixth query string, the most commonly employed keywords begin to reflect the intended context, as 'cost management' (pos. 1) and 'asset management' (pos. 4) are found in the top ten. Instead of supply chains, cost management literature is now pronounced in the most cited publications. The most relevant keywords show a similar inclination by including e.g. 'inter-organizational cost management' (pos. 62 / 134), 'target costing' (pos. 68) and 'open-book accounting' (pos. 76 / 77), which are typical labels for accounting techniques that span organizational boundaries (see p. 28-31).

The last step of the thematic analysis was to take a closer look at the most cited publications in the sixth query string. As far as cost management literature is concerned, the majority of research is founded on case studies and other qualitative research methods. Inter-organizational mediums (e.g. collaborative tools, accounting techniques, and information systems) are described in this literature, but always in relation to a specific case setting, which denotes that a common denominator or all-encompassing conceptualization for different kinds of mediums does not exist. In comparison to cost management (case) studies, asset management literature lacks a prominent inter-organizational research tradition altogether, as only two out of the six documents in the most cited publications of the sixth query string show a clear inter-organizational emphasis. These gaps in the scientific knowledge establish a need for further research (P1–P4), while the original feature of the thesis is to introduce a new concept, inter-organizational medium, as a means of integrating both streams of literature.

1.2 Research objective, questions and scope

As illustrated in **Figure 1.1**, this thesis has one main objective, "...to map the current state and underlying potential of inter-organizational mediums", which can be further broken down to three research questions (RQ1, RQ2, and RQ3). The current state and underlying potential are discussed in the context of cost management and asset management in compliance with the research context determined above. Research design-wise, the research questions are answered through different research approaches in individual publications. Because a full account of the design choices is presented in chapter 3 (see p. 43-48), the research approaches are not elaborated on here.

RQ1: *"What is the state of development and/or utilization of inter-organizational mediums?"* is addressed in publications 1 and 2. The qualitative part of P1 takes a stand on the prevalence of inter-organizational mediums among small, medium-sized and large Finnish organizations, particularly from a cost accounting and cost management perspective. P2 examines the concept of 'inter-organizational asset management' that retains two managerial levels: operational and strategic. Two inter-organizational mediums are discussed, one representing operational asset management, and the other strategic asset management. The benefits that organizations achieve from the use of these mediums are demonstrated by illustrating examples.

RQ2: *"What kind of unrealized potential is there for inter-organizational mediums?"* is addressed in publications 1 and 3. The quantitative part of P1 endeavors to form an overall picture of Finnish cost management, including those practices that exceed traditional organizational boundaries. Organizations' joint cost management orientation mapped in P1 reflects the potential for inter-organizational mediums. P3 investigates how information disclosure between and among organizations can be facilitated by the Internet of Things (IoT) technologies, e.g. sensors. These novel, still emerging technologies are positioned as a new, transformative force that intermediates asset management and information disclosure in inter-organizational relationships.

RQ3: *"How are inter-organizational mediums to be implemented in order to unleash their potential?"* is addressed solely in P4, where an implementation framework for inter-organizational mediums is created from the theory. Unlike most contemporary science that is based on the quantitative and/or qualitative research tradition, P4 is labeled as 'design science'. The objective of all design sciences is to develop general knowledge to support the design of solutions to field problems, e.g. implementation of inter-organizational mediums. The theoretical foundation of the framework lies in the cost management literature, but the created solution should be applicable to a variety of inter-organizational mediums and thus managerial situations.

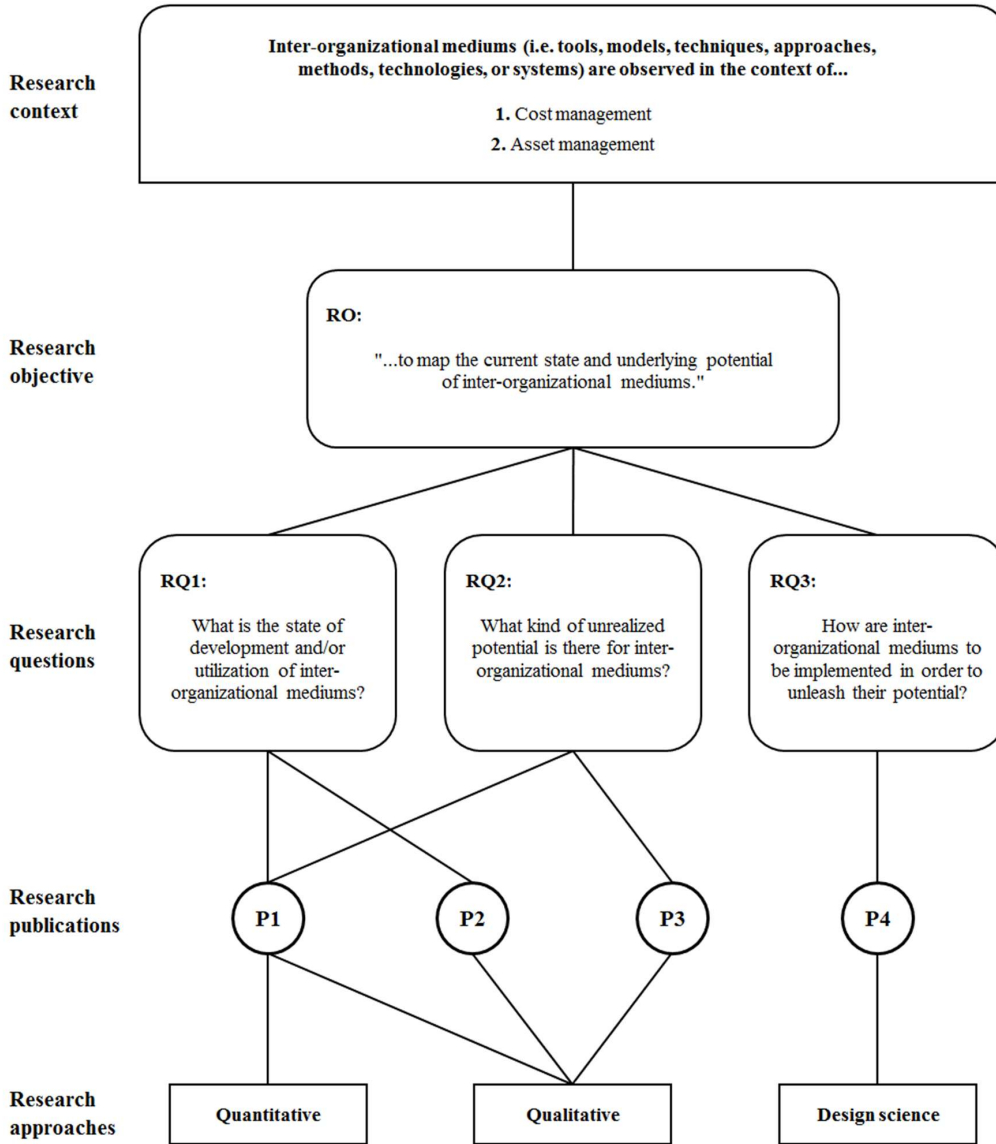


Figure 1.1 The research objective broken down to three research questions.

Furthermore, the scope of the thesis is presented in **Figure 1.2**. It is located in the intersection of three prominent areas of research (i.e. cost management, asset management and inter-organizational relations) that are further positioned within a broader frame of management control and decision support that inter-organizational mediums (i.e. tools, models, techniques, approaches, methods, technologies, and systems)

as managerial utilities are all part of. Conceptually, management control and decision support are two sides of the same coin. According to Malmi and Brown (2008), management controls are e.g. systems that are employed to guide others' behavior, whereas decision support does not retain the control element, but focuses on providing information for decision-making. An inter-organizational medium can be either or both.

When cost management, asset management and inter-organizational relations are portrayed as the axes of the scope, each publication is situated differently in relation to the three dimensions. P1 is purely a cost management -themed publication, while P4 taps into the existing cost management theories, but applies these prior ideas to a broader managerial discussion. Asset management context stands out in P2, where two specific inter-organizational mediums are demonstrated. P3 revolves more around technological development (i.e. IoT) and its ramifications on inter-organizational transparency than asset management per se, although the former influences the latter.

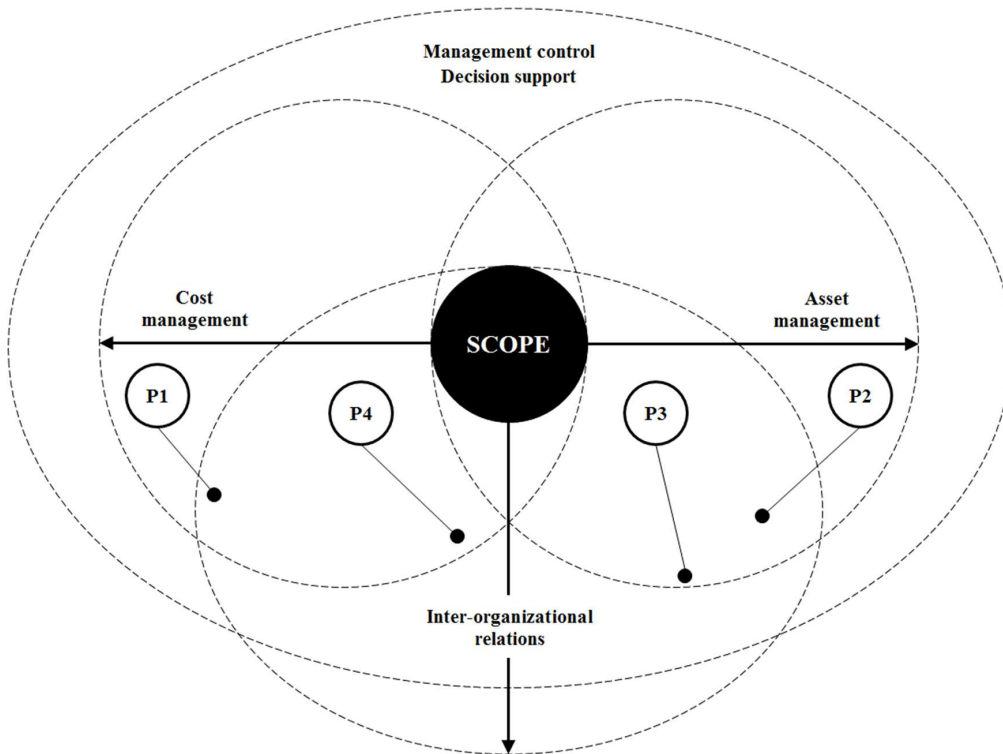


Figure 1.2 Scope of the thesis.

1.3 Outlining the structure of the thesis

The thesis consists of two parts, as shown in **Figure 1.3**. The first part provides an overview to the study through five chapters; introduction, theoretical background, research design, review of the results, and conclusions. The second part comprises the publications in which the conducted research is described. Each of the five chapters has a number of inputs and outputs, which help the reader to understand the choices made within the process. The inputs of chapter 1, for instance, are the research context, key concepts and the identification of the research gap, through which the motivation, research objective, research questions and the scope of the thesis are illuminated.

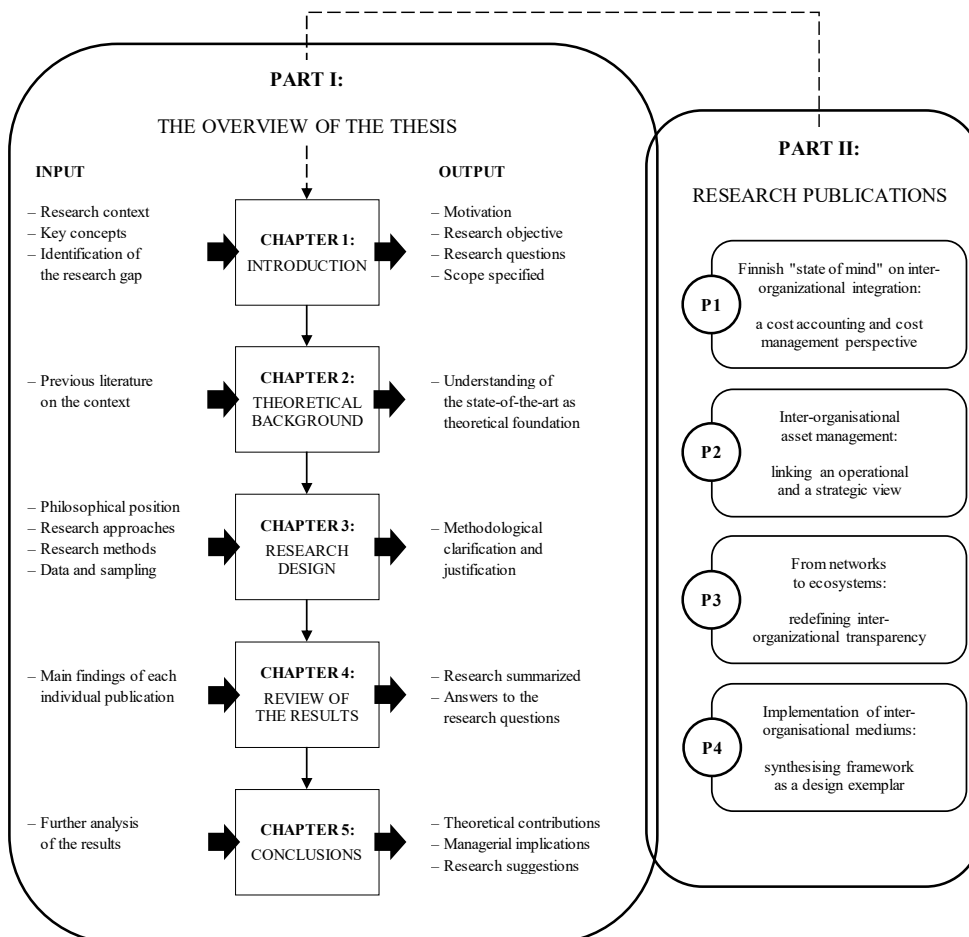


Figure 1.3 Outline of the structure of the thesis.

2 Theoretical background

2.1 The multifaceted nature of exchange: control vs. trust

‘Control’ is a key concept in the literature that discusses inter-organizational relationships. The most prominent control theory is the theory of transaction cost economics (TCE), where the formation of inter-organizational relationships is perceived as a calculated, managerial decision, the aim of which is to lower the costs of doing business that – in principle – consist of production and transaction costs (Williamson 1985; 1991). While lower production costs are attained typically by suppliers, higher transaction costs – associated with suppliers’ self-interested, opportunistic behavior – stem from the need to design control mechanisms. TCE hence proposes that each inter-organizational relationship is a balancing act, where transaction costs are proportioned to the risk of opportunism, which is dependent on transaction characteristics that are asset specificity (i.e. investment in relationship-specific assets), uncertainty (i.e. environmental and behavioral), and frequency/duration of the exchange (Williamson 1985; 1991).

According to Anderson and Dekker (2010), transaction costs comprise both pre-contractual costs related to supplier selection, negotiations and contract development, and post-contractual costs related to monitoring, enforcing contract compliance, and dispute resolution. Because organizations cannot (afford to) write complete contracts in regard to all aspects of the above-mentioned transaction characteristics (i.e. asset specificity, uncertainty, and frequency/duration), in particular monitoring is required. Monitoring refers mainly to formal control mechanisms that are in the literature typically divided to outcome controls and behavior controls (see e.g. Langfield-Smith & Smith 2003; Dekker 2004; Emsley & Kidon 2007). Outcome controls are employed to specify goals and measure results without interfering with the way they are obtained, whereas behavior controls specify and measure desirable behavior without necessarily focusing too much on the extent of goal achievement (Anderson & Dekker 2010).

Instead of control, organizations may seek to capitalize on ‘trust’ in order to influence each other’s intentions and behavior. Trust is a subtle, diffuse and elusive phenomenon (Noteboom 1996), which has been conceptualized in a multitude of ways. A cross-disciplinary definition is proposed by Rousseau et al. (1998), who outline trust as:

Trust (Rousseau et al. 1998, p. 395):

“Trust is a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another.”

The psychological nature of trust denotes two things. First, trust arises invariably from the people that inhabit organizations. Second, trust is not an action, but the positive expectations archetypical to the concept of trust result from actions that are either intended (i.e. intentions) or realized (i.e. behavior). Many scholars make a further distinction between two types of trust: competence trust and goodwill trust (see e.g. Noteboom 1996; Das & Teng 2001; Dekker 2004; Emsley & Kidon 2007; Dekker et al. 2013). Competence trust is the expectation that the other party has the ability to perform according to agreements, whereas goodwill trust is the expectation that the other party has good intentions and thus behaves in the interest of the relationship, not itself.

The origin of trust – i.e. what establishes the above-mentioned intention to accept vulnerability – has been studied as well. Poppo et al. (2008), for instance, argue that it has two particular origins, known as “shadow of the future” and “shadow of the past”. Their findings suggest that inter-organizational trust emerges from the shadow of the future (i.e. the expectation of continued interaction) that is indirectly mediated by the shadow of the past (i.e. prior exchange experiences). Trust, whether competence or goodwill, is therefore a complex product of shared history that enhances learning and builds conventions and routines, which causes the expectation of continuity.

There is a certain appeal in perceiving trust as an alternative mode to control, i.e. organizations can either accept the vulnerability that comes with positive expectations characteristic to trusting behavior, or resort to extensive control designs in fear of opportunistic behavior. However, Poppo and Zenger (2002) maintain that the nexus between TCE and so-called relational governance (i.e. trust-based relationships) is complementary rather than substitutive. On the basis of their findings, trust promotes contract (control) complexity, which together have a positive effect on the satisfaction experienced about exchange performance. Mellewigt et al. (2007) broaden this complement-substitute argument by making a distinction between control concerns and coordination concerns. According to them, trust and control are complements under high levels of trust when the use of controls is interpreted as “coordinating” not “controlling”.

The role that information plays in establishing inter-organizational trust has been contemplated by Tomkins (2001). He recognizes two types of information, type 1 information needed for a willingness to trust, and type 2 information needed for a collaborative mastery of events. Type 1 information is required when a relationship is established, when trust in the other’s competencies or goodwill without any kind of confirmation is naïve. Type 2 information, on the other hand, is necessary for task coordination in the later stages of the relationship. These notions of Tomkins (2001) suggest further that trust cannot exist without an element of control. The information that

is needed for both developing trust (i.e. type 1) and sustaining trust (i.e. type 2) is connected to control mechanisms, which can be outcome and behavior controls, or something less formal, e.g. cost and accounting controls (Caglio & Ditillo 2008).

Based on the literature, trust and control have an intricate relationship that can be summarized and perhaps simplified by means of purchasing strategy choices, as illustrated in **Figure 2.1**, where trust is approached by relational, long-term purchasing strategy and control by transactional, arm's length purchasing strategy.

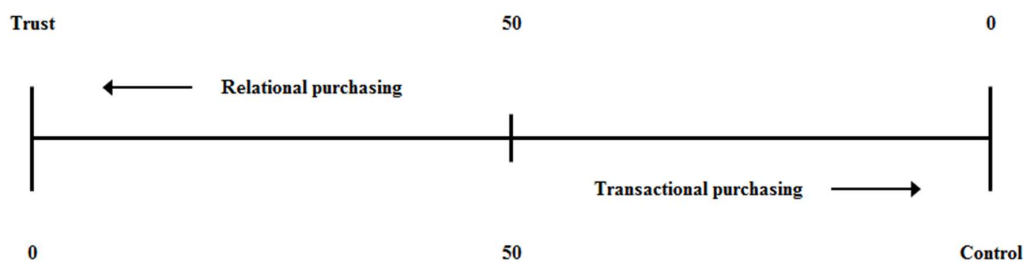


Figure 2.1 Purchasing strategies: trust-control perspective.

The term “approaches” is applied to denote that there are no absolutes. When control exceeds trust, inter-organizational relationships become increasingly dependent on contracts and formal controls as per the theory of TCE. Trust and control act as substitutes, although some competence trust arises most likely from the antecedent supplier selection. In proportion, inter-organizational relationships characterized by relatively high levels of (goodwill) trust rely on collaborative, “softer” controls that provide information for the mastery of events. Because controls serve a coordination purpose rather than a control purpose, trust and control act as complements. In these relationships, excessive formality in the control design would be a signal of mistrust.

As this thesis focuses on inter-organizational relationships that are founded on the relational purchasing strategy, inter-organizational mediums (IOM) studied in the cost management (see chapter 2.2) and asset management contexts (see chapter 2.3) rely mostly on the “softer” forms of control that provide information for the collaborative mastery of events. As each relationship is a unique combination of relational and transactional characteristics, contracts and other controls emerge in the empirical literature despite high levels of trust. If not otherwise stated, the concept of control is synonymous to monitoring in the thesis, as monitoring is the most frequent control type in any given relationship between its contractual initiation and termination.

2.2 Cost management in inter-organizational relationships

The idea of disclosing costs in inter-organizational relationships was introduced to the academia by Munday (1992) in his seminal paper; “Accounting cost data disclosure and buyer-supplier partnerships – a research note”. By referring to customer-supplier relationships where cost disclosure is feasible as partnerships, he recognized that such interactions are characterized by repeated, long-term exchanges rather than sporadic, arm’s length transactions. Axelsson et al. (2002) termed this approach later as the relational purchasing strategy, which is founded on deep ties and cost and value orientation in contrast to price, which is often the deciding factor in more transactional relationships (Axelsson & Wynstra 2002). As customers and suppliers become both operationally intertwined and economically interdependent, new avenues for cost management spanning traditional organizational boundaries are established.

Two interrelated concepts are often discussed in the literature on cost management in inter-organizational relationships; ‘inter-organizational cost management’ (IOCM) and ‘open-book accounting’ (OBA). IOCM stands for coordinated efforts between and/or among customers and their suppliers, the aim of which is to plan and control costs collaboratively, e.g. to reveal cost reduction opportunities (Cooper & Slagmulder 2004; Kajüter & Kulmala 2005; Coad & Cullen 2006; Agndal & Nilsson 2009; Möller et al. 2011; Fayard et al. 2012; Sohn et al. 2015). As some of these authors seem to associate IOCM with specific upstream, supply-side techniques, such as target costing and functionality-price-quality tradeoffs (e.g. Cooper & Slagmulder 2004; Agndal & Nilsson 2009; Sohn et al. 2015), its use in the general sense of the term is therefore eschewed in the thesis. Conceptual discrepancies aside, the search for streamlined cost structures in customer-supplier interfaces is a strategic, long-term endeavor. Because of this, some contributors have drawn a parallel between IOCM and strategic cost management as well (Dubois 2003; Anderson & Dekker 2009a; 2009b).

The second concept, OBA, refers to a practice of disclosing (accounting) information between and/or among customers and their suppliers in order to rationalize joint costs (Seal et al. 1999; Mouritsen et al. 2001; Kajüter & Kulmala 2005; Suomala et al. 2010; Agndal & Nilsson 2010; Windolph & Möller 2012; Alenius et al. 2015). Despite its name, OBA is not an accounting technique per se, but a systematic approach to planning and controlling costs similarly to IOCM. Based on research whose theoretical underpinnings stem from OBA and IOCM, it is however difficult to make a clear-cut distinction between the concepts. Möller et al. (2011), for instance, argue that information transparency is not necessarily a requirement for IOCM, whereas the adoption of OBA does not denote that organizations share cost management practices, e.g. accounting techniques or information systems. On the other hand, there is also evidence suggesting that in particular a poor

state of suppliers' cost accounting may weaken OBA significantly (e.g. Kulmala et al. 2002; Suomala et al. 2010; Caglio 2017).

Instead of clinging to the conceptual discussion, this chapter concentrates on the nature of relationships to which IOCM, OBA and other boundary-spanning cost management phenomena are often connected in the literature. A closer look is also taken on studies that describe – mostly indirectly – IOMs. To begin with, **Figure 2.2** illustrates how inter-organizational relationships are understood in the cost management literature.

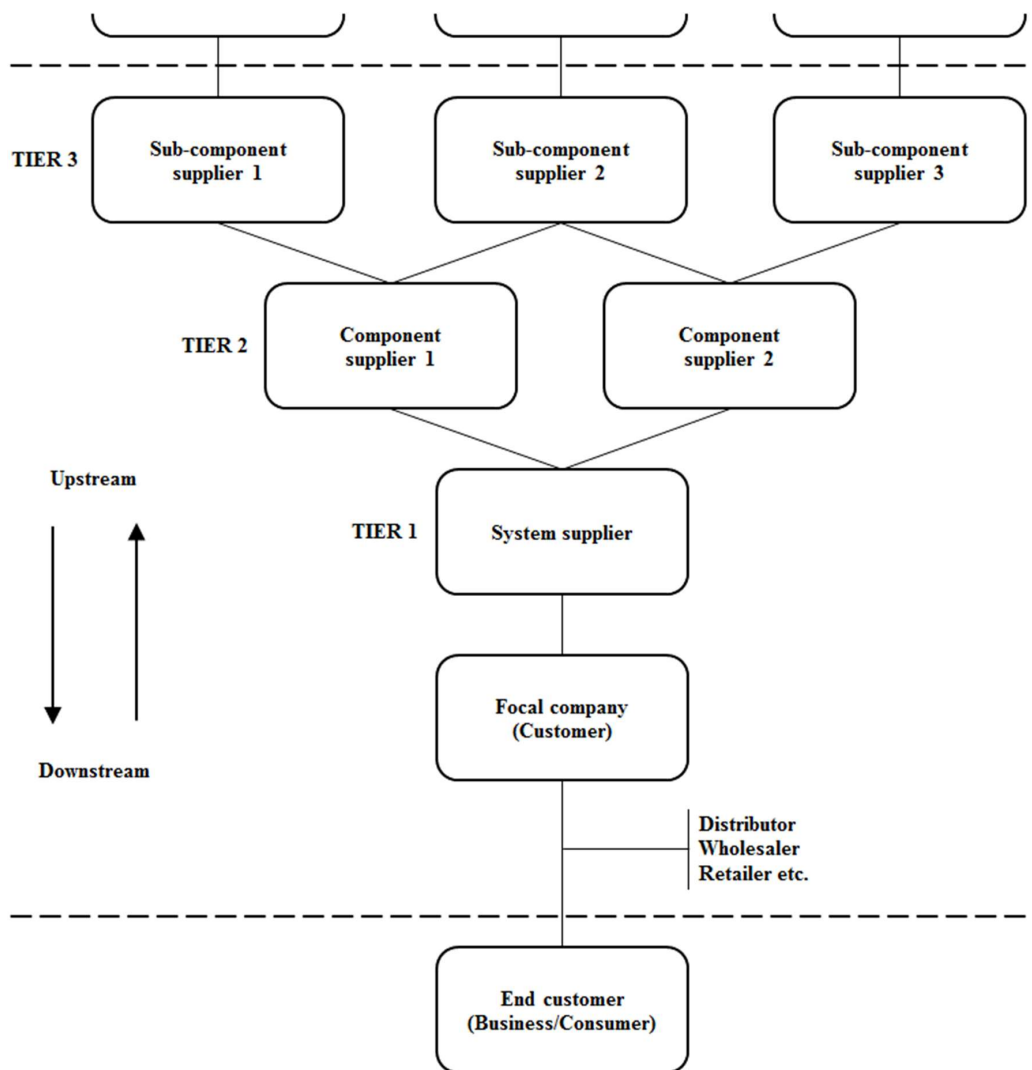


Figure 2.2 Cost management perspective to inter-organizational relationships.

As customers are typically responsible for initiating collaboration, the majority of research to date has also perceived the customer as the focal company of the inter-organizational entity that is – for the sake of simplicity – referred here to as a network. As far as the empirical context is concerned, a large number of studies concern automotive networks (Cooper & Yoshikawa 1994; Carr & Ng 1995; Seal et al. 1999; Cooper & Slagmulder 2004; Kajüter & Kulmala 2005; Agndal & Nilsson 2009; Möller et al. 2011; Windolph & Möller 2012; Pernot & Roodhooft 2014). This automotive emphasis is reflected in the labels for the three tiers of suppliers, but the network composition could also be portrayed differently. A good example of an alternative viewpoint is that of Alenius et al. (2015), who have observed cost management in the food grocery sector, where the focal company is a retail chain, tier-1 supplies pre-packaged meat products, tier-2 supplies meat cuts, and tier-3 is comprised of slaughterhouses.

According to Windolph & Möller (2012), there are three dimensions to disclosing information in inter-organizational relationships: the direction of information exchange, the degree and quality of disclosure, and the boundaries to openness. Despite the fact that the exemplary network in the figure shows a set of relationships, most studies have investigated the link between the customer and the (tier-1) supplier (e.g. Mouritsen et al. 2001; Dekker 2003; Kulmala 2004; Agndal & Nilsson 2010; Caglio & Ditillo 2012; Ellström & Hoshi Larsson 2017), which consequently denotes that the boundaries to openness are dyadic in these instances. More extensive practices have been reported, but only in a handful of studies (Cooper & Slagmulder 2004; Kajüter & Kulmala 2005; Coad & Cullen 2006; Alenius et al. 2015). Due to customers' focal and dominant position, the direction of information exchange is often unilateral, i.e. suppliers disclose costs and related information to customers. Reciprocity is also documented, but frequently limited to support, e.g. technical assistance (see e.g. Kajüter & Kulmala 2005; Kumra et al. 2012).

The degree and quality of disclosure is connected to the type of information (actual cost data vs. cost-relevant information) and its level of detail (unspecific vs. internal accounting data), as phrased by Windolph & Möller (2012). This is the most abstract dimension, as both degree and quality are context-specific properties and – to a great extent – also dependent on the decision-making situation. Agndal & Nilsson (2008), for instance, have found altogether 17 decision-making processes throughout the stages of supplier selection, pre-production and full-speed production, where information disclosure between and among customers and their suppliers can be advantageous. Because of this heterogeneity of relational contexts and different decision-making situations, it is necessary to focus on IOMs that are applied to the customer-supplier relationships rather than to just tell how cost management in inter-organizational relationships is executed in specific circumstances.

An IOM is – as the presented definition states (see p. 16-17) – an intermediary agency that facilitates the inter-organizational relationship in question. They are largely disregarded in the existing literature, which has concentrated on IOCM, OBA and other similar phenomena. As IOMs are representations of arrangements between customers and suppliers, they are still indirectly described in the literature, case studies in particular. **Table 2.1** below (see p. 32-35) presents an extensive, but likely a non-exhaustive list of cost management IOMs. The following discussion summarizes the information presented in the four-page long table. It should be acknowledged that this categorization is an interpretation of the literature, which aims only at clarifying what IOMs actually are.

Based on the descriptions in the table, three IOM categories have been identified:

- 1) **Accounting tools and techniques**
(Cooper & Yoshikawa 1994; Dekker & Van Goor 2000; Dekker 2003; Cooper & Slagmulder 2004; Coad & Cullen 2006; Agndal & Nilsson 2009; Zachariassen & Stentoft Arlbjörn 2011; Schulze et al. 2012; Wouters & Sandholzer 2018)
- 2) **Contracts and other formal controls**
(Langfield-Smith & Smith 2003; Free 2007; Chua & Mahama 2007; Vélez et al. 2008; Kumra et al. 2012; Romano & Formentini 2012; Pernot & Roodhooft 2014; Alenius et al. 2015; Ellström & Hoshi Larsson 2017)
- 3) **Collaborative approaches and methods**
(Carr & Ng 1995; Seal et al. 1999; Mouritsen et al. 2001; Kulmala 2004; Kajüter & Kulmala 2005; Agndal & Nilsson 2010; Suomala et al. 2010; Caglio & Ditillo 2012; Mahama & Chua 2016)

Accounting tools and techniques have a strong methodical emphasis. These IOMs rely especially on topical accounting fads and related calculation techniques to generate information for decision-making. A good example is the study of Dekker (2003), where the activity costs in the inter-organizational interface are mapped by means of value chain analysis. Written agreements that govern information disclosure and other types of designed control mechanisms are the basis of contracts and other formal controls. Costs are not necessarily exchanged in these IOMs, but the structure and objectives are still cost management by definition. To exemplify this, the study of Ellström & Hoshi Larsson (2017) shows how a dynamic price contract that guarantees a static margin to the supplier promotes inter-organizational transparency. Lastly, collaborative approaches and methods are built on rapport, which means that they are less technical and perhaps also less formal or control-driven than IOMs in the above-mentioned categories. The harmonization of costing principles by Suomala et al. (2010), for instance, illustrates how mutual understanding is achieved without complex control mechanisms.

Table 2.1 Inter-organizational mediums in cost management literature (chronological order).

Medium	Description
Inter-organizational cost management system <i>Cooper & Yoshikawa (1994)</i>	An inter-organizational cost management system is a set of procedures among a customer and its suppliers on two tiers. Apart from the target costs imposed upstream, e.g. product functionalities are often discussed and balanced. Minimum cost investigation meetings are held to exchange further ideas.
Total cost achieving activity <i>Carr & Ng (1995)</i>	The case company had a dedicated, team-based structure for controlling upstream costs, known as total cost achieving activity (TCAA). Internal objectives are shaped into target costs to suppliers that work together with multidisciplinary TCAA teams (finance, purchasing etc.) to achieve them.
Joint action plan <i>Seal et al. (1999)</i>	In exchange for transparency/rolling cost cuts, the customer assures demand and the supplier's participation in research and development in a proposition, alliance agreement. Instead of the agreement, a less formal joint action plan is devised that covers e.g. process fine-tuning and new product development.
Activity-based costing <i>Dekker & Van Goor (2000)</i>	An activity-based costing (ABC) model was developed for a three-tier supply chain, encompassing logistic activities (i.e. inbound, warehousing and outbound) and related costs. The ABC model was able to support inter-organizational decisions to relocate activities, e.g. stock-keeping and transportation.
Target cost management and functional analysis <i>Mouritsen et al. (2001)</i>	Due to rapid technological advancements, the development of new technology is outsourced to suppliers. Control is retained by implementing target cost management with an emphasis on functional analysis, i.e. costs are budgeted and followed, but the compliance with existing infrastructure is more important.
Value chain analysis <i>Dekker (2003)</i>	Value chain analysis (VCA) was initiated by the case company as a means to increase supply performance and decrease costs. As the foundation of VCA, an activity cost analysis model was created where the activities span organizational boundaries. The model enables e.g. benchmarking and what-if analyses.

<p>Risk-reward scheme <i>Langfield-Smith & Smith (2003)</i></p>	<p>Information technology and telecommunications function was outsourced in order to access technical expertise and bring discipline to spending. The supplier's performance is controlled with a risk-reward scheme, where a bonus is paid on top of the direct costs on the basis of cost, quality and time.</p>
<p>Development of cost management practices <i>Kulmala (2004)</i></p>	<p>Three customer-supplier cases are presented where suppliers' cost management practices are improved to support either price negotiations, sales batch optimization or the delivery of a new product group depending on the case. The subsequent cost disclosure occurs in two out of three relationships.</p>
<p>Inter-organizational cost management techniques <i>Cooper & Slagmulder (2004)</i></p>	<p>Inter-organizational cost management (IOCM) is observed in the customer-supplier joint product development context. IOCM refers to techniques that complement target costing: functionality-price-quality tradeoffs, inter-organizational cost investigations, and concurrent cost management.</p>
<p>Total cost management <i>Kajüter & Kulmala (2005)</i></p>	<p>Total cost management (TCM) is a collaborative approach to meet target costs and identify upstream cost reduction opportunities. TCM relies on data disclosure that is supported by tools such as value chain flow chart and cost breakdown worksheets. Technical support is also offered to suppliers.</p>
<p>Value chain analysis <i>Coad & Cullen (2006)</i></p>	<p>A value chain analysis (VCA) project in the case company was started with mapping internal processes and activities for weaknesses and thus potential improvements. The idea of VCA was then introduced to suppliers, who changed routines at the boundaries of the organizations e.g. to eliminate costs.</p>
<p>Supply-chain accounting <i>Free (2007)</i></p>	<p>Supply-chain accounting refers to various types of inter-organizational control that are conjoined with category management in a retailing context. The types of controls consist of a scorecard (with operational/financial measures), joint forecasting and exchange of e.g. customer's margins.</p>
<p>Accounting controls as performance measures <i>Chua & Mahama (2007)</i></p>	<p>Product and service pricing becomes a source of controversy in an alliance, as the measurement of suppliers' performance emphasizes timeliness and functionality over costs. As an attempt to increase transparency, accounting controls are devised and trialed, such as the operation break-even number.</p>

<p>Management control system <i>Vélez et al. (2008)</i></p>	<p>The case company implemented a multifaceted management control system (MCS) to its distribution channel, which comprised agents responsible for generating most of the sales. The MCS contains elements like electronic integration, channel database, agent evaluation system, and joint meetings.</p>
<p>Inter-organizational cost management techniques <i>Agndal & Nilsson (2009)</i></p>	<p>Target costing, trade-offs and continuous improvement, as well as techniques related to suppliers' costs (e.g. cost tables) are regarded as inter-organizational cost management (IOCM). The application of IOCM depends on the activity, i.e. supplier selection, concept discussion, joint product design etc.</p>
<p>Development of cost management practices <i>Suomala et al. (2010)</i></p>	<p>In this interventionist study, the researchers were responsible for improving suppliers' costing by establishing activity-based cost models for selected pilot products. In one of the two cases, the development initiative was later expanded successfully to a whole range of products delivered to the same customer.</p>
<p>Formalized cost disclosure and cross-functional meetings <i>Agndal & Nilsson (2010)</i></p>	<p>A highly formalized disclosure policy has been established. Suppliers are encouraged to disclose costs on standardized forms that support discussions at cross-functional meetings. Suppliers are also given feedback including reference values, benchmarks, and suggestions for further improvements.</p>
<p>Total cost of ownership <i>Zachariassen & Stentoft Arlbjørn (2011)</i></p>	<p>In order to recognize direct and indirect costs associated with its supply base, the case company had adopted total cost of ownership (TCO) in the purchasing division. In relationships where the complexity of cost drivers is high, the use of TCO underlines savings potential especially in indirect costs.</p>
<p>Systematic accounting information exchanges <i>Caglio & Ditillo (2012)</i></p>	<p>A target cost was laid down to suppliers in the pre-production stage, which was then translated into a standard cost for the production stage. Costs, yield rates, scraps, reworks, and the timing of consecutive activities were all monitored in a recurrent manner. Feedback was also given to the suppliers.</p>
<p>Activity-based costing <i>Schulze et al. (2012)</i></p>	<p>A need to standardize cost information arises when a supply chain shifts from a make-to-stock to a build-to-order operating logic. Through the adoption of activity-based costing (ABC), multiple avenues to cut order processing costs are revealed. ABC changes e.g. picking, wrapping and packing activities.</p>

<p>Cost disclosure as a selection mechanism <i>Kumra et al. (2012)</i></p>	<p>In new product development, only pre-approved suppliers that are able to meet the requirements of the customer are invited to tender. At this stage, a detailed cost breakdown including e.g. analyses and explanations of incurred costs is required. Specific disclosure forms are provided to suppliers.</p>
<p>Incentivized cost disclosure <i>Romano & Formentini (2012)</i></p>	<p>The selection of supplier incentives that match the customer's sourcing strategy is seen as a premise for cost disclosure. Incentives that are reported to advance disclosure include e.g. negotiation support with second-tier suppliers, forecast data, technical support, and agreement to source greater volumes.</p>
<p>Management control system <i>Pernot & Roodhooft (2014)</i></p>	<p>The study shows how a supplier's performance was connected to the customer's management control system (MCS). The performance of the supplier had started to decline due to increased production complexity and responsibilities, which was fixed by adjusting the MCS with a new set of controls.</p>
<p>Cost-plus deals combined with open calculations <i>Alenius et al. (2015)</i></p>	<p>A Customer, a first-tier and second-tier supplier signed cost-plus deals to increase profitability. The organizations utilized open calculation spreadsheets to disclose both financial and nonfinancial information. Eventually, the established database was applied to other relationships, e.g. to benchmark suppliers.</p>
<p>Integrated solution <i>Mahama & Chua (2016)</i></p>	<p>Warehousing and distribution was outsourced to two suppliers. An integrated solution refers to a method of vetting suppliers, negotiating service level agreements and fixed service pricing, deciding a time schedule for cost reductions, and having electronic access to suppliers' data for monitoring purposes.</p>
<p>Dynamic pricing <i>Ellström & Hoshi Larsson (2017)</i></p>	<p>The customer and supplier engage in a relationship that is based on a dynamic price contract, in which sales and a fixed return on capital employed are guaranteed to the supplier. As the supplier's new facility is dedicated to the customer's products, the determination of the capital employed is simple.</p>
<p>Cost of ownership <i>Wouters & Sandholzer (2018)</i></p>	<p>An industry-wide perspective to the cost of ownership (COO) is presented. The calculation of COO is mediated by standards, which act as a common ground for customers and suppliers. The standards contain default input values that can be mixed with a convenient amount of internal data in negotiations.</p>

2.3 Asset management in inter-organizational relationships

Roughly 20 years ago, Spires (1996) wrote that asset and maintenance management are becoming a boardroom issue in organizations. Rather than just a mere engineering conundrum, he stated that senior management had begun to understand asset and maintenance management as an opportunity to reduce operational costs and increase organizational performance. Asset management thinking denoted a paradigm shift from the cost doctrine of conventional maintenance in which especially the management of physical assets was perceived as a “necessary evil” (Amadi-Echendu 2004). In his seminal paper, Amadi-Echendu (2004) argues further that assets are – in fact – “entities” that have the capability to both create and sustain (economic) value throughout their deployment in organizations. Because of this characteristic, asset (El-Akruti 2013) and maintenance management (see e.g. Tsang 2002; Murthy et al. 2002; Pinjala et al. 2006) are increasingly seen as an integral part of the overall business strategy.

As Wijnia et al. (2014a; 2014b) point out, asset management is an emerging concept that has a wide range of uses, as well as different levels of maturity across industrial sectors. On the other hand, a common denominator for the engineering asset management stream of research in particular seems to be the emphasis on a life-cycle perspective, which is already visible in early studies, such as that of Amadi-Echendu (2004). According to Van der Lei (2012), the life cycle of an asset comprises eight stages, including (1) concept, (2) design, (3) manufacturing, (4) assembly, (5) commissioning, (6) operation, (7) maintenance, and (8) disposal. From the asset owner’s standpoint, stages from (1) to (5) characterize the acquisition process of an asset, whereas the remaining stages (6), (7) and (8) are related to its actual utilization in the organization. As management responsibility typically changes from acquisition to utilization, and also various cost considerations are addressed to a degree in isolation during the stages, managing the life cycle as a whole can be a challenge (Schuman & Brent 2005).

Asset management approaches that integrate the entire life cycle seamlessly have had – at least so far – any kind of substance only in academic abstractions. In practice, organizations seem to have a managerial tendency towards specific life-cycle stages (Wijnia et al. 2014a; 2014b). A similar tendency is displayed in the empirical research tradition that mostly concentrates on stages (6) and (7) of the above-mentioned asset life cycle. Collectively, these two are often referred to as operations and maintenance in the literature (see e.g. Waeyenbergh & Pintelon 2004; Liyanage 2007). As far as asset management in inter-organizational relationships is concerned, a vast majority of studies are also situated within the operations and maintenance frame (e.g. Bertolini et al. 2004; Hui & Tsang 2006; Holmström et al. 2010; de Jong & Smit 2012; Toossi et al. 2013; Ylimäki & Vesalainen 2015; Braun et al. 2017).

The reason why the inter-organizational domain is of importance to operations and maintenance in particular stems from the past industrial trend to outsource asset maintenance to external service providers (Campbell 1995; Martin 1997; Levery 1998; Garg & Deshmukh 2006; Persona et al. 2007). Even though some recent evidence suggests that organizations are insourcing maintenance again because of issues in the relationships with their providers (see e.g. Cabral et al. 2014; Braun et al. 2017), the relevance of asset and maintenance management services is not disappearing. They belong to a broader service infusion and servitization phenomenon, where equipment manufacturers are also becoming service providers (e.g. Vandermerwe & Rada 1988; Oliva & Kallenberg 2003; Brax 2005; Neely 2008; Kastalli & Van Looy 2013; Kowalkowski et al. 2017). The interplay between the customer who is the asset owner, the equipment manufacturer and a potential third-party service provider form the inter-organizational entity in the asset management context, as illustrated in **Figure 2.3**.

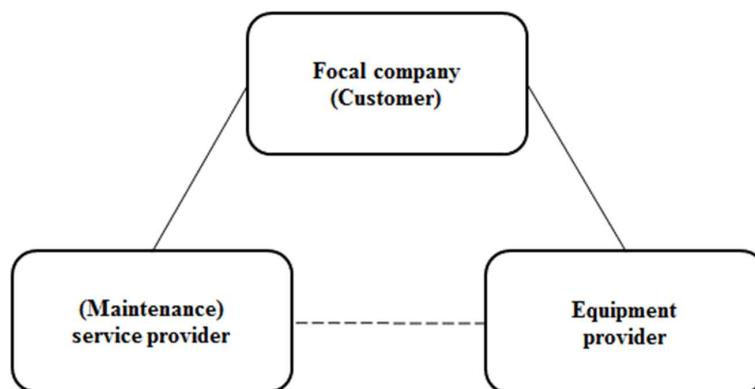


Figure 2.3 Asset management perspective to inter-organizational relationships.

Service provision could naturally occur in a triadic setting similar to the figure. Most research to date has, however, observed the dyadic inter-organizational relationship between a customer and its maintenance service provider that is either the equipment manufacturer (e.g. Kumar et al. 2004; Brax & Jonsson 2009; Macdonald et al. 2011; Lehtonen et al. 2012), or a third-party operator (e.g. Bertolini et al. 2004; Panesar & Markeset 2008a; 2008b; Uusipaavalniemi & Juga 2009; Ylimäki & Vesalainen 2015; Braun et al. 2017). Other types of asset management services have also been mentioned, but rather sparsely (e.g. Holmström et al. 2010; Marttonen et al. 2013; Rabetino et al. 2015). Especially the flexible asset management concept proposed by Marttonen et al. (2013) is distinct from the usual maintenance centricity. It is an inter-organizational approach where customers and service providers manage their assets on the balance sheet, including e.g. fixed assets and spare part inventories, in collaboration.

Despite the fact that the significance of inter-organizational relationships has increased in the asset and maintenance management context, information disclosure has received relatively little attention in the literature. For instance, de Jong and Smit (2012) argue that the contractual environment does not promote organizations to exchange information. According to them, customers and service providers could align their objectives better with collaborative contracts, which would also denote a shift from transactional to more relational customer-provider relationships. Another potential barrier is asset information management in outsourcing situations, which requires proper data collection, i.e. what kind of data is collected and which party is held responsible (Murthy et al. 2015). Technological advancements in asset monitoring, such as IoT, will be likely to alleviate data-related challenges in the future (e.g. Emmanouilidis et al. 2009; Jonsson et al. 2009; Lee et al. 2013; 2015; Porter & Heppelmann 2014; 2015).

The fact that information disclosure is barely addressed in the literature denotes consequently that empirical, case-based evidence on IOMs is limited. **Table 2.2** below (see p. 39-40) presents an extensive, but likely a non-exhaustive list of asset management IOMs. The following discussion summarizes the information presented in the two-page long table. Similarly to the preceding chapter, the categorization should be understood as an interpretation of the literature. A lack of studies in comparison to cost management literature resulted in a situation where IOMs were mapped in a broader fashion.

Based on the descriptions in the table, two IOM categories have been identified:

- 1) **Contracting and service delivery improvement frameworks**
(Bertolini et al. 2004; Kumar et al. 2004; Panesar & Markeset 2008a; 2008b; Holmström et al. 2010; Lehtonen et al. 2012; Ylimäki & Vesalainen 2015)
- 2) **Asset and maintenance management tools and approaches**
(Uusipaavaniemi & Juga 2009; Brax & Jonsson 2009; Macdonald et al. 2011; Marttonen et al. 2013; Sinkkonen et al. 2016; Braun et al. 2017)

Contracting and service delivery improvement frameworks comprise IOMs that are designed to either support outsourcing contract negotiations or to develop service delivery. A good example of the former is the study of Bertolini et al. (2004) who have created an approach to selecting among contract types, whereas the latter can be exemplified by the study of Holmström et al. (2010) who propose that the visibility to asset management needs enables advanced service constellations. Asset and maintenance management tools and approaches are concerned with collaborative managerial practices that may also retain exchange of information. Sinkkonen et al. (2016), for instance, have built a tool that facilitates joint decision-making regarding long-term asset maintenance.

Table 2.2 Inter-organizational mediums in asset management literature (chronological order).

Medium	Description
Decision support system to contract type selection <i>Bertolini et al. (2004)</i>	As maintenance outsourcing often represents a multi-criteria decision problem, the authors have created a decision support system based on the analytical hierarchical approach. It is applied to a case company that must select between the internal maintenance function and four alternative service contracts.
Service delivery negotiations framework <i>Kumar et al. (2004)</i>	A framework for service delivery negotiations is proposed. Desirable inputs, as well as undesirable inputs and outputs should be discussed between the customer and the provider. Performance measurement that reflects both parties' needs has to be included in the final agreement, i.e. the desirable output.
Contract design guidelines <i>Panesar & Markeset (2008a)</i>	The study recognizes several contractual factors that affect innovativeness, i.e. ways for service providers to improve maintenance efficiency and effectiveness. The following design characteristics are crucial: long-term agreements, flexibility, formality, performance targets, and compensation.
Service innovation management framework <i>Panesar & Markeset (2008b)</i>	Service innovation refers to the creation of new services or the improvement of existing services, which is portrayed as a process that requires inter-organizational management and coordination. Based on a survey and interviews, a framework is developed for managers as a guide to service innovation.
Maintenance information integration framework <i>Uusipaavalniemi & Juga (2009)</i>	There are six elements and three levels of integration in the framework that is used to assess the case company's integration with maintenance and planning service providers. The elements (e.g. information attributes or sharing practices) influence the extent of exchange, i.e. the level of integration.
Integrated solution offering <i>Brax & Jonsson (2009)</i>	An integrated solution refers to a complex, customized offering that extends beyond a bundle of products and services. Two cases are discussed where equipment manufacturers offer maintenance solutions to their customers based on real-time asset information received from the customers' installed base.

<p>Provider-customer constellations tool <i>Holmström et al. (2010)</i></p>	<p>Different provider-customer constellations rely on visibility, i.e. service providers' access to information. When visibility is granted early to the customer's asset management demand chain (planning → asset use → maintenance → service purchasing), advanced service constellations are enabled.</p>
<p>Value-in-use framework <i>Macdonald et al. (2011)</i></p>	<p>The proposed framework contains the assessment of provider processes (i.e. service quality, relationship quality and network quality), usage process quality and value-in-use. The customer should articulate the value-in-use in terms of objectives that are derived from provider processes and usage process quality.</p>
<p>Asset information availability in the service delivery <i>Lehtonen et al. (2012)</i></p>	<p>The role of asset information is emphasized in the study. The findings suggest that almost 40 percent of failed service visits are either directly or indirectly caused by missing information. Collaboration and the availability of asset information are therefore the keys to improving service delivery performance.</p>
<p>Flexible asset management model <i>Marttonen et al. (2013)</i></p>	<p>Flexible asset management (FAM) is an approach where a company's profitability is connected to the management of fixed assets and working capital on its balance sheet. As a new type of service, FAM can be used to adjust the ownership of assets (e.g. fixed/spare parts) and improve the payment terms.</p>
<p>Value proposition model <i>Ylimäki & Vesalainen (2015)</i></p>	<p>The customer and provider develop a plant maintenance service concept by using collaborative stage-gate model, which comprises five stages including e.g. present state analysis and service process design. This case-specific approach is generalized further as a value proposition model.</p>
<p>Life-cycle model <i>Sinkkonen et al. (2016)</i></p>	<p>The study presents an asset-level decision-making tool for maintenance services, known as the life-cycle model (LCM). LCM has been built for inter-organizational purposes as it contains the perspectives of the customer, the maintenance service provider and the equipment manufacturer.</p>
<p>Gain-sharing policy <i>Braun et al. (2017)</i></p>	<p>The case company and its maintenance service provider had an agreement where the gain sharing arising from joint improvement actions was determined. Although the policy was later wound up due to financial challenges, the gains (e.g. cost savings) were initially shared based on a 60 to 40 division.</p>

2.4 Inter-organizational mediums: two domains of application?

The IOMs described above in relation to cost management (chapter 2.2) and asset management (chapter 2.3) have certain commonalities, but also points of departure. As far as the categorization of IOMs is concerned, contracts and other formal controls are somewhat similar to contracting and service delivery frameworks. Supplier/provider selection mechanisms and related contract formation criteria were found in both contexts (e.g. incentives to suppliers in Romano & Formentini 2012 vs. contract design guidelines in Panesar & Markeset 2008a). Formal control methods to managing existing inter-organizational relationships are discussed exclusively in the cost management literature (e.g. MCS in Vélez et al. 2008). Another clear difference between the two streams of research is that asset management IOMs feature more academic precepts than reported industrial practices (e.g. the negotiations framework in Kumar et al. 2004).

Asset and maintenance management tools and approaches, on the other hand, combine elements from accounting tools and techniques as well as collaborative approaches and methods. One congruence of these three categories stems from the required relational content and related transparency (e.g. information exchange in Caglio & Ditillo 2012 vs. timely asset information in Brax & Jonsson 2009), although the asset management literature lacks in empirical observations, as pointed out in the preceding chapter. Information collection from assets becomes easier with IoT, which denotes that IOMs in the asset management context will comprise these mediating technologies in the future. It should be also noted that some asset management IOMs, such as those proposed by Marttonen et al. (2013) and Sinkkonen et al. (2016), have a strong accounting orientation, which is another resemblance between the above-mentioned categories.

So far, cost management IOMs have been distinguished from asset management IOMs in this thesis. The question is, however, whether they are really applied to detached managerial domains. As outlined in **Figure 2.4**, it can be argued that the domain of cost management does indeed overlap with the domain of asset management. An inter-organizational entity (e.g. the network in the figure) is as successful as its boundary-spanning management, which governs how much value is created for the customers. Organizations cannot afford to overlook neither domain. Thus, the figure should be understood as a contextual framework that justifies the premise of this thesis, i.e. that it is meaningful to study cost management and asset management in tandem.

From the perspective of the focal company in particular, cost management in inter-organizational relationships ensures that the chain of consecutive production activities that transcends multiple tiers of suppliers is cost-efficient and competitive. This is achieved through collaborative planning and control of costs, which lowers the costs of

the focal company's products and ultimately also increases the value for the end customer. In proportion, asset management in inter-organizational relationships guarantees that the focal company is able to realize value from assets in collaboration with its service providers. In the case of outsourced asset maintenance, coordination is required to uphold the focal company's production-critical assets in the operating condition. Flexible asset management might also be considered. When both of these domains are managed simultaneously with appropriate IOMs, the network will maximize its value creation.

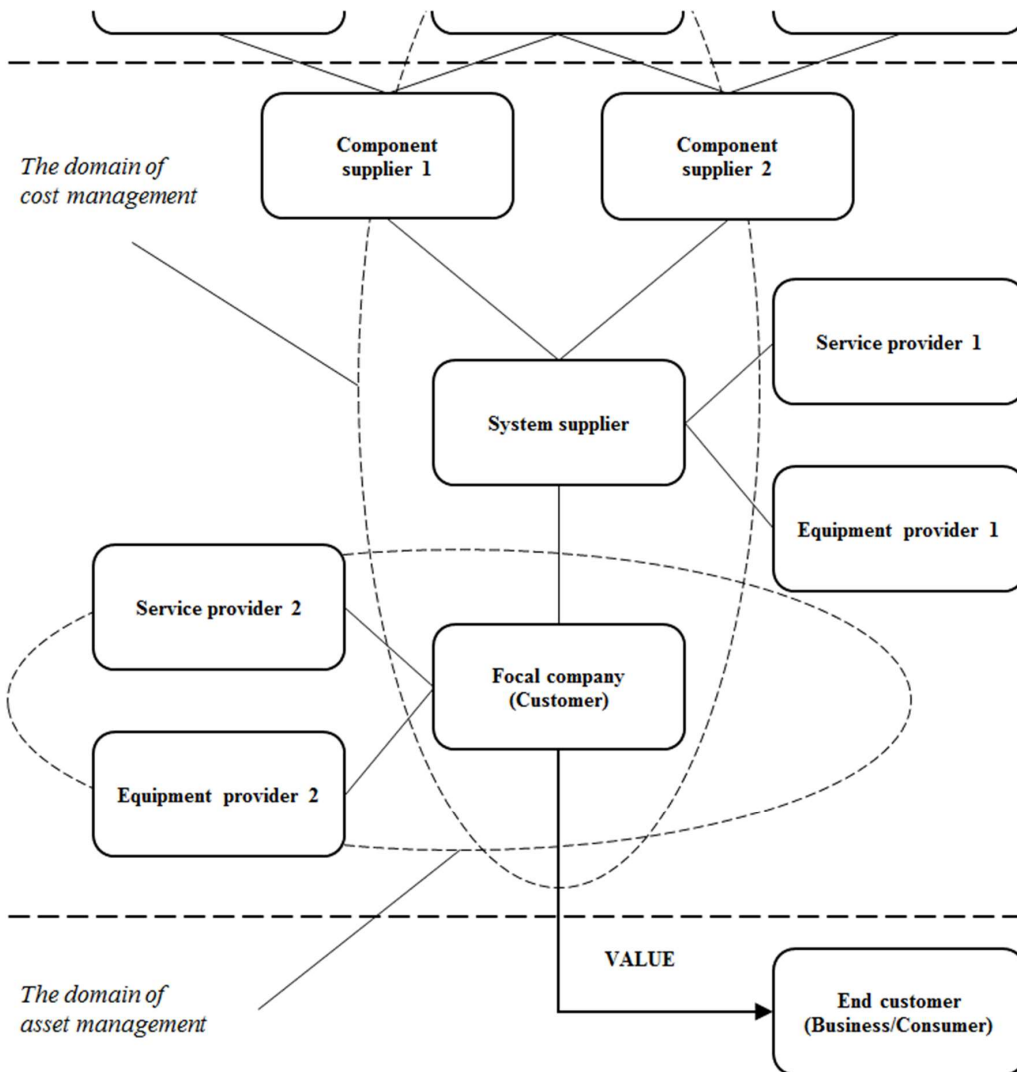


Figure 2.4 The overlapping domains for inter-organizational mediums.

3 Research design

3.1 Philosophical position of the thesis

According to Creswell (2013), the philosophy of science is built on four basic assumptions, which are ontology, epistemology, axiology, and methodology. Of these basic assumptions, ontology is concerned with the existence of – and relationships between – people, society and the world in general (Eriksson & Kovalainen 2008). Therefore, the ontological position should be perceived as a reflection of how the researcher understands the nature of reality. Bryman and Bell (2011) identify two ontological positions, ‘objectivism’ and ‘constructionism’, the latter of which is also known as ‘subjectivism’ (Eriksson & Kovalainen 2008). An objectivist claims that social phenomena and their meanings exist independently from social actors, i.e. there is an external reality. A subjectivist, on the other hand, argues that phenomena and their meanings are constantly accomplished by social actors, i.e. the reality is a construction. Subjectivism relies on two assumptions about the social world; it is ever-changing and produced through social interaction. The idea of multiple, subjective realities is typically embraced in qualitative research (Eriksson & Kovalainen 2008; Creswell 2013).

The second assumption, epistemology, is concerned with the production of scientific knowledge, i.e. what is knowledge and how knowledge claims are justified in science. According to Bryman and Bell (2011), a central epistemological question is related to whether or not the social world can be studied similarly to the natural world. Again, alternative positions, ‘positivism’ and ‘interpretivism’, are distinguished. A positivist advocates that the social world should be observed with the methods of natural sciences. An interpretivist, on the other hand, would criticize this approach because people and their institutions are distinct from the subject matters of natural sciences. Similarly to ontology, there is thus an “objectivist view” (i.e. positivism) and a “subjectivist view” (i.e. interpretivism) in the epistemology (Eriksson & Kovalainen 2008), which is also the reason why ontological and epistemological considerations are often discussed inseparably under the heading of e.g. philosophical positions (Eriksson & Kovalainen 2008), paradigms (Denzin & Lincoln 2011), or interpretive frameworks (Creswell 2013).

Although the array of philosophical positions is expanding continuously (see e.g. Creswell 2013), there are prevalent positions, such as ‘critical realism’ (i.e. postpositivism) and (social) ‘constructionism’, the latter of which is also known as ‘interpretivism’ (Eriksson & Kovalainen 2008; Denzin & Lincoln 2011). They are situated in the middle of the continuum from purely objectivist to purely subjectivist outlooks (Järvensivu & Törnroos 2010). The most significant point of philosophical

departure between them seems to be ontological, which is rather surprising, as the epistemological roots of critical realism lie in the natural sciences -based model of positivism, hence the term postpositivism. A critical realist does not challenge the existence of reality, but entertains the idea that research can only move towards understanding the reality through (objective) empirical observations and scientific consensus. In contrast, a constructionist sees that there are multiple viewpoints to knowledge and truth. Multiple realities are understood through (subjective) empirical observations and scientific dialogue. (Järvensivu & Törnroos 2010)

As the thesis leans on the qualitative research approach and methods (see chapter 3.2), the ontological stand of subjectivism (i.e. the reality is a construction) and the epistemological stand of interpretivism (i.e. people/institutions are distinct from the subject matters of natural sciences) are taken here. When deciding between the two moderate philosophical positions associated with the above-mentioned ontological and epistemological considerations, this thesis adheres best to constructionism. There is a transient reality, but it is revised constantly by social actors, which makes the true, objective reality unapproachable for science. Even though these stands are often connected to qualitative research as indicated above, there are certain quantitative methods that rely on interpretation and discretion. In the case of factor analysis, for example (see p. 46), the researcher defines a threshold value that dictates which reciprocal correlations between variables are strong enough to constitute a factor.

The third assumption, axiology, is concerned with the role of values. Even though all research is value-laden because it is carried out by people, only qualitative researchers tend to admit their biases (Creswell 2013). According to Bryman and Bell (2011), the conduct of research is affected by three types of influences: personal values, politics of research and practical considerations. While politics have not mediated this thesis, practical considerations and personal values have arguably played a certain role. The formulation of the research questions, for instance, has been affected by the research design and vice versa. As regards the researcher-participant relationship, Eriksson and Kovalainen (2008) argue that the researcher can (a) remain detached, neutral and distant to the research objects, (b) participate marginally (i.e. participant-observer), or (c) facilitate the research process. Option (a) is followed in P1/P2, and (b) in P3/P4. Due to a closer researcher-participant relationship, personal values are accentuated in (b).

Lastly, methodology is concerned with the approach to scientific inquiry where the selection of the research logic is a central decision. The nexus between theory and empirical research can be based on 'deduction' (theory → observations/findings) or 'induction' (observations/findings → theory) (Bryman & Bell 2011). The logic of

reasoning is interrelated with the purpose of research; deductive reasoning leads to a research design that is explanatory and therefore employed in the testing of existing theories, whereas inductive reasoning is typically connected to the generation of new theory through an exploratory design. According to Eriksson and Kovalainen (2008), there is a third logic referred to as ‘abduction’, which is also suitable for exploratory research. This thesis, however, complies with an inductive, exploratory design. Even though there is arguably a deductive element in the formulation of the research questions (i.e. the research gap has been recognized from literature), abduction would require multiple, iterative cycles between theory and observations/findings (see e.g. Järvensivu & Törnroos 2010). The inductive approach is also archetypical for constructionist researchers (Creswell 2013). The philosophical position is summarized in **Table 3.1**.

Table 3.1 Summary of philosophical assumptions and position.

Assumption	Issue	Stand taken
Ontology	“The nature of reality”	Subjectivism
Epistemology	“The nature of knowledge”	Interpretivism
Axiology	“The role of values in research”	Value-laden and biased
Methodology	“Research logic and purpose”	Inductive, exploratory design
Position	Σ (ontology, epistemology...)	Constructionism

3.2 Research approaches and methods

Out of the four publications, P2 and P3 are founded on the qualitative research approach, which is suitable for inductive research (Bryman & Bell 2011). A mixed methods approach that combines both quantitative and qualitative research is adopted in P1. According to Creswell and Plano Clark (2011), there are six major mixed methods designs (i.e. convergent, explanatory, exploratory, embedded, transformative, and multiphase), of which embedded design matches P1. In embedded design, both types of data are collected and analyzed within a traditional qualitative or quantitative study in order to improve the overall research design. P1 follows a quantitative design complemented with concurrent collection of qualitative data (i.e. the survey instrument consisted of closed-ended claims and open-ended questions). Further, the approach of P4 is portrayed here as design science, although some researchers might perceive it as a “strand” of qualitative research. The relationship between conventional quantitative and qualitative approaches and design sciences is clarified in the following paragraphs when the research method of P4 is discussed. The research approach of each individual publication and the employed research methods are presented in **Table 3.2**.

Table 3.2 Research approaches and methods by individual publications.

Publication	P1	P2	P3	P4
Approach	Mixed methods	Qualitative	Qualitative	Design science
Method	Factor analysis, cluster analysis, content analysis	Case study, analytical modeling	Multiple case study	Design science

As can be noticed, three research methods have been utilized in P1; factor analysis, cluster analysis and (qualitative) content analysis. Factor analysis addresses the problem of analyzing the structure of relationships (i.e. correlations) among a large number of variables by defining a set of common underlying dimensions also known as factors (Ghauri and Grønhaug 2002). Cluster analysis, on the other hand, is applied as a subsequent method after conducting factor analysis. The units of analysis, e.g. organizations, are in cluster analysis grouped according to their factor-specific characteristics. The grouping approach of P1 was k-means clustering, where the formation of clusters depends on detecting the similarities and dissimilarities (i.e. “distances”) in an n-dimensional space (Ghauri and Grønhaug 2002). As the factor analysis resulted in three factors in P1, this space in the cluster analysis was three-dimensional. The definitive number of clusters (i.e. five) was determined through experimentation. Lastly, the qualitative strand of the study was based on (qualitative) content analysis. Bryman and Bell (2011) distinguish between two forms of content analysis; quantitative (predetermined categories, higher replicability) and qualitative (revised categories, lower replicability). Even though the analysis started with predetermined categories, they were revised multiple times during the analysis.

P2 and P3 are founded on the case study method. According to Creswell (2013), case study is a qualitative research method in which the researcher explores a real-life, contemporary bounded system (i.e. a case), or numerous bounded systems (i.e. cases), over time, involving several sources of information, and then reports a case description and case themes. Hence, the unit of analysis can be either a single case or multiple cases. There might also be an embedded design, which refers to multiple levels of analysis within a single study (Eisenhardt 1989). By building up on these definitions, this thesis retains two distinct types of case studies; a single case with two levels of analysis (P2) and multiple cases with one level of analysis (P3). The bounded system in the former is a dyadic inter-organizational relationship where operational and strategic levels of analysis are introduced. In proportion, the latter case discusses and compares the

technological development in two industries and countries (i.e. Norway and Finland). Despite the fact that the case study method is often perceived as a qualitative form of inquiry, quantitative data can also be used to build a case (Eriksson and Kovalainen 2008). By means of analytical modelling, such “quantification” is sought out especially in P2.

P4 is classified as design science. According to Holmström et al. (2009), it is fundamentally different from both the theory-building (i.e. qualitative research) and theory-testing approaches (i.e. quantitative research), as the process of exploration through design is emphasized. Van Aken (2004) states that design science has two missions; to develop knowledge for the design of artefacts (i.e. to solve construction problems), and to develop knowledge for the design of interventions that enhance the performance of existing artefacts (i.e. to solve improvement problems). The characteristics of both knowledge and problem are essential, as design science is concerned with developing general knowledge to solve field problems (van Aken 2004; van Aken & Romme 2009). Hodgkinson and Rousseau (2009) even argue that design science is a way to bridging the rigor-relevance gap of social sciences, management research in particular. P4 solves an improvement problem by developing general knowledge (i.e. an implementation framework) to support the design of interventions (i.e. IOM implementation). The framework also addresses the rigor-relevance gap, as it provides guidelines for managers based on the existing literature.

3.3 Sampling strategies and data collection

Three different sampling strategies have been used in this thesis, as shown in **Table 3.3**. According to Bryman & Bell (2011), ‘quota sampling’ is a non-probabilistic sampling strategy, the aim of which is to produce a sample that reflects a population in terms of relative proportions of people in certain categories. The researcher employs typically predetermined categories known as quotas and decides the number of people to be interviewed in each quota. Instead of people, however, the sample of P1 consists of organizations, which is the reason why the quotas are based on two organizational attributes, i.e. size and industry. P2 and P4 take advantage of another strategy, ‘convenience sampling’. The virtue of this particular strategy originates from the accessibility of the sample (Bryman and Bell 2011). The case of P2 was derived from a research project that was active at the time of the study, whereas the implementation framework of P4 was tested by students who participated in a continuing education program. The last strategy is ‘maximum variation sampling’. As the name suggests, the selection of research sites and participants relies on the maximization of differences relative to certain criteria (Creswell 2013). In P3, the two cases were selected because they represented two different levels of adoption regarding IoT.

Table 3.3 Sampling strategies and data sources by individual publications.

Publication	P1	P2	P3	P4
Sample	Quota sample	Convenience sample	Maximum variation	Convenience sample
Data collection	Descriptive survey	Archival material and organizational documents	Semi-structured interviews and organizational documents	Questionnaire

The data collection for P1 was done with a survey. Ghauri and Grønhaug (2002) divide surveys to analytic and descriptive ones. The former emphasizes specifying independent, dependent and extraneous variables in order to test theories, whereas the latter focuses on the characteristics of a specific population of subjects. P1 represents the descriptive approach. The data was collected by conducting interviews over the phone with the respondents, who were mainly senior managers (CEOs and CFOs). The interviews were based on a questionnaire that comprised 24 closed-ended claims and three open-ended questions. In the course of two months (October – November, 2014), altogether 1507 responses were received from Finnish companies ranging from small and medium-sized enterprises (SME) to large multinationals. The contacted population was around 3500 companies, which yields a tolerable response rate of approximately 43 %.

Organizational documents (P2 and P3) are a heterogeneous collection of data sources, which is of importance to management research, not least because of the quantity of information that is available in organizations (Bryman & Bell 2011). As archival materials (e.g. financial statements) are identified as an independent data source, organizational documents refer to internal documentation. In this thesis, they include operations and maintenance (cost) data and other documents, e.g. internal correspondence. Apart from such documents, also interviews were carried out for P3. Eriksson and Kovalainen (2008) differentiate between three types of interviews: structured and standardized interviews, semi-structured and guided interviews, and unstructured and open interviews. The semi-structured alternative was followed in P3, which means that the outline of topics and questions was prepared in advance, while the tone of the interviews – carried out in September 2015 (Case 1: Norway) and February 2016 (Case 2: Finland) – remained conversational. Lastly, the framework in P4 was tested in November 2016 with a simple questionnaire that was completed by 27 students participating in a continuing education program targeted at engineers and managers.

4 Review of the results

4.1 Publication 1: ‘a disparity between the state and the rhetoric’

Publication 1 – Finnish “state of mind” on inter-organizational integration: a cost accounting and cost management perspective – had two main objectives; (1) to form an overall picture of Finnish cost management practices, including the inter-organizational domain, by categorizing the 1507 companies participating in the survey, and (2) to investigate the extent of the implementation and utilization of cost management IOMs. Factor analysis and subsequent cluster analysis were conducted so that reaching objective (1) could be determined. The factor analysis resulted originally in five factors, three of which were accepted as the basis of clustering. Each of these factors symbolizes a dimension of cost management, as presented in **Table 4.1**. Further information, e.g. factor rejection criteria, can be found in the publication.

Table 4.1 Three factors as the three dimensions of cost management.

Name of the factor →	Factor 1: ‘orientation to joint cost management’		Factor 2: ‘the current state of cost management’		Factor 3: ‘interest to develop cost management’	
Sample mean	2.82	Med.	3.56	High	2.39	Low
Reciprocal correlations	F2	0.09	F1	0.09	F1	0.39
	F3	0.39	F3	-0.13	F2	-0.13

Note: low mean ≤ 2.50 | $2.50 < \text{medium mean} < 3.50$ | $3.50 \leq \text{high mean}$

Factor 1: ‘orientation to joint cost management’ measures a company’s interest to increase inter-organizational integration through joint cost management. The mean of Factor 1 is medium in the sample, which indicates that an average Finnish company is moderately interested in inter-organizational aspects, such as disclosing information to counterparts, i.e. suppliers and/or customers. Factor 2: ‘the current state of cost management’, on the other hand, measures a company’s ability to interpret costs by applying different cost accounting techniques and principles. The mean of Factor 2 is high in the sample, which indicates that an average Finnish company has good knowledge of costs and contemporary costing techniques, including also ABC. Lastly, Factor 3:

‘interest to develop cost management’ measures a company’s willingness to improve cost management by investing in new cost accounting systems and related services, e.g. training or consulting. The mean of Factor 3 is low in the sample, which indicates that an average Finnish company does not perceive this as a topical question. As also shown in the table, there is a significant positive, reciprocal correlation (0.39) between Factor 1 and Factor 3, which implies that companies wanting to develop cost management seek improvements in both intra- and inter-organizational domains.

The factor analysis as the foundation, five distinctive clusters of companies were identified from the survey sample. As presented in **Table 4.2**, a name was given to each cluster that represents its factor-specific characteristics, such as low, medium or high interest to increase inter-organizational integration. This orientation to joint cost management is high especially in Cluster 2 and Cluster 4, which together account for nearly 40 % of the companies. These two clusters are, however, dissimilar in terms of Factor 3. By excluding Cluster 2 from the analysis, the above-mentioned positive correlation between Factor 1 and Factor 3 becomes even stronger (0.39 → 0.60).

Table 4.2 Cost management practices characterized by five clusters.

Name of the cluster ↓	Factor 1: ‘orientation to joint cost management’		Factor 2: ‘the current state of cost management’		Factor 3: ‘interest to develop cost management’		N
Cluster 1: ‘the cost experts’	2.14	Low	4.18	High	1.71	Low	327
Cluster 2: ‘the trustful’	3.70	High	3.79	High	2.14	Low	358
Cluster 3: ‘the holdouts’	1.75	Low	2.82	Med.	1.79	Low	236
Cluster 4: ‘the trailblazers’	3.71	High	3.49	Med.	3.66	High	240
Cluster 5: ‘the uncertain’	2.65	Med.	3.30	Med.	2.82	Med.	346

Note: low mean ≤ 2.50 | $2.50 < \text{medium mean} < 3.50$ | $3.50 \leq \text{high mean}$

Cluster 1: ‘the cost experts’ (327 companies, 21.7 % of the sample) is the group of companies that has the highest mean in Factor 2 (4.18), and consequently the lowest mean in Factor 3 (1.71). The impression of cost expertise among these companies thus arises from the combination of claimed cost awareness as well as unwillingness to develop cost management practices. There is also another explanation. Some of these companies might be excessively self-confident or even partly ignorant of the status quo by assuming that the costs are completely under their control. In the case of the alternative explanation, the name of the cluster, ‘the cost experts’, receives a slightly sarcastic tone.

Cluster 2: ‘the trustful’ (358 companies, 23.8 % of the sample) is a group of companies whose name originates in particular from two considerations. Similarly to Cluster 1 above, these companies are confident about the current state of their cost management (i.e. Factor 2). In addition, ‘the trustful’ put also their faith in suppliers and customers, as they have the second highest mean in Factor 1 (3.70). Both Cluster 1 and Cluster 2 are reluctant to develop cost management, although ‘the trustful’ are less absolute.

Cluster 3: ‘the holdouts’ (236 companies, 15.7 % of the sample) is the group of companies that has the lowest mean in Factor 2 (2.82), which denotes that they are the least cost-oriented in the survey sample. The name, ‘the holdouts’, however, stems from these companies’ negative approach to progress, which is manifested in Factor 1 and Factor 3. Cluster 3 has – by far – the lowest mean in Factor 1 (1.75), which truly shows how cynical ‘the holdouts’ are towards joint cost management and related inter-organizational integration. As far as Factor 3 is concerned, ‘the holdouts’ seem to resist change, while the state of their cost management is poor compared to the other clusters.

Cluster 4: ‘the trailblazers’ (240 companies, 15.9 % of the sample) is a group of companies that is remarkably balanced in their attitudes. Cluster 4 has the highest mean in both Factor 1 (3.71) and Factor 3 (3.66). Unlike the other networking-oriented cluster, ‘the trustful’, ‘the trailblazers’ are interested in improving their cost management practices further. They also have the third highest mean in Factor 2 (3.49). Apart from lower understanding of costs and costing techniques in comparison to Cluster 2 and especially Cluster 1, this might come from a better ability to assess their competencies.

Cluster 5: ‘the uncertain’ (346 companies, 23.0 % of the sample) is a group of companies that are conspicuously indecisive and neutral in regard to all measures. Despite the striking neutrality, ‘the uncertain’ have the second highest mean in Factor 3 (2.82), indicating that they are more willing to develop cost management in comparison to the other clusters. It has to be noted, however, that the reluctance of the others makes ‘the uncertain’ look more interested than they actually are based on the mean.

In addition to the factor and cluster analyses, the responses to an open-ended question – “Does your company have any network-level cost accounting tools, methods or even system in place?” – were analyzed by means of (qualitative) content analysis. The breakdown of the above-mentioned question forms the answer to objective (2) mentioned in the beginning of the chapter. The first basis of classification was the tone of the response, which was interpreted as being either positive or negative. The second basis of classification relied on the content, and also on the finer nuances of each individual response. Five categories were identified, as shown in **Table 4.3**.

Table 4.3 Prevalence of cost management IOMs in practice.

Positive 393 responses						
	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	N
Category 1	17.0 % (↓)	34.8 % (↑)	13.4 % (↓)	19.6 % (↑)	15.2 % (↓)	112
Category 2	18.9 % (↓)	30.6 % (↑)	10.0 % (↓)	21.1 % (↑)	19.4 % (↓)	180
Category 3	28.7 % (↑)	27.7 % (↑)	10.9 % (↓)	17.8 % (↑)	14.9 % (↓)	101
Negative 1114 responses						
	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	N
Category 4	15.6 % (↓)	31.3 % (↑)	18.8 % (↑)	15.6 % (↓)	18.8 % (↓)	32
Category 5	22.2 % (↑)	20.9 % (↓)	17.2 % (↑)	14.5 % (↓)	25.2 % (↑)	1082

The positive responses comprise three categories; Category 1: ‘technique is named and/or its purpose of use is explained in detail’, Category 2: ‘claims to have, but response is ambiguous and/or incoherent’, and Category 3: ‘has misunderstood the question, only internal techniques in use’. The negative responses comprise two additional categories; Category 4: ‘has something, but not necessarily in the cost management context’, and Category 5: ‘does not have, does not know, or does not want to comment’. The last category in particular was straightforward to put together, because the majority of the respondents phrased their answer simply as ‘no’ (991 out of 1082 respondents).

Even though the positive side accounts roughly for 26 % of the companies, the actual prevalence of cost management IOMs is significantly lower. A closer look reveals that IOMs are found specifically in those companies that belong to Category 1, which denotes that only around 7 % of them have something tangible to facilitate collaboration in the

inter-organizational domain. The networking-oriented clusters, Cluster 2 and Cluster 4, stand out in Category 1. The proportions of ‘the trustful’ (23.8 % → 34.8 %) and ‘the trailblazers’ (15.9 % → 19.6 %) are both elevated in relation to the survey sample. This observation holds true equally for Category 2, where some of the companies may also have cost management IOMs in use. The issue with Category 2 is, however, the ambiguity of the responses. Overall, ‘the trustful’ and ‘the trailblazers’ are consistently highlighted more on the positive than the negative side, which indicates that the managerial outlook of the companies belonging to these clusters is optimistic.

When the results of the cluster analysis were compared with the responses to the open-ended question, there was a disparity between the rhetoric and the state of affairs. The companies, especially ‘the trustful’ and ‘the trailblazers’ (~ 40 %), were interested in increasing inter-organizational integration through joint cost management. However, this orientation did not emerge from the (qualitative) content analysis, as only a small portion of the surveyed companies (~ 7 %) had cost management IOMs in place.

4.2 Publication 2: ‘towards inter-organizational asset management’

Publication 2 – Inter-organisational asset management: linking an operational and a strategic view – had two main objectives; (1) to demonstrate how organizations benefit from the use of asset management IOMs, such as the life-cycle model (LCM) and flexible asset management model (FAM), which require that customers and service providers engage in information exchange, and (2) to conjoin the above-mentioned two levels of ‘inter-organizational asset management’; operational represented by LCM and strategic represented by FAM. The publication was founded on the case study method in which quantification to the otherwise qualitative research approach was achieved by the means of analytical modelling. In order to reach objective (1), two sources of data were employed. Operations and maintenance data was collected directly from the case company (i.e. the customer) to demonstrate how organizations achieve benefits with LCM. The financial statements of the customer and its service provider were also retrieved to exemplify the use of FAM on the level of the dyadic relationship.

The first of the two asset management IOMs is LCM, which is a maintenance management tool for asset-level decision-making, monitoring realized costs and profits from the past and planning the future. In comparison to other similar maintenance management tools, the unique characteristic of LCM comes from its inter-organizational nature, as it incorporates by default the perspectives of the customer, the (maintenance) service provider and the equipment manufacturer. LCM takes advantage of the present value method in which the cash flows consisting of cost and profit items related to the

asset are discounted/appreciated annually to their present-day values. A key figure in LCM for measuring achievable economic benefits is the cumulative net present value (CNPV), which shows the difference between cumulative discounted profits and cumulative discounted costs at each stage of the asset life cycle. Further information, e.g. the full equation for determining the CNPV, can be found in the publication.

The case company, Company A, is a Finnish manufacturing organization of several distinct bulk products that have a variety of diverse industrial and other professional applications worldwide. The subject of the study was the past and planned future maintenance of Company A's production asset that plays a key role in the processing of its raw materials. Even though Company A had used external workforce in the past to maintain the above-mentioned production asset in operating condition, they had recently outsourced its entire maintenance to a small, local service provider, Company B. The received operations and maintenance data as the starting point, a scenario was created with LCM. **Figure 4.1** illustrates how the CNPV developed in the scenario.

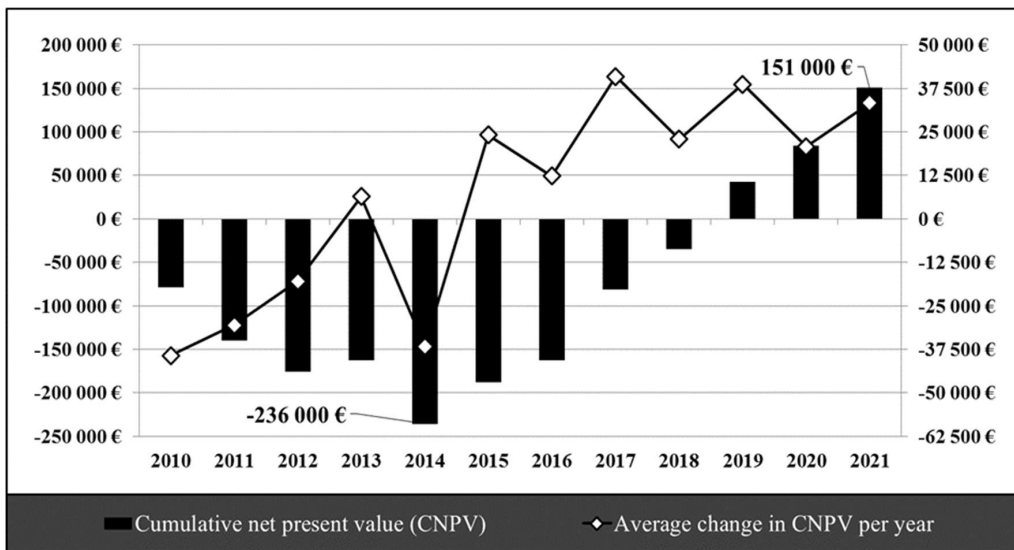


Figure 4.1 Development of CNPV (10 % interest rate in discounting).

As can be seen in the figure, the CNPV is heavily negative throughout the beginning of the asset life cycle, where high cost levels dominate over the smaller profit items. The turning point is the year 2014, which is consequently also the transition year from the realized past to the planned future. After 2014, the CNPV starts to improve gradually, reaching a life-cycle end value around 151 000 €. The positive outcome was naturally

expected, as the created scenario emphasized both operational improvements and cost intensifications. The magnitude of the figure was, however, unexpected. Just over seven years, Company A could benefit more than 385 000 € through rather small, gradual changes in asset maintenance. Despite the fact that the scenario was created from the perspective of the customer (i.e. Company A), the service provider (i.e. Company B) could also benefit from the improvements. Collaborative planning reduces the service provider's costs and increases its profit margin. It is also possible that the customer distributes some of its benefits to the service provider, e.g. a bonus as a sign of goodwill.

The latter of the two asset management IOMs is FAM, which is an alternative way to understand a company's relative profitability, a typical measure of which is return on investment (ROI), where the earnings of a financial period are proportioned to the capital employed (i.e. equity and liabilities with an interest). Instead of the capital employed, FAM concentrates on organizational assets that are situated on the other side of the balance sheet. The denominator of FAM therefore consists of fixed assets and working capital, which is the difference between current assets (i.e. inventories and accounts receivable) and current liabilities (i.e. accounts payable). Earnings before interest, tax, depreciation and amortization (EBITDA) are situated in the numerator. Because FAM utilizes the cash conversion cycle (CCC) to measure the employment of working capital, both EBITDA and fixed assets (FA) are divided by total sales, resulting in the use of the EBITDA% and FA%. By decreasing FA% and/or CCC, the organization increases its ROI and thus its profitability. Further information, e.g. the full equation for determining the ROI, can be found in the publication.

Encouraged by the positive past experiences from asset maintenance, Company A and Company B have decided to extend their collaboration to flexible asset management to be able to realize additional benefits from the relationship. As the relative profitability of the small Company B has been unbearably low for years, the ownership of its fixed assets and inventories have been transferred to Company A, which is – by far – Company B's largest customer. By getting rid of overlapping assets, Company A's balance sheet in terms of fixed assets and inventories has become lighter despite the reorganization efforts. The companies have also agreed to revise the mutual terms of payment in order to shorten Company B's CCC substantially. In addition to the non-existing inventories that have already had a positive effect on the CCC, the new payment terms guarantee that Company B acquires all outstanding accounts receivable faster from Company A. The impacts that this kind of flexible asset management scenario has had on the companies and customer-provider relationship are shown in **Table 4.4**. The values for the EBITDA%, FA% as well as CCC in the baseline situation have been determined as a three-year average from the financial statements of Company A and Company B.

Table 4.4 Comparing the baseline against flexible asset management.

Component	Company A		Company B		Relationship	
	Baseline	Flexible	Baseline	Flexible	Baseline	Flexible
EBITDA%	10.0 %	10.0 %	2.1%	2.1%	9.8%	9.8%
FA%	134.1 %	127.5 %	4.1%	0.0 %	131.7%	125.1 %
CCC	59.9 d	58.3 d	70.3 d	19.0 d	130.2 d	77.3 d
ROI	3.4 %	3.5 %	3.6 %	39.6 %	3.0 %	3.5 %

As can be seen in the table, the transfer of fixed assets to Company A's balance sheet brought the FA% of Company B naturally down to zero. At the same time, the removal of asset overlap decreased the FA% of Company A by almost 7 percentage points. Because of the size difference between the companies, the relationship-level FA% follows largely Company A's figure. The plunge in the relationship-level CCC, on the other hand, originates from Company B. Its CCC benefitted around 31 days from the reorganization of inventories, while another 20 days came from the revised payment terms. As far as the CCC of Company A is concerned, the benefits gained from smaller inventory levels were revoked partly by the expedited cycle time of accounts payable.

By looking at the numbers, the overwhelming winner in the flexible asset management scenario seems to be Company B, the ROI of which has increased by impressive 36 percentage points. Its lighter asset structure equals higher profitability. The overall benefits are, however, significantly more moderate, as the relationship-level ROI has improved only by a half percentage point. A scenario such as this would likely require that Company B will provide certain incentives to Company A. It could e.g. change the pricing of its maintenance services. Cheaper maintenance will benefit Company A directly, thus increasing the EBITDA% that contributes towards higher profitability.

LCM and FAM are two distinct asset management IOMs designed for different managerial purposes; LCM steers operational decisions regarding asset maintenance, and FAM teaches organizations how the balance sheet is treated as a strategic instrument. They are therefore separate, but also complementary IOMs. As illustrated in **Figure 4.2**, the link between the two levels of inter-organizational asset management, i.e. operational and strategic, lies in the CNPV and EBITDA%. In other words, better maintenance decision-making will eventually show on the financial statement. If an organization has several production-critical assets, the sum of their CNPVs equals the change in the EBITDA%. This forms the answer to objective (2).

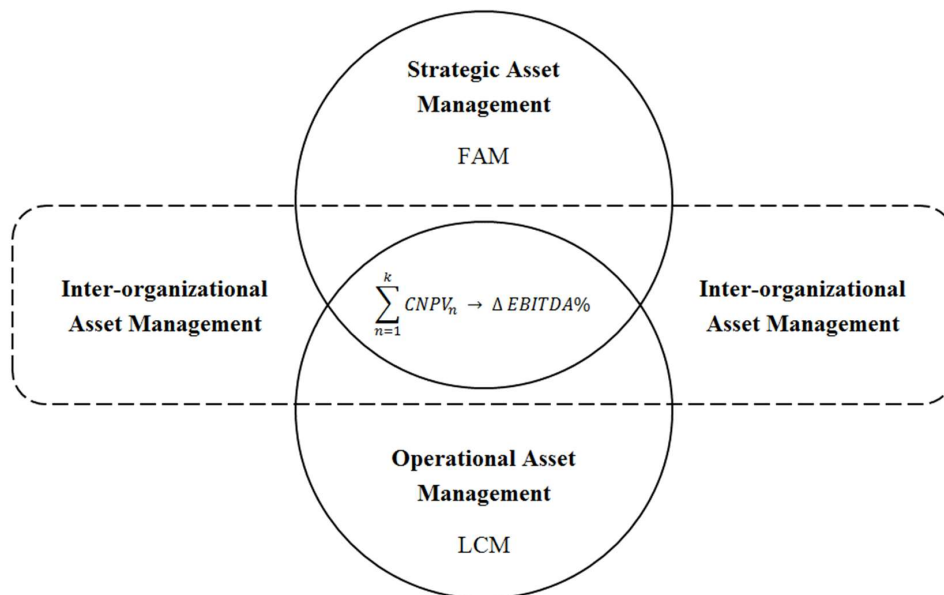


Figure 4.2 Inter-organizational asset management: linking an operational and a strategic view.

4.3 Publication 3: ‘information disclosure facilitated by technology’

Publication 3 – From networks to ecosystems: redefining inter-organizational transparency – had one main objective: to understand how Internet of Things (IoT) technologies might support information disclosure, which has traditionally been challenging in the asset management context. The publication suggests that inter-organizational relationships, referred to as ‘networks’, are shading into complex ‘ecosystems’ where interdependency applies to both the animate (i.e. organizations populated by individuals) and the inanimate alike (i.e. industry saturated by smart connected assets utilizing IoT technologies). Due to the exploratory nature of the objective, multiple case studies were chosen as the method of scientific inquiry. The transition from networks to ecosystems is discussed by the means of two cases; Norwegian oil and gas (i.e. Ecosystem I) and Finnish pulp and paper (i.e. Ecosystem II). One interview was conducted in each of the two case ecosystems. The persons interviewed were an Integrated Operations Advisor (IOA) of an oil and gas exploration and production company, and a Director of Operations (DOO) of a pulp and paper production company. A summary of the key findings is compiled in **Table 4.5**.

Table 4.5 The nature of inter-organizational relationships and technology use in the cases.

	Topic	Ecosystem I	Ecosystem II
1.	Focus on long-term inter-organizational relationships beyond simple transactions	Yes, esp. with key partners	No, the case is an exception
2.	Types of benefit-sharing arrangements used in the above-mentioned relationships	Risk-reward contracts	No sharing arrangements
3.	The disclosure of data and/or information over traditional organizational boundaries	Yes, but NDA protected still	Yes, calendar roll data as a pilot case
4.	Types of data and/or information usually exchanged with suppliers and/or customers	Technical data, also budgets	Mostly technical data at this point
5.	The direction of data and/or information disclosure and the boundaries to openness	Bilateral / even triadic	Bilateral / strictly dyadic
6.	Use of inter-organizational mediums (IOM) in the exchange of information	A large variety, e.g. custom-made	Packages sent from a server
7.	Utilization of Internet of Things (IoT) technologies in assets, such as sensors	Yes, sensors and even robotics	Yes, currently piloting sensors
8.	The current role of fleet asset management, i.e. managing assets instead of an asset	No, but improving for upper mgmt.	No, but potential on the roll level
9.	The quality of data and/or information from the perspective of joint decision-making	Getting better, but requires work	Pilot ongoing, still unknown
10.	Access to the data and/or information that the assets are currently generating	Limited due to complexities	As it stands, good to roll data

The first of the two cases, Ecosystem I, presents a situation where the adoption of IoT technology is a result of a longer trend. As an industry, Norwegian oil and gas has transitioned from conventional to integrated operations, the aim of which is to integrate onshore and offshore operations with advanced information and communication technology across organizational boundaries. An important piece of this technological puzzle is an information system known as the Secure Oil Information Link (SOIL) that is based on fiber-optic cables on the Norwegian seabed, complemented with radio and satellite communications. Because of integrated operations and the SOIL in particular, the industry has undergone a major restructuring that has brought oil and gas producers, service providers, and different support and supply organizations closer together.

As highlighted by the IOA, long-term relationships are sought actively in the industry especially with key partners. Organizations make risk-reward type of contracts where the service providers are paid for certain performance. Information exchange in these relationships is typically bilateral, but regulated by non-disclosure agreements (NDA). In addition to technical data that is mostly disclosed to service providers, the IOA mentioned that key partners are involved e.g. in their budgeting process. The transition from conventional to integrated operations has introduced the organizations also to IoT. The assets on the field are saturated with sensors that gather technical data, which is transferred by the means of the SOIL to onshore support centers for joint decision-making. According to the IOA, they have also ongoing projects around e.g. artificial intelligence and robotics, as well as new communication and collaboration systems. Another significant area for further improvement is access to the data generated by the assets as there are too many systems and databases that are not fully integrated.

The latter of the two cases, Ecosystem II, shows how ecosystem thinking is emerging in the Finnish pulp and paper industry, by highlighting an exemplary relationship between a paper producer, Company A, and an equipment manufacturer, Company B, which also provides maintenance services to the former. They have set in motion a big data project that focuses on utilizing sensor data in the maintenance of calender rolls that play a critical role in the paper production process. Due to its series-connected nature where production phases follow each other in a sequence, papermaking is extremely sensitive to unexpected malfunctions, such as defective calender rolls. Within the limits of the joint project, Company B has been granted access to the process and roll data of Company A in order to develop its maintenance practices.

In comparison to Ecosystem I, where long-term relationships have become an industry standard, the partnership agreement that Company A has recently established with Company B is unique in its relationship portfolio. The exchange of information is

organized as follows: Company A forwards large amounts of process and sensor data about the calendar rolls to Company B, which then analyzes the received data. Actual data is therefore disclosed in a unilateral fashion, but in return, Company A receives models about potential improvements to their asset maintenance. Apart from this particular occasion, information is not disclosed in Company A's other relationships. The still emerging nature of Ecosystem II denotes also that sensors are currently the main IoT technology. As the pilot case has been restricted purposefully to calendar rolls, the companies have good access to the required data. The DOO of Company A stated in the interview that – rather than access to data – the variety of data forms, including e.g. time-based and event-based data, is a big challenge for effective decision-making.

As far as the information disclosure-supporting role of IoT is concerned, the case ecosystems differ both in “breadth” and “depth”. Ecosystem I presents a more mature setting where the integrated operations model has influenced the industry as a whole. Ecosystem II – comprising Company A and Company B – is still exploring its options regarding IoT technologies. These companies have, however, established a level of transparency that already exceeds the conventional practices in the industry.

4.4 Publication 4: ‘a design exemplar to guide implementation’

Publication 4 – Implementation of inter-organisational mediums: synthesising framework as a design exemplar – had one main objective: to create an implementation framework for IOMs from the existing theory base as a ‘design exemplar’ to managers. The term design exemplar stems from the selected research approach/method, which is design science, the purpose of which is to develop general knowledge to support the design of solutions to field problems. This particular knowledge can be expressed e.g. in the form of a design exemplar that follows the logic of; “if you want to achieve Y in situation Z, then perform something like action X”. Each design exemplar should be understood strictly as a solution concept, which denotes that a specific variant of the general solution has to be always generated for a specific situation. As far as the existing theories are concerned, the framework is founded on OBA-themed cost management literature. As IOMs and their implementation revolve around how information is disclosed between and/or among organizations, the OBA research stream as an established knowledge base forms a logical premise for the implementation framework.

The created design exemplar, i.e. an implementation framework for inter-organizational mediums (IFFIM), consists of two ancillary parts, IFFIM_1: the relational view, and IFFIM_2: the process view. The first part of the framework concerns the multidimensional nature of inter-organizational relationships. IFFIM_1 thus illustrates

possible relational complexities visually through the OBA dimensions discussed by Windolph & Möller (2012). The second part of the framework is an outlook to the stepwise process of implementing an IOM. The phases of implementation in IFFIM_2 are based on the enterprise system experience cycle of Markus and Tanis (2000), which has been later modified by Nah et al. (2001). By integrating the factors that influence OBA implementation (Kajüter & Kulmala 2005) further to the above-mentioned phases, a manner of representation is established that recognizes the important variables.

IFFIM_1, as shown in **Figure 4.3**, demonstrates the interplay between the OBA dimensions, which are the degree and quality of disclosure, the direction of information exchange, and the boundaries to openness (Windolph & Möller 2012). As an inter-organizational entity, this exemplifying illustration presents a network triad that is comprised of three dyadic inter-organizational relationships; Customer - Supplier A (CSA), Customer - Supplier B (CSB), and Supplier A - Supplier B (SASB).

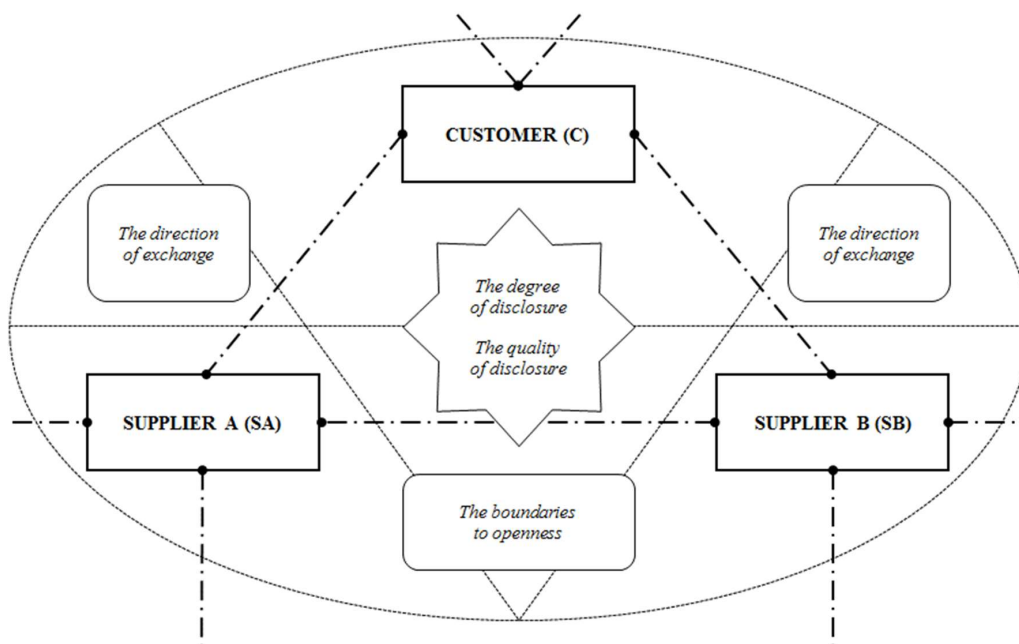


Figure 4.3 IFFIM_1: the relational view.

The degree and quality of disclosure has been placed to the core of IFFIM_1 because the other dimensions are insignificant without it. Incongruous (i.e. wrong degree) or inadequate information (i.e. flawed quality) would most likely undermine also the direction of information exchange and the boundaries to openness. The direction is

represented by the stronger dashed lines in the figure, while the nature of exchange (unilateral vs. bilateral disclosure) delineates how they are presented visually. Taking relationship CSA as an example, it can be organized as follows: unilateral disclosure from SA to C, unilateral disclosure from C to SA, or alternatively the companies engage in bilateral disclosure. The boundaries, on the other hand, are illustrated by the lighter dashed lines that both surround and segregate the companies. There are effectively four boundaries in the triad, such as the left-hand diagonal that segregates SA from the relationship CSB as well as the circular borderline that sets restrictions in relation to external actors (e.g. second-tier suppliers and end customers). Several boundaries may exist simultaneously, but each constrains transparency.

IFFIM₂, as shown in **Figure 4.4**, emphasizes factors that influence the stepwise implementation process of an IOM. Three categories of factors are recognized in the figure, including endogenous factors, network-specific factors and exogenous factors (Kajüter & Kulmala 2005). The endogenous factors comprise organizational size, information systems and purchasing strategy, whereas structure and maturity, network infrastructure, and relationships and trust are subsumed into the network-specific factors. The exogenous factors are, however, demarcated outside the process view, as organizations' ability to control their environment is questionable at best. The impact of each factor is assessed on a tripartite scale (i.e. low / medium / high) in the example.

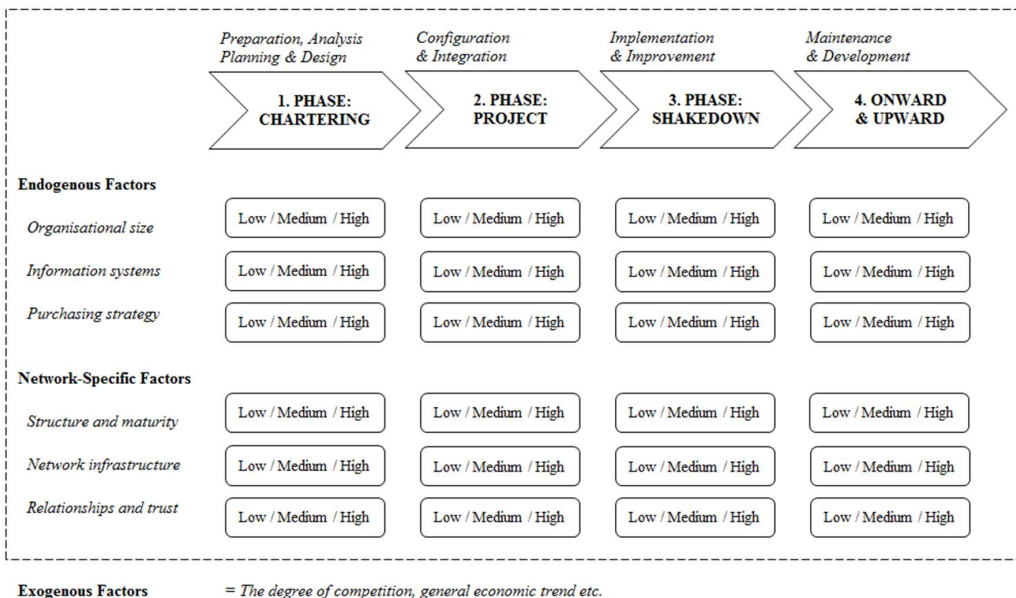


Figure 4.4 IFFIM₂: the process view.

It should also be pointed out that the right configuration of implementation phases depends on the IOM in question, as IOMs conceptually retain mediums that are not entirely commensurable relative to the extent of their application (i.e. tools, models, techniques, approaches, methods, technologies, and systems). A decision-making tool, for instance, does not necessarily require a full-scale implementation process, but an information system probably does. Overall, IFFIM_2 increases managerial awareness towards both endogenous and network-specific factors that may hinder or even prevent the implementation of an IOM to be a success. Although the exogenous factors are disregarded in the framework, their potential influence on the overall process cannot be downplayed. A new IOM is arguably challenging to deploy e.g. in times of recession.

4.5 Summary of the results

The main findings of this thesis are summarized in **Figure 4.5** (see p. 65). By addressing each research question individually, the following answers are given.

RQ1: *“What is the state of development and/or utilization of IOMs?”*

The review of the cost management literature (see chapter 2.2) showed that a large number of case studies documenting cost management IOMs extensively have been conducted between 1994 and 2018. The prevalence of such IOMs is, however, mostly unknown, as the previous literature lacks survey-based empirical evidence. P1 fills this gap in the literature by presenting the results of a survey participated by 1507 companies. The survey contained an open-ended question that inquired about the organizations' IOM utilization. The positive responses were divided to three categories that accounted for 26 % of the companies. Based on the response analysis, around 7 % of the companies used cost management IOMs (i.e. Category 1: ‘technique is named and/or its purpose of use is explained in detail’). The rest of the respondents were either too ambiguous/incoherent or had clearly misunderstood the question in the first place (i.e. Category 2: ‘claims to have, but response is ambiguous and/or incoherent’ and Category 3: ‘has misunderstood the question, only internal techniques in use’).

The review of the asset management literature (see chapter 2.3), on the other hand, showed that asset management IOMs consist largely of academic frameworks developed between 2004 and 2017. In comparison to the cost management context, this stream of literature lacks case-based evidence about IOM applications. P2 addresses this shortcoming by presenting a case study that demonstrates what kind of benefits organizations can attain with two particular asset management IOMs referred to as LCM and FAM. The use of these IOMs requires that customers and their service providers are

willing to disclose information. The operational view to asset management (i.e. the use of LCM) is also linked in P2 to the strategic view to asset management (i.e. the use of FAM). This unified approach that combines both IOMs and their benefits to organizations is termed as ‘inter-organizational asset management’.

RQ2: *“What kind of unrealized potential is there for IOMs?”*

In addition to mapping the prevalence of cost management IOMs, an overall picture of cost management practices was also formed in P1. Five clusters of companies were identified from the data, each representing a unique outlook (i.e. Cluster 1: ‘the cost experts’, Cluster 2: ‘the trustful’, Cluster 3: ‘the holdouts’, Cluster 4: ‘the trailblazers’, and Cluster 5: ‘the uncertain’). Out of these five clusters, the orientation to joint cost management was high in ‘the trustful’ and ‘the trailblazers’, which together accounted for nearly 40 % of the surveyed companies. Unlike ‘the trustful’, ‘the trailblazers’ were also interested in developing cost management in general. Based on these findings, organizations that belong to ‘the trustful’ and ‘the trailblazers’ have the greatest underlying potential for new cost management IOMs. The interest to develop cost management observed in ‘the trailblazers’ positions them as the most likely adopters.

P3 examines how IoT technologies support information disclosure in the asset management context. Two case ecosystems are discussed where such novel technologies are currently utilized; the Norwegian oil and gas (i.e. Ecosystem I) and the Finnish pulp and paper (i.e. Ecosystem II). As far as the information disclosure-supporting role of IoT is concerned, the ecosystems differ in “breath” and “depth”. Ecosystem I is a mature setting where offshore assets are saturated with sensors that gather technical data, which is then transferred to onshore support centers for joint decision-making. There are ongoing projects around e.g. artificial intelligence and robotics. Ecosystem II is still emerging, and calendar roll maintenance has been chosen as a pilot case for sensor technologies. Despite the early stage, a level of transparency has been established that exceeds conventional practices in the industry. These two cases exemplify how IoT can mediate relationships. The underlying potential for IoT technologies as a form of asset management IOMs is massive in the future.

RQ3: *“How are IOMs to be implemented in order to unleash their potential?”*

P4 considers the question of implementing IOMs. A design exemplar is proposed to managers as a guide to implementation. The created design exemplar, i.e. an implementation framework for inter-organizational mediums (IFFIM) consists of two ancillary parts; IFFIM_1: the relational view, and IFFIM_2: the process view. The first part of the framework, IFFIM_1, demonstrates the interplay between the OBA

dimensions that are the degree and quality of disclosure, the direction of information exchange, and the boundaries to openness. The second part of the framework, IFFIM_2, emphasizes factors that influence the stepwise implementation process of an IOM. Two factor categories are highlighted; endogenous factors and network-specific factors. The endogenous factors comprise organizational size, information systems and purchasing strategy, while structure and maturity, network infrastructure, and relationships and trust are included in the network-specific factors.

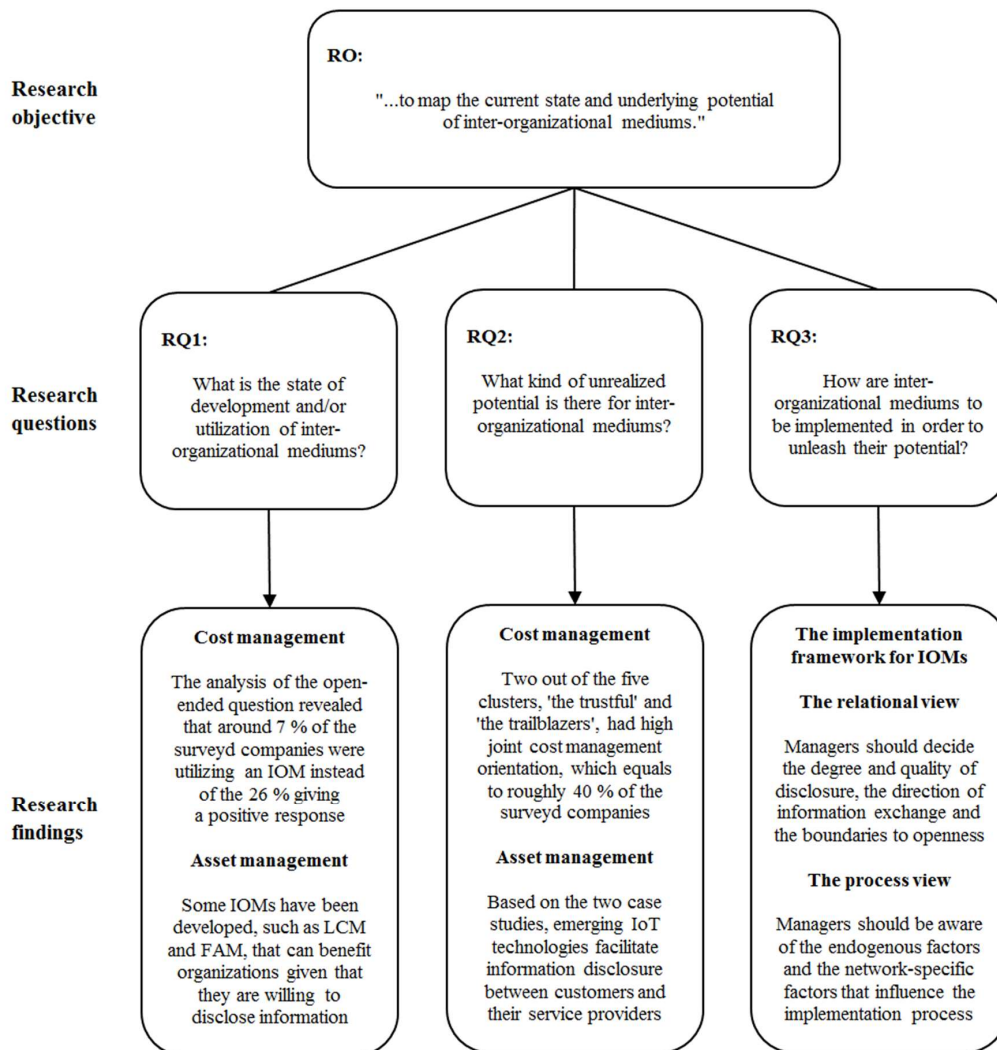


Figure 4.5 Summary of the answers to the research questions.

5 Conclusions

5.1 Theoretical contributions

The four publications constituting the thesis carry major and minor contributions to the theory. The major contributions arise from P1 and P2, and minor ones from P3 and P4. The contribution that Part I: the overview of the thesis (see p. 24) makes to both conceptual and contextual scientific discussion are highlighted as well.

P1 contains several theoretical contributions. The first contribution is related to identifying certain organizational archetypes. The data suggests that there are five different outlooks to cost management, represented by five clusters of companies (i.e. Cluster 1: ‘the cost experts’, Cluster 2: ‘the trustful’, Cluster 3: ‘the holdouts’, Cluster 4: ‘the trailblazers’, and Cluster 5: ‘the uncertain’). The differences between the clusters stem from orientation to joint cost management (i.e. Factor 1), the current state of cost management (i.e. Factor 2), and interest to develop cost management (i.e. Factor 3). The second contribution is related to mapping organizations’ general willingness to conduct cost management in inter-organizational relationships, and the prevalence of cost management IOMs. A high orientation to joint cost management (i.e. Factor 1) was discovered in 40 % of the companies, which belonged to ‘the trustful’ and ‘the trailblazers’. Cost management IOMs were utilized by 7 % of the companies.

The third contribution is related to the reciprocal correlations of the factors. A high correlation between an organization’s orientation to joint cost management (i.e. Factor 1) and its interest to develop cost management (i.e. Factor 3) indicates that the willingness to develop intra-organizational cost management and corresponding inter-organizational practices are highly interconnected. This particular connection becomes even stronger when ‘the trustful’ are excluded from the analysis (0.39 → 0.60). The fourth contribution is related to the discussion about the roles of intra-organizational cost management and inter-organizational cost management. It would seem that a good state of cost management (i.e. Factor 2) supports a joint cost management orientation (i.e. Factor 1), as both ‘the trustful’ and ‘the trailblazers’ are very cost-conscious clusters.

P2 makes two important contributions. The first contribution is related to conceptual discussion. The concept of ‘inter-organizational asset management’ is introduced by drawing a parallel to ‘inter-organizational cost management’, which often refers to certain supply-side IOMs in the cost management literature. It is argued that inter-organizational asset management comprises an operational and a strategic level, which both have their unique IOMs (i.e. LCM and FAM). The second contribution is related to demonstrating

the benefits that organizations can attain from the two asset management IOMs. To some extent, these benefits have been discussed in the previous literature, but always in isolation. Hence, the unique feature of P2 is forming a link between operational asset management and strategic asset management. In addition to linking these two managerial levels, the benefits of both levels are also associated.

Publications 3 and 4 both carry minor contributions to the theory. P3 contributes by providing some preliminary evidence on the information disclosure-supporting role of IoT technologies in the asset management context. If IoT is the differentiator between ‘business networks’ and ‘business ecosystems’, this notion implicates that the latter concept should be emphasized more in the scientific discussion, as the former concept is no longer congruent with the state of the practice. P4 contributes to the theoretical discussion by recognizing what influences the implementation of IOMs. The synthesis of the existing OBA literature forms an understanding of the dimensions (i.e. relational influence) as well as the factors (i.e. processual influence) that should be acknowledged by organizations/managers.

Apart from the above-mentioned major and minor contributions that are made in individual publications, the beginning chapters of the thesis overview (see p. 24) introduce an additional contribution to scientific discussion. As the foundation of this additional contribution, Chapter 1: Introduction proposes a new concept – inter-organizational medium (IOM) – as a reference to certain tools, models, techniques, approaches, methods, technologies, and systems that are implemented and used over organizational boundaries. Chapter 2: Theoretical background supports this conceptualization by clarifying what kind of “things” constitute IOMs. A relatively large number of examples was collected, reviewed and analysed from the literature focusing especially on cost management and asset management perspectives. The background chapter concludes with a contextual framework (see p. 42).

The term ‘contextual’ in the name of the framework refers not only to the types of relationships where IOMs are employed in the field (i.e. the relational context), but also to an understanding of cost management and asset management as intertwined, overlapping managerial domains (i.e. the managerial context). The originality of the thesis concerning the relational context lies in the argument that IOMs as something tangible that intermediate relationships between and among organizations are just as important as other relationship-defining determinants (e.g. a relational purchasing strategy or willingness to invest in relationship-specific assets). Organizations should therefore consider carefully what kinds of managerial practices are applied in the implementation of IOMs and how they are operationalized over organizational

boundaries afterwards, as these decisions influence exchange performance. As regards the managerial context, a proposition is put forth that cost management and asset management should be perceived as overlapping managerial domains with aligned objectives, both seeking e.g. effectiveness in resource use, competitive advantage, and value creation for the end customer. As this kind of interconnection between cost management and asset management has previously not been suggested in the literature dealing with inter-organizational relationships, the proposition establishes, at the very least, unexplored avenues for complementary research in the future.

5.2 Managerial implications

The thesis contains major and minor implications to the practice. The major implications arise from P4, while minor implications are pointed out in P1, P2 and P3.

P4 addresses the rigor-relevance gap, which is a term employed often in references to the utilization problem of management research, i.e. that research findings are not used by practitioners. The gap between scientific rigor and practical relevance is bridged with design science, which is concerned with developing general knowledge to support the design of solutions (i.e. artefacts and/or interventions) for field problems. General knowledge regarding the solution can be expressed in the form of a design exemplar, e.g. IFFIM. Such exemplars act as guidelines that practitioners are able to follow when designing solution variants for specific situations. IFFIM thus assists managers to design the implementation of IOMs. Whereas IOMs can be perceived as artefacts in the inter-organizational interface, the implementation is a managerial intervention. Because of the nature of design science research, it could be even argued that P4 contributes to the practice rather than carries implications as an “after-thought”.

Publications 1, 2 and 3 contain minor implications to practice. P1 identifies certain distinct outlooks to cost management (i.e. clusters) and analyses the responses to an open-ended question on IOM utilization. These can be of interest to practitioners. The managerial implications of the survey have been discussed more extensively by Ylä-Kujala et al. (2016). P2 provides an illustration and even managerial instructions on how to attain benefits with LCM and FAM. The cause-and-effect relationship between the two levels of inter-organizational decision-making – i.e. operational (LCM) and strategic (FAM) – is also highlighted. P3 presents two case studies where IoT technologies support information disclosure. The case-based evidence may offer ideas to managers on how to utilize IoT technologies to promote collaboration and transparency between and among organizations.

5.3 Suggestions for further research

As reminded above in the theoretical contributions, the thesis has put forward a new concept known as the inter-organizational medium (IOM), which refers collectively to various “things” that intermediate relationships between and among organizations. The first suggestion stems from extending this conceptualization by exploring the relationship-mediating role of tools, models, techniques, approaches, methods, technologies, and systems in diverse relational contexts. By recognizing IOMs as important determinants that characterize relationships, novel insights into the design, implementation and utilization of IOMs can be found that might begin to explain why certain inter-organizational relationships are successful while others are destined to fail.

Industrial organizations’ outsourcing strategies establish two overlapping managerial domains (i.e. cost management and asset management) where various IOMs are of particular importance. Hence, the second suggestion is to observe how organizations might benefit from employing cost management IOMs and asset management IOMs simultaneously. Further research could e.g. investigate in which ways the two management contexts can be integrated when the number of involved organizations on the supply side becomes greater (i.e. cost management with supplier tiers and asset management with equipment manufacturers and maintenance service providers).

An integral part of design science research is the testing and grounding of design exemplars. The path from a proposal to a proven design exemplar was not yet achieved in P4, which only presented and discussed the results of a preliminary testing of IFFIM. The third suggestion is therefore to conduct multiple rounds of testing to IFFIM. This could follow the so-called CIMO-logic (i.e. context, intervention, mechanisms, and outcome), as comparable interventions will likely result in slightly different outcomes, depending on the application context as well as the mechanisms that the intervention triggers in that specific context. This kind of extensive, repetitive field testing and eventual grounding of IFFIM is attainable for instance with multiple case studies.

The fourth suggestion is to conduct further research into the nexus between IoT and information disclosure, as e.g. P3 is a working paper that can be refined to a journal article. The fifth suggestion concerns P1, the findings of which, e.g. clustering and the prevalence of IOMs, could be verified by conducting comparative studies in other countries. Based on the literature, cost management in inter-organizational relationships (see chapter 2.2) has received much more attention in the academia than asset management in inter-organizational relationships (see chapter 2.3), denoting that additional work to P2 is still required. Thus the last suggestion is to continue expanding the literature by creating new asset management IOMs and studying their applications.

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Appendix A: The most cited publications (query string 4)

	Document title	Authors	Cited	T*	R*	N*
1	The balanced scorecard - measures that drive performance	Kaplan & Norton	5724			
2	Welcome to the experience economy	Pine & Gilmore	1347			
3	Performance measures and metrics in a supply chain environment	Gunasekaran et al.	966	X		
4	Closed-loop supply chain models with product remanufacturing	Savaskan et al.	890	X		
5	Relational governance as an interorganizational strategy: an empirical test...	Zaheer & Venkatraman	800		X	
6	Consumer switching costs: a typology, antecedents, and consequences	Burnham et al.	707			
7	How do suppliers benefit from information technology use in supply chain...	Subramani	671	X		
8	A dynamic model of customers' usage of services: usage as an antecedent...	Bolton & Lemon	629			
9	The effects of an integrative supply chain strategy on customer service and...	Vickery et al.	600	X		
10	Supplier integration into new product development: coordinating product...	Petersen et al.	556	X		
11	The quantity flexibility contract and supplier-customer incentives	Tsay	550	X		
12	Modeling supply chain dynamics: a multiagent approach	Swaminathan et al.	550	X		
13	Success factors for integrating suppliers into new product development	Ragatz et al.	532	X		
14	Resources, transactions and rents: managing value through interfirm...	Madhok & Tallman	497		X	
15	Drivers and barriers to environmental supply chain management practices...	Walker et al.	496	X		
16	Supply management orientation and supplier/buyer performance	Shin et al.	463	X		
17	The relationships between supplier development, commitment, social...	Krause et al.	455	X		
18	Control of inter-organizational relationships: evidence on appropriation...	Dekker	448	X		
19	Capital disadvantage: America's failing capital investment system	Porter	421			
20	Agile manufacturing: a framework for research and development	Gunasekaran	413			
21	Controlling supplier opportunism in industrial relationships	Stump & Heide	400	X		
22	Buyer-supplier relationships and customer firm costs	Cannon & Homburg	392		X	
23	Responsive supply chain: a competitive strategy in a networked economy	Gunasekaran et al.	383	X		
24	Promoting relationship learning	Selnes & Sallis	370		X	
25	An analysis of the supplier selection process	Verma & Pullman	369	X		
26	Supplier's optimal quantity discount policy under asymmetric information	Corbett & De Groote	364	X		
27	Causes and effects of delays in Malaysian construction industry	Sambasivan & Soon	349			X
28	Impact of eBusiness technologies on operational performance: the role of...	Devaraj et al.	346	X		
29	Risk management processes in supplier networks	Hallikas et al.	342	X		
30	The power of virtual integration: an interview with Dell computer's....	Dell	332			
31	When does commitment lead to loyalty?	Fullerton	331		X	
32	The influence of power driven buyer/seller relationships on supply chain...	Benton & Maloni	327	X		
33	Build-to-order supply chain management: a literature review and...	Gunasekaran & Ngai	324	X		
34	The effect of vendor managed inventory (VMI) dynamics on the bullwhip...	Disney & Towill	321	X		
35	Global supplier selection: A fuzzy-AHP approach	Chan et al.	310	X		
36	Safeguarding interorganizational performance and continuity under ex...	Jap & Anderson	310	X		
37	Trust, contract and relationship development	Woolthuis et al.	304		X	
38	Network design for reverse logistics	Srivastava	298	X		
39	Supply chain scheduling: batching and delivery	Hall & Potts	290	X		
40	The contingency effects of environmental uncertainty on the relationship...	Wong et al.	286	X		
41	Supplier development: improving supplier performance through knowledge...	Modi & Mabert	282	X		
42	Understanding the key risks in construction projects in China	Zou et al.	277			X
43	IT outsourcing strategies: universalistic, contingency, and configurational...	Lee et al.	273			X
44	Coordinating for flexibility in e-business supply chains	Gosain et al.	271	X		
45	Manufacturer benefits from information integration with retail customers	Kulp et al.	263	X		
46	Use the supply relationship to develop lean and green suppliers	Simpson & Power	260	X		
47	The role of the internet in supply chain management	Lancioni et al.	259	X		
48	Analysis of success factors and benefits of partnering in construction	Black et al.	253			X
49	Designing supply contracts: contract type and information asymmetry	Corbett et al.	250	X		
50	Modal choice in a world of alliances: analyzing organizational forms in the...	Contractor & Kundu	249			X

*Note: T = Transactional focus, R = Relational focus, N = Non-industrial topic

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Appendix B: The most cited publications (query string 5)

	Document title	Authors	Cited	T*	R*	I*
1	What's your strategy for managing knowledge?	Hansen et al.	2337			X
2	Shareholder value, stakeholder management, and social issues: what's...	Hillman & Keim	1238			
3	How do suppliers benefit from information technology use in supply chain...	Subramani	671	X		
4	Success factors for integrating suppliers into new product development	Ragatz et al.	533	X		
5	Gaining from vertical partnerships: knowledge transfer, relationship...	Kotabe et al.	504		X	
6	Resources, transactions and rents: managing value through interfirm...	Madhok & Tallman	497		X	
7	Understanding retail branding: conceptual insights and research priorities	Ailawadi & Keller	445			X
8	The role of trust and relationship structure in improving supply chain...	Handfield & Bechtel	442		X	
9	Drivers of supply chain vulnerability: an integrated framework	Peck	270	X		
10	IS application capabilities and relational value in interfirm partnerships	Saraf et al.	215		X	
11	Management control of interfirm transactional relationships: the case of...	Meer-Kooistra & ...	212	X		
12	Time value of commercial product returns	Guide et al.	206	X		
13	Performance contracting in after-sales service supply chains	Kim et al.	194	X		
14	A hybrid approach to supplier selection for the maintenance of...	Ha & Krishnan	193	X		
15	Interfirm strategic information flows in logistics supply chain relationships	Klein & Rai	189	X		
16	Relational antecedents of information flow integration for supply chain...	Patnayakuni et al.	187	X		
17	Beyond the exchange - the future of B2B	Wise & Morrison	183		X	
18	The winner's curse in IT outsourcing: strategies for avoiding relational...	Kern et al.	175	X		
19	Achieving best value in private finance initiative project procurement	Akintoye et al.	162			
20	Comparing the resource-based and relational views: knowledge transfer and...	Mesquita et al.	146		X	
21	The performance effects of process management techniques	Ittner & Larcker	145			
22	The differing and mediating roles of trust and relationship commitment in...	Aurier & N'Goala	144		X	
23	Strategic management of product recovery	Toffel	138			
24	Unravelling the process from closed to open innovation: evidence from...	Chiaroni et al.	130			
25	Protecting intellectual capital in international alliances	Baughn et al.	125			X
26	Towards an intellectual capital-based view of the firm: Origins and Nature	Martín-de-Castro et al.	118			X
27	Greening the supply chain: when is customer pressure effective?	Delmas & Montiel	112	X		
28	The adoption of total cost of ownership for sourcing decisions - a structural...	Wouters et al.	111	X		
29	Supply chain challenges: building relationships	Beth et al.	106	X		
30	Managing cooptation through horizontal supply chain relations: linking...	Wilhelm	101		X	
31	Evaluating the performance of third-party logistics arrangements...	Knemeyer & Murphy	101	X		
32	Integrating the warehousing and transportation functions of the supply chain	Mason et al.	101	X		
33	Competing in product and service: a product life-cycle model	Cohen & Whang	99	X		
34	Factors affecting supplier quality performance	Forker	98	X		
35	A resource-based-view of the socially responsible firm: stakeholder...	Litz	94			
36	An exploratory study of the manufacturing strategy process in practice	Maruchek et al.	88			
37	Using R&D cooperative arrangements to leverage managerial experience...	McGee & Dowling	87			X
38	Analyzing supplier development criteria for an automobile industry	Govindan et al.	86	X		
39	Multi-objective contractor's ranking by applying the moora method	Brauers et al.	86	X		
40	The strategic impetus for social network ties: reconstituting broken CEO...	Westphal et al.	85			X
41	The dyadic capabilities concept: examining the processes of key supplier...	Croom	85	X		
42	Building trust in construction projects	Khalfan et al.	82		X	
43	Managing and measuring relational equity in the network economy	Sawhney & Zabin	80			X
44	Design and development of product support and maintenance concepts for...	Markeset & Kumar	77	X		
45	Assessing intellectual capital creation in regional clusters	Pöyhönen & Smedlund	76			X
46	Measuring service quality in B2B services: an evaluation of the...	Gounaris	71			
47	Relationship stability and supplier commitment to quality	Lai et al.	69	X		
48	Role stress and effectiveness in horizontal alliances	Nygaard & Dahlstrom	68			X
49	Industrial service profiling: matching service offerings and processes	Johansson & Olhager	66	X		
50	Tapping supplier innovation	Wagner	65	X		X

*Note: T = Transactional focus, R = Relational focus, I = Intangible assets

Appendix C: The most cited publications (query string 6)

	Document title	Authors	Cited	C*	A*	S*
1	Interorganizational cost management and relational context	Cooper & Slagmulder	183	X		
2	Value chain analysis in interfirm relationships: a field study	Dekker	168	X		
3	Inter-organizational controls and organizational competencies: episodes...	Mouritsen et al.	164	X		
4	Stakeholders' implicit claims and accounting method choice	Bowen et al.	164			
5	Open-book accounting in networks: potential achievement and reasons for...	Kajüter & Kulmala	130	X		
6	Disembedding the supply chain: institutionalized reflexivity and inter-firm...	Seal et al.	96	X		
7	Realizing savings from online reverse auctions	Emiliani & Stec	91			X
8	Walking the talk? Supply chain accounting and trust among UK...	Free	78	X		
9	An exploration of the adoption of E-auctions in supply management	Hartley et al.	70			X
10	Supply chain cost management and value-based pricing	Christopher & Gattorna	67	X		
11	Transmission system management and pricing: new paradigms and...	Tabors	65		X	
12	Life with a sub-contractor: new technology and management accounting	Jönsson & Grönlund	62			
13	The role of cost management in network relationships	Kulmala et al.	60	X		
14	Inter-organizational cost management systems: the case of the...	Cooper & Yoshikawa	58	X		
15	Cooperative strategies in customer-supplier relationships: the role of...	Laaksonen et al.	54	X		
16	Outsourcing: from cost management to innovation and business value	Weeks & Feeny	50			
17	Behavioral research opportunities: understanding the impact of enterprise...	Arnold	47	X		
18	Contracting out maintenance and a plan for future research	Martin	45		X	
19	Target cost management in Japanese companies: current state of the art	Tani et al.	45	X		
20	Adding value through outsourcing: contribution of 3PL services to...	Power et al.	44			X
21	Applying activity-based costing in a supply chain environment	Schulze et al.	42	X		
22	The emergence of boundaries and accounting in supply fields...	Thrane & Hald	40	X		
23	Accounting in an interorganizational setting	Håkansson & Lind	38	X		
24	Antecedents of proactive supply chain risk management - a contingency...	Grötsch et al.	35			X
25	A distributed topology information system for optical networks based on the...	van der Ham et al.	35			
26	Effect of internal cost management, information systems integration, and...	Fayard et al.	33	X		
27	Accounting cost data disclosure and buyer-supplier partnerships...	Munday	33	X		
28	EDM: Earned Duration Management, a new approach to schedule...	Khamooshi & ...	32			
29	Framework for implementation of maintenance management in distribution...	Gómez Fernández et al.	31		X	
30	Comparing provider-customer constellations of visibility-based service	Holmström et al.	30		X	
31	Measuring downstream supply chain performance	Cirtita & Glaser-Segura	29			X
32	Strategic cost management in supply chains, part 1: structural cost...	Anderson & Dekker	28	X		
33	Management controls and inter-firm relationships: a review	Meira et al.	27	X		
34	Full-cost pricing rules within the National Health Service internal market...	Ellwood	27			
35	The complexity of management accounting change: bifurcation and...	Thrane	25	X		
36	Opening the black box of management accounting information exchanges in...	Caglio & Ditillo	24	X		
37	Third party assessment: the role of the maintenance function in...	Bamber et al.	24		X	
38	Interaction between management accounting and supply chain management	Ramos	23	X		
39	Integrating strategic cost management with a 3DCE environment: strategies...	Ellram & Stanley	22			X
40	Strategic cost management in supply chains, part 2: executional cost...	Anderson & Dekker	20	X		
41	On the convergence of management accounting and financial accounting...	Taipaleenmäki & ...	19			
42	Accounting in networks	Håkansson et al.	19	X		
43	Research issues on the use of ERPS in interorganizational relationships	Nicolaou	19	X		
44	New economy – new business models – new approaches	Walters	19			
45	Factors causing cost variation for constructing wastewater projects in Egypt	Aziz	18			
46	A Japanese case study of functional cost analysis	Yoshikawa et al.	18	X		
47	Modeling and multi-objective optimization of closed loop supply chains...	Bottani et al.	17			X
48	BIM in the operations stage: bottlenecks and implications for owners	Bosch et al.	17		X	
49	Trusting an auction	Griffiths	16			X
50	Open-book accounting: reason for failure of inter-firm cooperation?	Windolph & Möller	15	X		

*Note: C = Cost management focus, A = Asset management focus, S = Supply chain focus

Publication 1

Ylä-Kujala, A., Marttonen-Arola, S. & Kärri, T.

**Finnish “state of mind” on inter-organizational integration:
a cost accounting and cost management perspective**

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Finnish “state of mind” on inter-organizational integration:

a cost accounting and cost management perspective

ABSTRACT

Purpose – The role of management control is frequently emphasized in connection with inter-organizational relationships and value networks. For example, boundary-spanning cost and accounting control techniques have been studied in multifaceted empirical settings. The prevalence of such techniques is, however, currently unknown in conjunction with companies’ interests to increase inter-organizational integration in general. Additionally, also the nexus between the internal state of cost management and the company’s willingness to develop inter-organizational relationships requires further investigation. The paper aims to discuss these issues.

Design/methodology/approach – The study is based on an extensive survey that was responded to by more than 1500 CEOs and CFOs from large, medium-sized and small Finnish enterprises in a variety of industries. As the authors chose the mixed-methods approach, both quantitative and qualitative data were collected for the study.

Findings – The findings suggest that companies can be allocated to five clusters: “the cost experts”, “the trustful”, “the holdouts”, “the trailblazers” and “the uncertain”. When the networking-oriented clusters, “the trustful” and “the trailblazers” are combined, the authors can conclude that 40 percent of the studied companies are interested in increasing inter-organizational integration. However, only 7 percent have boundary-spanning techniques in use. There is also a correlation between interest in integrating and developing cost management.

Research limitations/implications – This paper contains several theoretical implications, although further research, e.g. comparative studies, is required to verify the findings. The scarcity of managerial implications can be regarded as a limitation.

Originality/value – This paper fills several untapped research gaps by studying inter-organizational integration in the cost management context from multiple, complementary perspectives with a particularly large set of data.

Keywords – Cost accounting, Cost management, Management control, Control techniques, Finnish survey, Inter-organizational relationships

Paper type – Research paper

1 INTRODUCTION

30 years have passed since “networks” were identified as the third form of organization alongside conventional “markets” and “hierarchies” (Håkansson 1982; Thorelli 1986). In the course of time, the nature of inter-organizational relationships has been metamorphosing from arm’s length transactions toward relational, and thus more complex interactions through subcontracting, outsourcing, alliances and joint ventures. This kind of development, which can be described as network formation, is increasingly challenging academics’ outlook on management control (see e.g. Dekker 2004; Håkansson & Lind 2007; Caglio & Ditillo 2008). Caglio and Ditillo (2008) emphasize that management control in the inter-organizational domain comprises three distinct layers; control archetypes, management control, and cost and accounting control. Out of these layers of control, this paper is focused specifically on cost and accounting control, which by definition transgresses organizational boundaries.

The tradition of inter-organizational cost and accounting control began in the 1990s and early 2000s by the introduction and application of management concepts, such as “open-book accounting” (OBA) (Munday 1992; Carr & Ng 1995; Seal et al. 1999; Mouritsen et al. 2001; Axelsson et al. 2002) and “inter-organizational cost management” (IOCM) (Cooper & Yoshikawa 1994; Carr & Ng 1995; Mouritsen et al. 2001; Axelsson et al. 2002; Cooper & Slagmulder 2004). OBA is a rather general approach, where costs and other supporting information are disclosed to a counterpart in a unilateral or a bilateral fashion. Reciprocal trust has been repeatedly mentioned as an important prerequisite for such transparency (Kajüter & Kulmala 2005). IOCM, on the other hand, can be described as a vacillating set of control techniques that are effectively based on target costing and functional analysis. These techniques are employed particularly in the upstream supply chain relations to influence the quality, functionality and/or price of a product, including, but not limited to, supplier selection, product design and manufacturing process development (Agndal & Nilsson 2009).

Later studies in the field have mainly followed in the footsteps of the early tradition. Both OBA (e.g. Kajüter & Kulmala 2005; Free 2008; Agndal & Nilsson 2010; Möller et al. 2011; Caglio & Ditillo 2012; Windolph & Möller 2012; Alenius et al. 2015) and IOCM (e.g. Agndal & Nilsson 2009; Möller et al. 2011; Fayard et al. 2012; Windolph & Möller 2012) have been the conceptual foundation of numerous distinguished publications. In addition to OBA and IOCM, certain authors have also associated the concept of “value chain analysis” (VCA) with the inter-organizational cost and accounting control (Dekker 2003; Coad and Cullen 2006). As perceived e.g. by Dekker (2003), VCA is a control technique in which the chain of consecutive inter-organizational activities – from raw materials to the end customer

– is broken down and observed by employing activity-based costing (ABC) principles. It has to be, however, underlined that drawing the line between the different concepts and somewhat parallel control approaches is not by any means straightforward. For example, the utilization of IOCM techniques may, or may not, require disclosure of costs and other accounting information (i.e. OBA), depending on the breadth of collaboration (Agndal & Nilsson 2009).

The above-mentioned literature on inter-organizational cost and accounting control is characterized by three idiosyncrasies. The first is the predominance of qualitative research. Most authors have applied the case study method by incorporating a single case study (e.g. Seal et al. 1999; Dekker 2003; Free 2008) or multiple case studies (e.g. Mouritsen et al. 2001; Kajüter & Kulmala 2005; Agndal & Nilsson 2010). Some have classified their specific approach as interventionist or action research, where the authors have influenced the outcome actively (e.g. Coad & Cullen 2006; Suomala et al. 2010; Romano & Formentini 2012). To date, quantitative data and corresponding analysis can be found in a relatively limited number of scientific publications (i.e. Ittner et al. 1999; Kulp 2002; Wouters et al. 2005; Möller et al. 2011; Fayard et al. 2012; Windolph & Möller 2012; Caglio & Ditillo 2012; Caglio 2017). Despite its merits, the qualitative research approach has also some shortcomings. On the basis of the literature, we know that boundary-spanning control techniques, such as OBA, IOCM and VCA, are currently used by practitioners. However, unknown are the prevalence of these techniques and companies' interest in advancing inter-organizational cost and accounting control in general.

The second idiosyncrasy of the literature on inter-organizational cost and accounting control is the limited understanding of the nexus between intra- and inter-organizational management control techniques. Dekker (2016) has recently called for more research on how internal management accounting practices might either support or constrain the development of inter-organizational relationships. Prior evidence indicates that a poor state of companies' internal costing systems is a barrier for OBA and IOCM (Seal et al. 1999; Kajüter & Kulmala 2005; Agndal & Nilsson 2009; Suomala et al. 2010; Fayard et al. 2012). In dyadic customer-supplier relationships, especially the customer could often dispense resources, knowledge, and assistance to improve suppliers' cost accounting (see e.g. Kajüter & Kulmala 2005). Therefore, the connection between the state of cost management, and the company's interest to develop more profound inter-organizational relationships should be investigated further.

The third idiosyncrasy of the literature on inter-organizational cost and accounting control is the dominance of customer-supplier relationships in the form of bilateral (one-to-one) or

multilateral arrangements (one-to-many / many-to-many). In their rather comprehensive review of the literature, Caglio and Ditillo (2008) point out that upstream relationships have been studied in abundance by contrast to downstream relationships and whole value chains. There are sparse examples of research settings that consist of both suppliers and customers simultaneously (e.g. Coad and Cullen 2006; Thrane & Hald 2006; Carlsson-Wall et al. 2009). The prevalence of studies on upstream relationships might stem from the use of specific control techniques, as for instance IOCM has been frequently associated with the supply chain and supplier management. There is thus a need for more complete network approaches.

By building upon the above-mentioned idiosyncrasies of inter-organizational cost and accounting control literature as specific issues of concern, our research questions are phrased as follows:

- RQ1:** *How can companies be categorized relative to their orientation to joint cost management, current state of cost management, and interest to develop cost management?*
- RQ2:** *What is the influence of organizational size and industry on the categorization of RQ1?*
- RQ3:** *What is the extent of the implementation/utilization of inter-organizational cost and accounting control techniques (e.g. tools, methods and information systems) in practice?*

RQ1 takes a stand on first and second idiosyncrasies. First of all, companies' inclination to advance inter-organizational management control, cost management control in particular, is mapped through a large set of quantitative data. This orientation to joint cost management is then linked, still within the same data set, to a company's "cost management strategy" that is represented by its current state of cost management, and its interest to develop cost management practices in the future. By connecting these three dimensions with each other, we are able to categorize organizations based on their similarities and dissimilarities. RQ2, on the other hand, is an extension of RQ1, where the influences of most significant background variables, organizational size and industry, are examined in detail.

RQ3 complements RQ1 by introducing another perspective to the first idiosyncrasy. As mentioned above, the prevalence of boundary-spanning control techniques is currently unknown. The question is phrased in such a way that "a technique" is understood as broadly as possible in the context of cost management, in order to include also other techniques than

OBA, IOCM and VCA. As far as the third idiosyncrasy is concerned, both upstream and downstream relationships have been acknowledged in the collection of data. When references are made to “network” or “value network”, they are composed of the closest inter-organizational relationships perceived by the respondent. The quantitative nature of the data has led us to examine the average relationship in each network of suppliers and customers.

According to Lind (2017), the role of accounting has been mostly neglected in the lengthy tradition of IMP (i.e. industrial marketing and purchasing) inspired research that is founded on the so-called “interaction approach”, which challenges the conventional understanding of industrial marketing and purchasing as purely transactional, and inherently dissimilar activities (Håkansson 1982). In the center of the IMP thinking is the idea that each business relationship is determined by the interplay between three fundamental elements; activity links, resource ties and actor bonds (Håkansson & Snehota 1995). In this sense, a natural way for IMP scholars is to understand activity links through the socio-material flow of reciprocal exchange (i.e. from purchasing to marketing). As accounting is the monetary value dimension of activities, resources and actors, and thus quintessential for the measurement, calculation, evaluation and representation of economic value and profitability in terms of money, its role as a particular kind of activity layer should be rather emphasized than ignored (Håkansson & Olsen 2015).

An important avenue within the broader IMP frame of research has been the study of resource ties in the interface between customers and suppliers (see e.g. Araujo et al. 1999; Håkansson & Waluszewski 2002; Baraldi & Strömsten 2006; Baraldi et al. 2012; Araujo et al. 2016). As no single company controls all required resources to produce goods and services, the management of resource interfaces both upstream and downstream becomes a critical task. Prenkert (2016), for instance, has recently argued that systematical commitment of resources to these interfaces is parallel to conducting “market investments”, the aim of which is to create, maintain or develop resource interfaces that can be seen as “market assets”, i.e. valuable network positions. The introduction of an inter-organizational cost and accounting control technique to any resource interface between a customer and a supplier is, therefore, a market investment of tangible (e.g. cost accounting system) and intangible nature (e.g. ancillary accounting knowledge). The prevalence of, and the interest towards, such investments are observed in the paper.

Finally, this paper contributes also to the prior, rich tradition of Finnish management accounting surveys (Lukka & Granlund 1996; Hussain et al. 1998; Malmi 1999; Hyvönen 2003; Hyvönen 2005; Laitinen 2006). Our evidence sheds new light on how cost

management has evolved in the past ten years. This paper is structured as follows: the research design is described in Section 2, the analysis and findings are discussed in Section 3, and discussion and conclusions connect the research questions explicitly with the key findings. Finnish viewpoints are considered shortly in the last section as well.

2 RESEARCH DESIGN

2.1 Data collection

This paper is based on an extensive survey that was carried out in Finland in late 2014. In the course of roughly two months (October and November), altogether 1507 responses were received from organizations ranging from small and medium-sized enterprises (SMEs) to large multinationals. The initial population of the companies that were contacted was around 3500, which yields a rather tolerable response rate of approximately 43 percent. The population of the survey was specifically chosen to include organizations from all industries in Finland relative to their reciprocal sizes. As far as organizational sizes are concerned, medium-sized and large enterprises were slightly favored in order to obtain more relevant, and interesting findings. Micro enterprises (i.e. companies that employ under ten employees) were intentionally excluded from the population before the data collection was initiated.

The data were collected by conducting structured interviews over the phone with the respondents, who were senior managers, mainly either CEOs (1103 respondents) or CFOs (403 respondents), in their respective organizations. The interviewers' call sequence was completely random, so that the actualized population would be as similar as possible with the designed population. The interviews were based on a questionnaire that comprised 24 claims (referred from now on as questions; Q1, Q2, Q3, etc.) on the Likert scale (1-5) and three open questions. The full structure of the questionnaire is shown in **Appendix 1**. The above-mentioned claims can be placed under three topics: "current business and cost accounting practices" (Q1-Q9), "cost management needs: cost accounting systems and related services" (Q10-Q18) and "inter-organizational relationships and transparency in value networks" (Q19-Q24). As regards the open questions (Q25-Q27), it should be noted that only Q27 is addressed in this paper, as the phrasing of the question is particularly relevant to RQ3.

The proportions of different organizational sizes and industries in relation with the total sample of the survey are illustrated in **Figure 1**. The categorization of organizational sizes comes from the pan-European definition of SMEs (European Commission 2017), whereas

the industries are based on the national Standard Industrial Classification TOL 2008 (Statistics Finland 2015). As can be noticed, the majority of the companies in the sample are small enterprises (approx. 64 percent). By excluding micro enterprises from the national statistics, small enterprises seem to account for 83 percent, medium-sized enterprises for 14 percent, and large enterprises for 3 percent of Finnish companies (Statistics Finland 2016). Therefore, medium-sized organizations (14 percent → 31 percent) as well as large organizations (3 percent → 5 percent) are overemphasized in the sample, and thus in the findings, roughly by a coefficient of two.

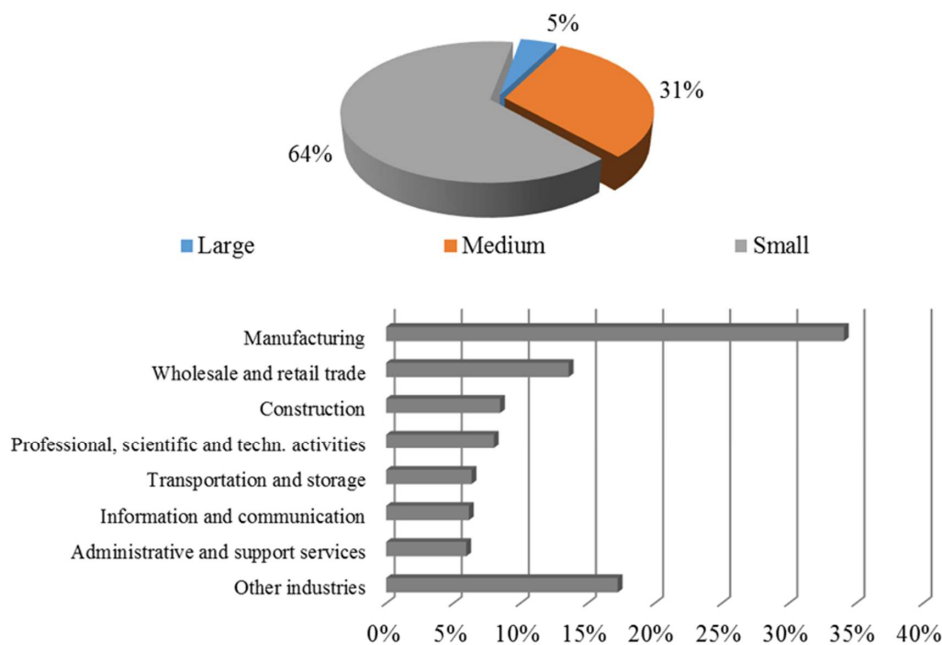


Figure 1. Overview of the background variables: organizational size and industry.

A quick glance at the industries in the sample of the survey reveals that “manufacturing” is evidently the largest industry (approx. 34 percent) followed by “wholesale and retail trade” (approx. 14 percent), and “construction” (approx. 9 percent). The miscellaneous group in the figure known as “other industries” is comprised of 11 separate, smaller industries, each constituting under 5 percent of the total sample. Three largest industries within the group

“other industries” are “human health and social work activities”, “financial and insurance activities”, and “electricity, gas, steam, and air conditioning”.

2.2 Descriptive statistics

A summary of the descriptive statistics is presented in **Table 1**. The highest means are found in Q3, Q5, Q8, Q9 and Q19, whereas Q14, Q16 and Q18 have the lowest means. The high mean in Q3 implies that an average Finnish company is satisfied with its information systems, including, but not limited to, cost accounting systems. The high mean in Q8 suggests that companies are also confident about their ability to determine the costs of different accounting items, such as customers. They seem to be particularly aware of the variable and direct costs of their products and services, as Q5 further clarifies. In the light of Q5 and Q8, the high mean in Q9 is not surprising. The pursuit of cost efficiency was defined as the most important business goal by quite many respondents. The highest mean is found in Q19 (approx. 4.48), which advocates for building long-term business relationships. Based on Q19 alone, it appears that Finnish companies have understood how important inter-organizational integration and different kinds of partnerships are in the present competitive conditions.

Table 1. Descriptive statistics.

Question	Mean	Median	SD	Variance
Q1	3.416	4	1.402	1.964
Q2	3.544	4	1.350	1.823
Q3	3.741	4	0.960	0.921
Q4	3.345	4	1.545	2.386
Q5	3.767	4	1.047	1.096
Q6	3.451	4	1.112	1.236
Q7	3.068	3	1.291	1.668
Q8	3.962	4	0.832	0.692
Q9	3.782	4	0.980	0.960
Q10	3.279	3	1.145	1.310
Q11	2.745	3	1.334	1.779
Q12	2.413	2	1.205	1.452
Q13	2.486	1	1.737	3.016
Q14	1.851	1	1.227	1.506
Q15	3.024	3	1.621	2.629
Q16	2.324	2	1.328	1.764
Q17	3.409	4	1.290	1.663
Q18	2.090	2	1.126	1.267

Q19	4.480	5	0.763	0.582
Q20	3.336	3	1.114	1.242
Q21	3.575	4	1.049	1.100
Q22	3.036	3	1.161	1.349
Q23	2.713	3	1.159	1.343
Q24	2.694	3	1.120	1.254

Furthermore, the low means in Q14, Q16 and Q18 imply that companies are currently reluctant to invest in new cost accounting systems (Q14) and cost accounting-related services (Q16 and Q18). The lowest mean is in Q14 (approx. 1.85), which indicates that the willingness to purchase systems is even lower among the companies than the willingness to acquire cost accounting-related services. Moreover, it seems that the low means are consistent with the high means. As Q5, Q8 and Q9 outlined, an average Finnish company could be described as “cost-conscious” and “cost-efficient”. Therefore, companies do not need new systems and related services to improve their already decent cost management practices. The greatest variances and thus standard deviations are found in Q13 and Q15, which means that some of the companies have also quite recently invested in new cost accounting systems (Q13) and cost accounting-related services (Q15), while others have not. The reluctance to invest in systems and services might thus stem either from a recent purchase or a feeling that the company is aware of its costs.

2.3 Research approach and methods

We decided on a mixed methods approach to be able to study the different sides of the phenomenon. Therefore, both quantitative (Q1-Q24) and qualitative data (Q25-Q27) were collected. According to Creswell (2015), the combination, and thus collective strength, of statistical trends (i.e. quantitative data) and personal experiences (i.e. qualitative data) provides more profound understanding than either form of data alone. From the three options to conduct mixed-methods research, this study adheres best to explanatory sequential design (ESD). Creswell (2015) states that the intent of ESD is to begin with a quantitative strand and then continue with a qualitative strand in order to explain the results of the former. Despite the fact that all our data were acquired simultaneously through the same instrument, the objective was from the beginning that the qualitative data would explain trends in the quantitative data.

The quantitative part of the study was conducted with SAS JMP Pro, which is a data-analysis software where conventional statistical models are complemented with advanced visualization and data mining capabilities. SAS JMP Pro might be an unorthodox tool to

conduct scientific research, but our choice was steered by the ability to generate better visualizations of the data. For the qualitative part of the study, a more unstructured approach was chosen. Each response to Q27 was categorized according to certain characteristics. The first basis of classification was the tone of the response (i.e. positive/negative), whereas the second basis of classification relied on the content and its finer nuances. This kind of an approach can be referred to as (qualitative) content analysis, in which the researcher searches for underlying themes from the data and illustrates them with e.g. brief quotations (Bryman & Bell 2011). Contrary to quantitative content analysis that relies on fixed coding, the equivalent process in the (qualitative) content analysis is more iterative by nature and initial categorizations often suggestive.

The analysis with SAS JMP Pro was initiated by examining correlations between the most significant background variables, such as organizational size and industry, and the questions (Q1-Q24). As such interrelationships did not exist, regression analysis was not perceived as a feasible approach. However, we noticed that many of the questions (Q1-Q24) had reciprocal correlations, which channeled our attention toward factor analysis. According to Ghauri and Grønhaug (2002), factor analysis is a method that addresses the problem of analyzing the structure of interrelationships (i.e. correlations) among a large number of variables by defining a set of common underlying dimensions (i.e. factors).

As the factoring method we used maximum likelihood combined with varimax rotation. We tried also quartimin in case the factors were oblique rather than orthogonal, but it did not affect the results. When the factors were set, the next logical step was to group the companies according to their factor-specific characteristics. We used k-means clustering as the method. After all, such grouping is based upon similarities or distances (i.e. dissimilarities) in an n-dimensional space (Ghauri & Grønhaug 2002). The definitive number of clusters was determined by experimenting in such a way that the adding of clusters was stopped when the characteristics of two clusters became excessively similar.

3 ANALYSIS, FINDINGS AND DISCUSSION

3.1 In search of reciprocal correlations: factor analysis

The foundation of cluster analysis is factor analysis, where sporadic survey questions are grouped to factors based on their reciprocal correlations. Our initial analysis resulted in five factors, of which two were rejected from further scrutiny. The first rejected factor comprised Q13 and Q15, and could be thus called e.g. “cost accounting systems and services purchased

recently”. The factor was eliminated because of its poor fit with the research questions. The second rejected factor comprised Q20 and Q21, and could be thus called e.g. “appreciation of transparency in cost structures and pricing”. Unlike the first rejected factor, this second one was content-wise relevant, but “appreciation” was considered too ambiguous conceptually. The decision to eliminate the factor was facilitated by the fact that the analysis resulted also in another factor that symbolized companies’ interest in joint cost management. The accepted factors are shown in **Table 2**. As can be noticed, each accepted factor incorporates at least three survey questions instead of two in the rejected ones, which grants them more strength of evidence.

Table 2. The accepted factors and their reciprocal correlations.

Ordinal/name of a factor →	Factor 1: “orientation to joint cost management”	Factor 2: “the current state of cost management”	Factor 3: “interest to develop cost management”
Questions included	Q22 + Q23 + Q24	Q5 + Q6 + Q7 + Q8	Q10 + Q12 + Q14 + Q16 + Q18
Mean in the survey sample	2.815 (Medium)	3.562 (High)	2.392 (Low)
Reciprocal correlations	Factor 2: 0.085 Factor 3: 0.386	Factor 1: 0.085 Factor 3: -0.131	Factor 1: 0.386 Factor 2: -0.131

Notes: low mean ≤ 2.50 ; $2.50 < \text{medium mean} < 3.50$; high mean ≥ 3.50

Factor 1: “orientation to joint cost management” is a measure of a company’s interest to increase inter-organizational integration through joint cost management. The mean of Factor 1 is medium, which indicates that an average Finnish company is reasonably interested in inter-organizational aspects, such as information disclosure and joint cost management. Factor 2: “the current state of cost management”, on the other hand, is a measure of a company’s overall cost consciousness achieved with the cost accounting techniques/principles in use (e.g. product/service costing). The mean of Factor 2 is high, which indicates that an average Finnish company has a good knowledge of costs and contemporary costing techniques, including ABC (Q7). Furthermore, Factor 3: “interest to develop cost management” is a measure of a company’s willingness to improve their current

cost management by investing in cost accounting systems and related services. The mean of Factor 3 is low, which indicates that an average Finnish company does not perceive improving cost management as topical. Interestingly, a lack of suitable software in the market (Q12) is correlated with an interest to invest in a new system (Q14), which denotes that all companies are not satisfied with their existing systems.






Regarding the reciprocal correlations of the factors, it is intriguing how the development of cost management practices (Factor 3) is interconnected with an interest to increase inter-organizational integration in the context of cost management (Factor 1). The high positive correlation between the factors (approx. 0.39) could even imply that companies seek for improvements in both intra- and inter-organizational practices. The correlation between Factor 2 and Factor 3 is negative (approx. -0.13), as expected. The weak nature of the correlation is, however, surprising. The only explanation is that there are certain companies that want to develop their cost management further, despite its good state.

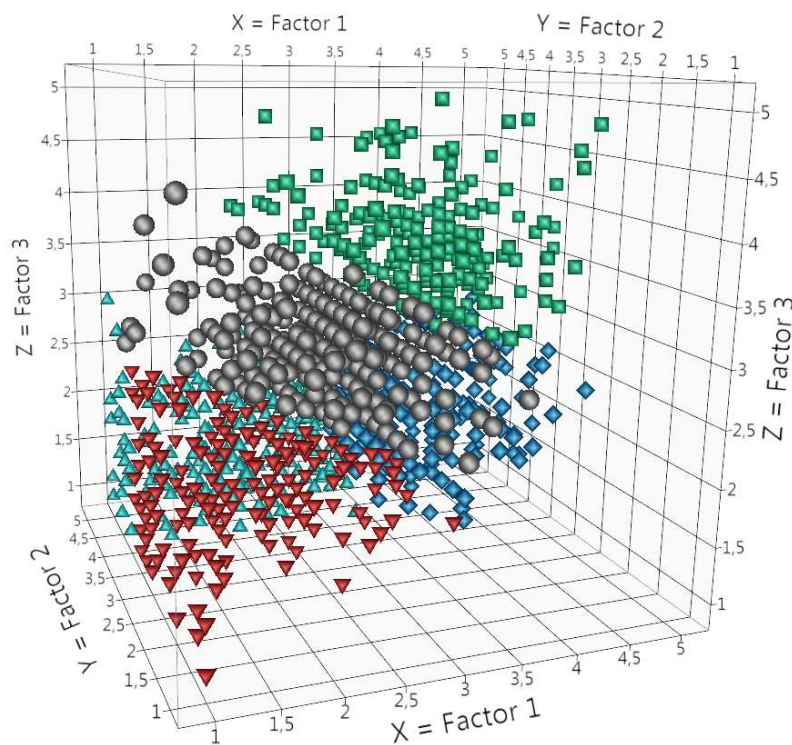
3.2 Categorizing companies: five distinctive clusters found

By employing the above-mentioned factor analysis as the premise, we were able to find five distinctive clusters of companies. As can be seen in **Table 3**, each identified cluster has been given a name that represents its factor-specific characteristics, such as low, medium or high interest to increase inter-organizational integration through joint cost management. The clusters are further illustrated in a three-dimensional space, where the factors function as axes of a cube ($X = \text{Factor 1}$; $Y = \text{Factor 2}$; $Z = \text{Factor 3}$). An individual respondent (i.e. company) has been associated with a cluster with an icon and a matching color. The N-column shows the total number of companies that belong to each cluster.

Three issues stand out immediately. First, the majority of companies appears to be situated in the background, which leaves the area of low Y-values mostly unoccupied. As discussed above, the knowledge of costs and related techniques is in general good. Sporadic dots in the foreground belong to either Cluster 3 or Cluster 5, which consequently also have the lowest states of cost management. Second, the positive correlation between Factor 1 and Factor 3 is visible in the figure, as the dots are diagonally aligned from the origin toward higher values on the X- and Z-axes. If Cluster 2 is excluded from the analysis, the reciprocal correlation becomes even stronger ($0.39 \rightarrow 0.60$). Third, companies' orientation to joint cost management seems to be relatively high in the survey sample. Almost 40 percent of the companies belong to the networking-oriented ones (Cluster 2 and Cluster 4), which is surprising.

Table 3. Clusters of companies based on their factor-specific characteristics.

Ordinal/name of a cluster ↓	X = Factor 1: “orientation to joint cost management”	Y = Factor 2: “the current state of cost management”	Z = Factor 3: “interest to develop cost management”	N
 Cluster 1: “the cost experts”	2.135 (Low)	4.178 (High)	1.711 (Low)	327
 Cluster 2: “the trustful”	3.696 (High)	3.794 (High)	2.142 (Low)	358
 Cluster 3: “the holdouts”	1.750 (Low)	2.824 (Medium)	1.791 (Low)	236
 Cluster 4: “the trailblazers”	3.707 (High)	3.488 (Medium)	3.660 (High)	240
 Cluster 5: “the uncertain”	2.652 (Medium)	3.295 (Medium)	2.823 (Medium)	346



Ylä-Kujala, A., Marttonen-Arola, S. & Kärrä, T. (2018). Finnish “state of mind” on inter-organizational integration: a cost accounting and cost management perspective, *IMP Journal*, Vol. 12, No. 1, pp. 171-191. Version of Record: <https://doi.org/10.1108/IMP-09-2016-0018> © Emerald Publishing Ltd.

Cluster 1: “the cost experts” (327 companies, 21.7 percent of the survey sample) is a group of companies that rank by far the highest in Factor 2 (approx. 4.18), which indicates that they are highly cost conscious. As a consequence, they are the least interested to develop cost management (approx. 1.71), which supports the impression of cost expertise. However, there might be another explanation. Some of these companies can also be excessively self-confident and even partly ignorant of the facts. They assume that everything is completely under control, and thus “the cost experts” do not feel the need to review their current cost management practices. If these companies truly excel in cost management, they would probably put more emphasis on the continuous improvement of cost accounting techniques as well.

Cluster 2: “the trustful” (358 companies, 23.8 percent of the survey sample) is a group of companies whose name originates from two considerations in particular. Similarly to Cluster 1, these companies are very confident about the current state of cost management. In contrast, however, “the trustful” are also interested in increasing integration within the value network, as they rank the second highest in Factor 1 (approx. 3.70). The reluctance to develop cost management is, however, common for both clusters, although “the trustful” are less absolute. The joint cost management orientation makes them intriguing.

Cluster 3: “the holdouts” (236 companies, 15.7 percent of the survey sample) is a group of companies that is not particularly cost-oriented, as they have the lowest mean in Factor 2 (approx. 2.82). The name of the cluster, “the holdouts”, is based on these companies’ negative approach to progress that is to some extent manifested in Factor 1 and Factor 3. Cluster 3 has by far the lowest mean in Factor 1 (approx. 1.75), which indicates that “the holdouts” are extremely cynical toward integration and joint cost management. When it comes down to Factor 3, it is rather peculiar how the managers of “the holdouts” resist change stubbornly, while the state of their cost management is poor compared to the other clusters.

Cluster 4: “the trailblazers” (240 companies, 15.9 percent of the survey sample) is a group of companies that is balanced in their attitudes to all the factors. They have the third highest cost consciousness (approx. 3.49), which might stem from an ability to assess their competences in cost management better. Cluster 4 ranks the highest in both Factor 1 (approx. 3.71) and Factor 3 (approx. 3.66) in the survey sample. Unlike “the trustful”, “the trailblazers” are also interested in developing their cost management practices.

Cluster 5: “the uncertain” (346 companies, 23.0 percent of the survey sample) is a group of companies that are conspicuously indecisive and neutral in regard to all measures. Despite this somewhat striking neutrality, “the uncertain” have the second highest mean in Factor 3

(approx. 2.82), which indicates that they are more willing to develop cost management in comparison to the other clusters. However, the reluctance of the others makes “the uncertain” look more interested than they actually are.

The data show that an inter-organizational emphasis is characteristic especially for “the trustful” and “the trailblazers”, consisting of 40 percent of the surveyed companies. There is, however, one notable difference between these two clusters, which can be demonstrated by adopting the ARA framework (activity links, resource interfaces and actor bonds) perspective (Håkansson & Snehota 1995) as illustrated in **Table 4**. Both clusters seem to recognize the importance of resource interfaces, which is manifested in the joint cost management orientation (Factor 1) and thus willingness to implement inter-organizational cost and accounting control techniques. By contrast, only “the trailblazers” are interested to develop cost management (Factor 3). As far as activity links are concerned, this may be problematic for “the trustful” as the dissimilarity of cost accounting practices (and internal accounting activity) constrains network-level cost management opportunities (Kulmala et al. 2002; Suomala et al. 2010; Caglio 2017). As a consequence, achieving deeper actor bonds in the cost accounting and cost management context becomes a challenge for “the trustful”, whereas “the trailblazers” have better premises for maintaining established connections as well as increasing integration to new directions.

Table 4. Networking-oriented clusters: the ARA framework perspective.

ARA dimension	Cluster 2: “the trustful”	Cluster 4: “the trailblazers”
Activity links	↓	↑
Resource interfaces	↑	↑
Actor bonds	Moderate, but challenging	Good state/potential

3.3 Going deeper into the clusters: the influence of organizational size and industry

The essence of each company in the data set is defined by the two significant background variables: organizational size and industry. When the analysis is taken to the level of these background variables, the idea is to reveal underlying differences and distinctions among the clusters in relation to the total sample of the survey. Only the most intriguing anomalies are,

however, emphasized separately and discussed in detail. A complete breakdown of organizational sizes (i.e. small, medium-sized and large enterprises) and the seven largest industries is shown, cluster by cluster, in **Appendix 2**.

As far as large enterprises are concerned, their proportion is highlighted specifically in “the trailblazers”. This is only logical, as larger companies have more disposable resources to develop their cost management practices and joint cost management techniques constantly in the inter-organizational domain. In addition to resources, the intensity of competition may also drive larger companies to progress continuously. On the other hand, the likelihood of finding a large enterprise in “the cost experts” is notably reduced. If the explanation that “the cost experts” are excessively self-confident is accepted, it makes sense that larger size increases self-awareness in terms of being able to assess one’s competencies better. Another possibility is that large enterprises need to integrate more with other companies, which would not only explain their diminished share in “the cost experts”, but in “the holdouts” as well.

On the basis of the findings on large enterprises, organizational size seems to correlate with an interest to develop cost management practices and increase inter-organizational integration, but we should not jump to any conclusions, because medium-sized enterprises would prove us wrong. They are less represented in “the trailblazers” and have a higher share in “the cost experts”. Medium-sized companies are less represented also in “the holdouts”, which indicates that they are a more diverse group than large enterprises, as “the holdouts” can be easily regarded as antithetical to “the trailblazers”. The heterogeneity might be explained by the fact that the definition of “medium-sized enterprise” is actually quite broad. Some of these companies operate only on the domestic market, whereas others export goods globally.

Small enterprises stand especially out in “the holdouts”, but are highlighted also in the networking-oriented clusters, “the trustful” and “the trailblazers”. It should be acknowledged that small enterprises are companies with diverging ambitions. On one hand, we have rapidly growing technology start-ups, and on the other hand stagnant family businesses. The start-ups are modern, enthusiastic companies that can be found among “the trustful” and “the trailblazers”, which are disassociated only by their dissimilarity in the interest to develop cost management. The family businesses belong more likely to “the holdouts”, as their old-timer CEOs are resistant to change.

As regards the industries, we concentrate here exclusively on “manufacturing”, “wholesale and retail trade”, “construction”, and “information and communication”, because the most substantial differences and distinctions are found among them. The largest industry is, by far,

“manufacturing” (514 companies, 34.1 percent of the survey sample), the proportion of which is high in “the uncertain” and “the trustful”, and reduced in “the trailblazers” and “the holdouts”. There is a lot of indecisiveness among manufacturing companies, as they emerge most among “the uncertain”. This might stem from intensified competition and increased customer demands. As an industry, it is mostly comprised of small upstream companies established around the original founder/proprietor. Therefore, it is surprising that “manufacturing” is actually less represented in “the holdouts”.

The second largest industry is “wholesale and retail trade” (205 companies, 13.6 percent of the survey sample). These companies have an increased proportion in “the holdouts” and “the trailblazers”, and decreased proportion in “the uncertain” and “the trustful”. Some wholesale and retail trade companies are networking-oriented, and they seek to improve their cost management practices as well, as “the trailblazers” are favored instead of “the trustful”. Given the position of “wholesale and retail trade” in the value chain, it is only natural that inter-organizational relationships with the upstream and downstream counterparts are accentuated. All things considered, it looks like “manufacturing” and “wholesale and retail trade” stand out from exactly opposite clusters. In the latter, the high proportion in “the holdouts” could be explained by a large number of small convenience stores and boutiques.

The third largest industry is “construction” (128 companies, 8.5 percent of the survey sample), which is highlighted in “the uncertain” and “the cost experts”. In addition, it has also a reduced share in the remaining clusters, i.e. “the trailblazers”, “the holdouts” and “the trustful”. Construction companies operate in an unsteady environment, where their livelihood is often reliant on obtaining new building projects constantly. Under such circumstances, cost expertise is helpful for drawing up tenders that are both cost efficient and competitive. On the other hand, some companies may also be overwhelmed by the situation, which is shown as increased uncertainty, positioning them thus in the cluster “the uncertain”.

“Information and communication” (93 companies, 6.2 percent of the survey sample) is not the fourth largest industry, but an interesting one, as its proportion fluctuates a lot among the clusters. “The holdouts” are saturated with information and communication companies, whereas “the trailblazers” and “the uncertain” lack them. As technology companies are easily labeled as some kind of forerunners in contemporary business solutions, their proportional increase in “the holdouts” is very surprising. It may be that the margins in “information and communication” are so good that most companies in the industry are accustomed to the “rule of thumb”, and do not thus need sophisticated cost accounting systems.

3.4 Prevalence of inter-organizational cost and accounting control techniques

In addition to the quantitative data that were employed in the above-mentioned factor and cluster analyses, qualitative data were collected from the respondents with Q27 in order to understand how common inter-organizational cost and accounting control techniques are in the companies. We have classified the responses to Q27 into five categories that are presented in **Figure 2**. The first basis of classification was the tone of the response, which is interpreted as being either positive or negative to the question; “Does your company have any network-level cost accounting tools, methods or even systems in place?” By following this logic, the data set contains 393 positive responses and 1114 negative ones. The second basis of classification relied on the content, and also on the finer nuances of each individual response.

The positive responses comprise three categories: Category 1: “technique is named and/or its purpose of use is explained in detail”, Category 2: “claims to have, but response is ambiguous and/or incoherent”, and Category 3: “has misunderstood the question, only internal techniques in use”. The negative responses comprise two additional categories: Category 4: “has something, but not necessarily in the cost management context”, and Category 5: “does not have, does not know, or does not want to comment”. The last category was straightforward to put together, because the majority of the respondents in Category 5 phrased their answer simply as “no” (991/1082 respondents).

Even though the positive side accounts roughly for 26 percent of the companies, the prevalence of inter-organizational cost and accounting control techniques is significantly lower. A closer look reveals that techniques are found specifically in those companies that belong to Category 1, which denotes that around 7 percent of the companies have actually something tangible to facilitate collaboration in the value network. As far as the clusters are concerned, the networking-oriented ones stand out in Category 1. The proportions of “the trustful” (23.8 percent → 34.8 percent) as well as “the trailblazers” (15.9 percent → 19.6 percent) are both elevated in relation to the total sample. This observation holds true equally for Category 2, where some of the companies may also have inter-organizational cost and accounting control techniques in use. The issue with Category 2 is, however, the ambiguity of the respondents. Overall, it seems that “the trustful” and “the trailblazers” are consistently highlighted more on the positive than the negative side, which indicates that the outlook of these companies is more optimistic and forward-looking in general.

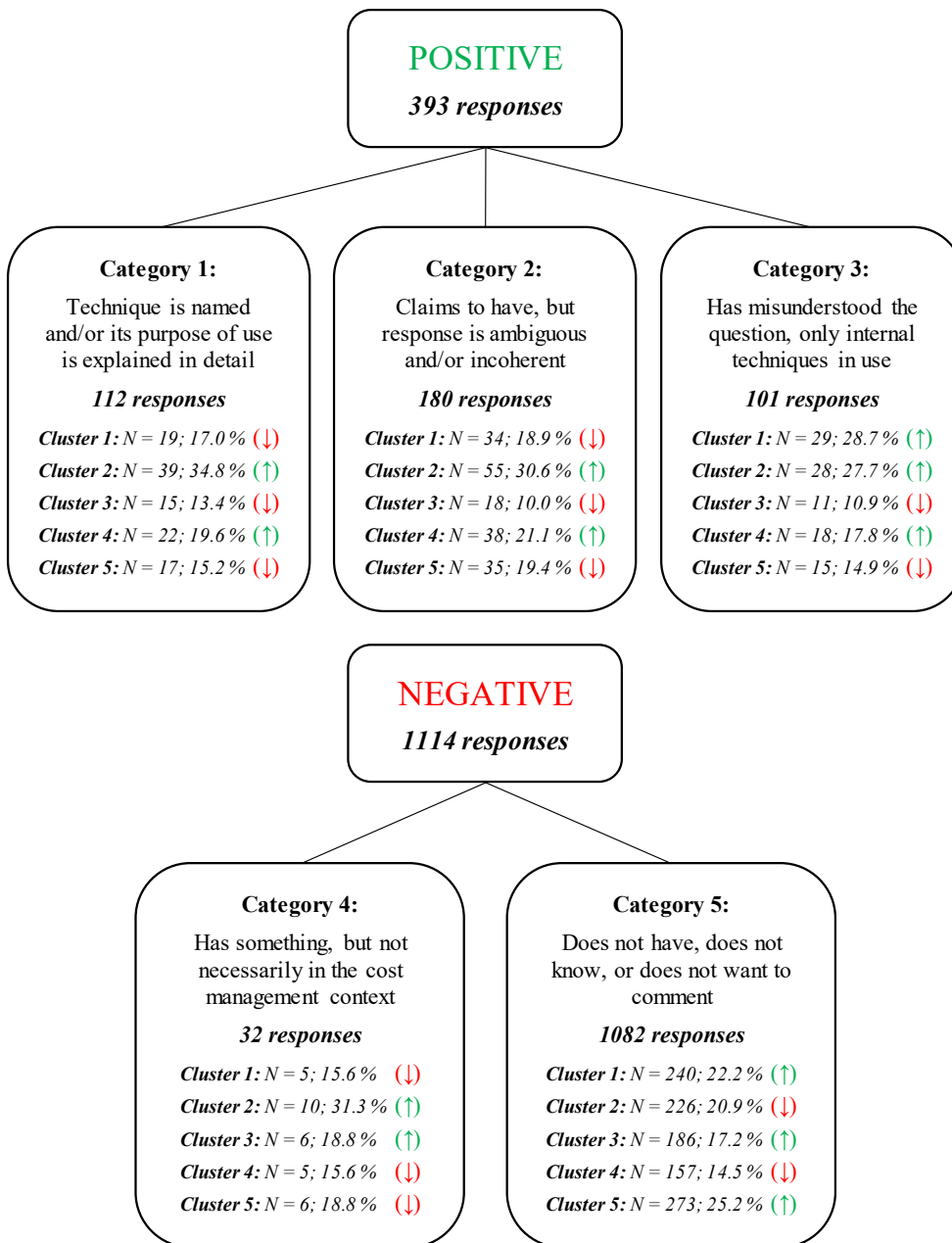


Figure 2. Categorization of the responses on Q27.

The following three exemplifying citations have been selected from Category 1. The first one states:

“We share Excel-sheets that contain information about unit production costs with our customers. What we do not have, however, is an actual information system that both parties would have access to.” – CFO of a small plastics manufacturer (Cluster 2: “the trustful”)

The first example describes a situation where the supplier discloses cost information to its customers in the form of unit production costs on spreadsheets. Based on the citation alone, it would seem that the collaboration relies on the supplier’s willingness to disclose information unilaterally to the customers. Similar settings with a simple information sharing tool in the inter-organizational interface were described in several responses in Category 1. The second citation states:

“Yes. We have certain strategic partners with whom information is disclosed in an open-book manner. We have developed collaborative reporting practices for this.” – CFO of a medium-sized electricity trading company (Cluster 4: “the trailblazers”)

In the second example, the companies have established a systematic method to disclose information. This was actually the only response where OBA was clearly identified as a concept to disclose information, which means that it is not part of managers’ daily language. In comparison to the first example, the relationships in the second example appear to be deeper, as there are “reporting practices” in place, and the respondent also refers to “certain strategic partners”. The third citation states:

“Our information system specialists have built a system that is suitable for the specific needs of our industry. It is based mainly on the idea of customer relationship management.” – CEO of a medium-sized transportations operator (Cluster 2: “the trustful”)

The company in the third example has developed an information system that is targeted at managing downstream rather than upstream relationships. Interestingly, a number of respondents in Category 1 mentioned that they were employing self-made or tailored information systems. In this specific example, however, the response is so vague that the purpose of the use of the system is very difficult to assess. It is also entirely possible that the referred system has nothing to do with cost management.

In addition to the above-mentioned examples, two more citations were selected, one from Category 2 and another from Category 3, to illustrate ways to misunderstand Q27. The former citation states:

“Yes, of course! In practice, I am able to access our network even from my summer cottage.” – CFO of a large specialized construction activities company (Cluster 1: “the cost experts”)

The first additional citation demonstrates how the meaning of “network” can be misunderstood despite the general context of the survey. Whereas this is an extreme example, other responses in Category 2 were much harder to interpret in terms of the technique described. That being said, it is still remarkable that large company CEOs and CFOs mix up these terminologies, especially when the preceding questions (Q19-Q24) had covered the subject matter from the inter-organizational perspective.

The other additional citation from Category 3 states:

“We have shared and integrated information systems within our group.”
– CFO of a large regional supermarket cooperative (Cluster 3: “the holdouts”)

As can be seen in Category 3 as a whole, surprisingly many of the senior managers perceive consolidated corporation as a synonym for their “value network” (101 respondents), which is the case also in the citation above. The nature of grocery retailing in Finland may explain why the term “network” is associated with consolidated corporation in this particular case. As there are two large supermarket cooperatives with nationwide coverage, synergies are actively sought among the regional branches.

4 CONCLUSIONS AND IMPLICATIONS

The factor analysis resulted in five factors three of which were eventually accepted: Factor 1: “orientation to joint cost management”, Factor 2: “the current state of cost management”, and Factor 3: “interest to develop cost management”. Based on these three factors, five distinctive clusters of companies were identified from the data: Cluster 1: “the cost experts”, Cluster 2: “the trustful”, Cluster 3: “the holdouts”, Cluster 4: “the trailblazers” and Cluster 5: “the uncertain”. These clusters form the answer to the following research question:

RQ1: *How can companies be categorized relative to their orientation to joint cost management, current state of cost management, and interest to develop cost management?*

As far as inter-organizational integration is concerned, “the trustful” and “the trailblazers” turned out to be the most intriguing clusters, as they both had a high mean in Factor 1 (~ 3.7). “The holdouts”, on the other hand, were a pessimistic group of companies that resist change, joint cost management included. When the networking-oriented clusters, “the trustful” and “the trailblazers”, were combined, it could be stated that almost 40 percent of the companies were willing to increase inter-organizational integration in the value network. It was further discovered that an interest to integrate (Factor 1) and develop cost management practices (Factor 3) were highly correlated (~ 0.4). The reciprocal correlation between these factors became even stronger when “the trustful” were excluded from the analysis (~ 0.6).

When a closer look was taken into organizational sizes and industries, it was noticed that there were certain differences among the clusters. Large enterprises stood out especially from “the trailblazers”, medium-sized enterprises from “the cost experts”, and small enterprises from “the holdouts”. Moreover, differences were identified particularly on four industries, including “manufacturing”, “wholesale and retail trade”, “construction”, and “information and communication”. The proportion of manufacturing companies seemed to be elevated in “the uncertain” and “the trustful”, and reduced in “the trailblazers” and “the holdouts”, which was exactly opposite to “wholesale and retail trade”. Construction companies, on the other hand, were highlighted in “the uncertain” and “the cost experts”. Surprisingly, the forward-looking “information and communication” stood out from the most change-resistant group of companies, “the holdouts”. The above-mentioned distinctions form the answer to the following research question:

RQ2: *What is the influence of organizational size and industry on the categorization of RQ1?*

Unlike the finding that a high portion of the companies wanted to increase inter-organizational integration could imply, only a few of them had already implemented/were utilizing inter-organizational cost and accounting control techniques. At the same time, it should be acknowledged that also well-designed intra-organizational accounting supports the relationship formation and consequential integration (Håkansson & Lind 2004). Based on the responses to Q27 (“Does your company have any network-level cost accounting tools, methods or even systems in place?”), it seemed that around 7 percent of the companies were employing boundary-spanning control techniques. A positive response was given by 26 percent of the respondents, but many of them had either misunderstood the question or were otherwise too ambiguous about the technique in question. The breakdown of Q27 forms the answer to the following research question:

RQ3: *What is the extent of the implementation/utilization of inter-organizational cost and accounting control techniques (e.g. tools, methods and information systems) in practice?*

When the results of the cluster analysis were compared with the responses to Q27, it could be stated that there was some disparity between the rhetoric and the current state of affairs. The companies, especially those in “the trustful” and “the trailblazers”, were interested to increase inter-organizational integration through joint cost management. This orientation did not yet manifest itself, as only a small portion of the companies had inter-organizational cost and accounting control techniques already in place.

Regarding the prior tradition of Finnish management accounting surveys, a few aspects should be briefly emphasized in comparison. According to Lukka and Granlund (1996), 20 years ago Finnish product costing principles were dominated by variable costing over full costing and a mixed approach. Based on our survey, it appears that this past situation has now changed, as the mean of Q5 (i.e. variable/direct costing) as well as that of Q6 (i.e. fixed/indirect costing) were both relatively high. It should be noted that the sample of Lukka and Granlund (1996) was comprised exclusively of large and medium-sized enterprises, which may have slightly accentuated the more comprehensive costing approaches.

However, the state of cost management has improved significantly in Finland, which was shown in the high mean of Factor 2 (~ 3.6). One of the reasons behind increased cost consciousness was apparently the rise of ABC in the organizations. The use of ABC principles (Q7) correlated with Q5 and Q6, and also with Q8 (i.e. ability to determine the costs of different accounting items), as these questions are the four constituents of Factor 2. Previous studies have reported mainly on low adoption rates of ABC, ranging from 5 to 27 percent (Lukka & Granlund 1996; Hussain et al. 1998; Malmi 1999; Hyvönen 2003). Even though the equivalent rate was over 80 percent in the study of Hyvönen (2005), the companies did not perceive ABC as particularly beneficial. Now, ten years later, it seems that ABC contributes for a good state of cost management as a constituent of sound accounting practice.

This paper contains several theoretical implications. First of all, both the extent of companies’ interest to increase inter-organizational integration in value networks (i.e. orientation to joint cost management), and the prevalence of cost and accounting control techniques were mapped in the survey. The high reciprocal correlation between an interest to integrate (Factor 1) and develop cost management practices further (Factor 3) is a novel finding. Based on the cluster analysis, we claim that companies can be allocated to five distinctive clusters

according to their orientation to joint cost management, the current state of cost management, and the interest to develop cost management. Moreover, Dekker (2016) has recently called for more evidence on how internal management accounting practices might support or constrain companies in developing inter-organizational relationships. Our findings suggest that a good state of cost management (Factor 2) is also a requirement for a joint cost management orientation (Factor 1), as “the trailblazers” and “the trustful” can be both regarded as very cost-conscious groups of companies.

Regarding the IMP research tradition, this paper furthers the understanding of the role of (cost) accounting in the inter-organizational domain. A decision to invest in inter-organizational cost and accounting control can be seen as a concrete action to create, maintain or develop resource interfaces among network actors, and a prior “state of mind” to such a decision is the willingness to increase integration. Our approach to interaction and integration is, however, limited in a sense of typologies developed by IMP scholars (Abrahamsen & Håkansson 2015; Håkansson & Ford 2016). A strong orientation to joint cost management in certain clusters can be interpreted as an effort to transition from business duels toward business duets (cf. Håkansson & Ford 2016) and from pure exchange toward full integration (cf. Abrahamsen & Håkansson 2015). Further research could thus address what type of relationship (e.g. a long-term duet) is the threshold for accounting information exchanges to take place.

The scarcity of managerial implications can also be regarded as a limitation. Of course, the clusters, the influence of organizational size and industry to clustering, and the prevalence of inter-organizational cost and accounting control techniques might be of some interest to managers. Another minor limitation is related to the data. Despite the fact that the data set was exceptionally large, it was still collected exclusively from Finnish organizations, which affects its generalizability. We also recognize that certain limitations stem from the selected research approach and the employed methods.

Finally, further research, e.g. comparative studies, are needed to verify our key findings, including the clusters. We are confident that similar categories can be found in other countries as well. After all, it has been previously highlighted that management accounting practices are rather converging than diverging in Europe (Shields 1998; Macintosh 1998) as well as globally (Granlund & Lukka 1998). Moreover, it would be interesting to see whether or not the prevalence of inter-organizational cost and accounting control techniques is higher elsewhere. All things considered, we think that more survey-based evidence is still needed in the crossroads of inter-organizational relationships and cost management.

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APPENDIX 1

- Q1.** Our products and/or services are mainly standardized by nature
- Q2.** We have illustrated our business processes within the last five years
- Q3.** Our information systems support our business processes well
- Q4.** We enter working hours systematically to an electronic system
- Q5.** We know the variable or direct costs that are allocated to a product or a service
- Q6.** We know the fixed or indirect costs that are allocated to a product or a service
- Q7.** We employ activity-based costing principles in our company
- Q8.** We are able to determine the costs of different accounting items (e.g. profit centers, product lines, customers... etc.)
- Q9.** Pursuing cost efficiency is the most important goal in our business

- Q10.** Through improved cost-consciousness, we would be able to develop our operations significantly
- Q11.** A spreadsheet program (e.g. Microsoft Excel) is an adequate tool for our cost accounting needs
- Q12.** We think that the markets lack a suitable software for cost accounting and profitability management
- Q13.** We have purchased a cost accounting system within the last five years
- Q14.** We are considering to purchase a cost accounting system in the near future
- Q15.** We have purchased cost accounting-related services (e.g. training or consulting) within the last five years
- Q16.** We are considering to purchase cost accounting-related services (e.g. training or consulting) in the near future
- Q17.** We prefer a comprehensive solution for cost accounting and profitability management (i.e. a software combined with training and consulting) to a plain cost accounting system.
- Q18.** We are interested in an analysis about the state of our cost accounting and profitability management made by external professionals

- Q19.** We build long-term relationships systematically with our business partners
- Q20.** Our customers appreciate especially the transparency of our cost structure and pricing
- Q21.** We appreciate especially the transparency of suppliers' cost structure and pricing
- Q22.** With joint cost accounting, we could improve the efficiency and competitiveness of our current value network
- Q23.** We are willing to deepen the collaboration of our current value network by disclosing cost structures and cost information bilaterally with others
- Q24.** We think that transparent disclosure of cost structures and cost information is realistic, at the moment or in the near future, in our current value network

- Q25.** What are the main characteristics of the systems and the services that could improve cost accounting and profitability management in your company?
- Q26.** What are the greatest challenges and/or obstacles in purchasing, implementing and maintaining a functioning and effective cost accounting system?
- Q27.** Does your company have any network-level cost accounting tools, methods or even systems in place? If you do, what are they and their main characteristics?

APPENDIX 2

TOTAL SAMPLE OF THE SURVEY		CLUSTER 1: 'THE COST EXPERTS'																																																																																											
<p>Proportion: Large ■ Medium ■ Small</p>		<p>Proportion: Large ■ Medium ■ Small</p>																																																																																											
<table border="1"> <tr> <td>Manufacturing</td> <td>514</td> <td>34.1 %</td> <td></td> </tr> <tr> <td>Wholesale and retail trade</td> <td>205</td> <td>13.6 %</td> <td></td> </tr> <tr> <td>Construction</td> <td>128</td> <td>8.5 %</td> <td></td> </tr> <tr> <td>Professional, sci. and techn. activities</td> <td>121</td> <td>8.0 %</td> <td></td> </tr> <tr> <td>Transportation and storage</td> <td>96</td> <td>6.4 %</td> <td></td> </tr> <tr> <td>Information and communication</td> <td>93</td> <td>6.2 %</td> <td></td> </tr> <tr> <td>Administrative and support services</td> <td>90</td> <td>6.0 %</td> <td></td> </tr> <tr> <td>Other industries</td> <td>260</td> <td>17.3 %</td> <td></td> </tr> <tr> <td>Total:</td> <td>1507</td> <td>100 %</td> <td></td> </tr> </table>		Manufacturing	514	34.1 %		Wholesale and retail trade	205	13.6 %		Construction	128	8.5 %		Professional, sci. and techn. activities	121	8.0 %		Transportation and storage	96	6.4 %		Information and communication	93	6.2 %		Administrative and support services	90	6.0 %		Other industries	260	17.3 %		Total:	1507	100 %		<table border="1"> <tr> <td>Manufacturing</td> <td>111</td> <td>33.9 %</td> <td>-0.2</td> <td>-0.5 %</td> </tr> <tr> <td>Wholesale and retail trade</td> <td>50</td> <td>15.3 %</td> <td>1.7</td> <td>12.4 %</td> </tr> <tr> <td>Construction</td> <td>32</td> <td>9.8 %</td> <td>1.3</td> <td>15.2 %</td> </tr> <tr> <td>Professional, sci. and techn. activities</td> <td>25</td> <td>7.6 %</td> <td>-0.4</td> <td>-4.8 %</td> </tr> <tr> <td>Transportation and storage</td> <td>21</td> <td>6.4 %</td> <td>0.1</td> <td>0.8 %</td> </tr> <tr> <td>Information and communication</td> <td>22</td> <td>6.7 %</td> <td>0.6</td> <td>9.0 %</td> </tr> <tr> <td>Administrative and support services</td> <td>19</td> <td>5.8 %</td> <td>-0.2</td> <td>-2.7 %</td> </tr> <tr> <td>Other industries</td> <td>47</td> <td>14.4 %</td> <td>-2.9</td> <td>-16.7 %</td> </tr> <tr> <td>Total:</td> <td>327</td> <td>100 %</td> <td></td> <td></td> </tr> </table>		Manufacturing	111	33.9 %	-0.2	-0.5 %	Wholesale and retail trade	50	15.3 %	1.7	12.4 %	Construction	32	9.8 %	1.3	15.2 %	Professional, sci. and techn. activities	25	7.6 %	-0.4	-4.8 %	Transportation and storage	21	6.4 %	0.1	0.8 %	Information and communication	22	6.7 %	0.6	9.0 %	Administrative and support services	19	5.8 %	-0.2	-2.7 %	Other industries	47	14.4 %	-2.9	-16.7 %	Total:	327	100 %											
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Publication 2

Ylä-Kujala, A., Marttonen, S., Kärri, T., Sinkkonen, T. & Baglee, D.

**Inter-organisational asset management:
linking an operational and a strategic view**

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Inter-organisational asset management: linking an operational and a strategic view

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Abstract: Interconnections and interdependencies are increasing globally. The formation of inter-organisational relationships is a result of the wide-ranging phenomenon of networking. When traditional organisational boundaries are blurred, many challenges arise in coordination and management. They can, however, be addressed by emphasising inter-organisational cost and asset management, a concept novel to the literature. We also claim that companies are able to realise concrete benefits from such joint actions, especially in the long-term. The main objective of the paper is to demonstrate the benefits of inter-organisational asset management on the operational and strategic level with our asset management models. Two focal conclusions emerge. Firstly, we exemplify, and prove, that companies can create economic value collaboratively on either, the operational or the strategic level. Secondly, the cause-and-effect relationship between operational decisions and strategic outcomes is highlighted by integrating the two levels of inter-organisational asset management. Managerial implications can be drawn from both.

Keywords: inter-organisational asset management; IOAM; operational asset management; strategic asset management; industrial maintenance; networks; value creation; economic value; modelling; inter-organisational cost management; IOCM; open-book accounting.

Reference to this paper should be made as follows: Ylä-Kujala, A., Marttonen, S., Kärri, T., Sinkkonen, T. and Baglee, D. (2016) 'Inter-organisational asset management: linking an operational and a strategic view', *Int. J. Process Management and Benchmarking*, Vol. 6, No. 3, pp.366–385.

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Timo Kärri is a Professor at the School of Business and Management, Lappeenranta University of Technology, Finland. He received his DSc (Tech.) in Industrial Management in 2007. His dissertation considered timing of capacity changes in capital intensive industries and his current research interests include capital, capacity and cost management.

Tiina Sinkkonen is a University Lecturer at the School of Business and Management of Lappeenranta University of Technology, Finland. She has been teaching cost management and currently, she is doing her doctoral dissertation. Her research interests are focused on maintenance cost models and life-cycle costing.

David Baglee gained his PhD from the University of Sunderland in 2005. He is a Senior Lecturer and Project Manager at the University of Sunderland, UK and Visiting Professor in Operations and Maintenance at the University of Luleå, Sweden. His research interests include the use of advanced maintenance techniques and technologies to support small businesses and maintenance within ultra-low carbon technologies including wind turbines, electric vehicles and hydrogen fuel cells.

1 Introduction

We live in a globalised society that is highly interconnected and interdependent both physically and virtually via the ever-growing internet, and industrial organisations are no exception to the rule. Fierce global competition in most traditional industries has forced companies to concentrate more on their core competencies and thus collaborate with other organisations, which has ultimately led to the formation of complex business networks (e.g., Shalij et al. 2009; Meira et al. 2010; Caglio and Ditillo 2012). There are several ways to establish an inter-organisational relationship between two legally independent companies, outsourcing of internal activities being a predominant one. In practice, most moderately sized organisations have nowadays outsourced at least one of their activities to an external service provider. Clearly, a burden of someone else is a core competence to others, and thus the literal basis of their existence. For instance, the entire maintenance service industry has originated from the willingness of industrial manufacturers to outsource (e.g., Campbell, 1995; Martin, 1997; Lavery, 1998; Al-Turki,

2011) the maintenance of fixed assets, e.g., plants and machinery. Moreover, industrial maintenance is just a small part of a greater framework called asset management that incorporates a variety of asset-related tasks and decisions within an organisation, or alternatively in the inter-organisational interface (e.g., Ahonen et al., 2010). That being said, industrial maintenance is contextually the operating environment in this paper, and asset management is the factual subject.

The continuous increase in inter-organisational relationships and networking will eventually blur organisational boundaries (Håkansson and Lind, 2004), which naturally, but unfortunately, easily creates confusion and conflicts between the collaborating partners. Yet, the economic success of these companies may depend greatly on enhancing network coordination and joint management, and thus overcoming anything and everything that hinders collaboration is essential. The grown demand for inter-organisational transparency and openness of formerly internal, and sensitive data are arguably eminent topics in the area, and also potential sources for the above-mentioned disagreements. The method for disclosing multifaceted cost data and other information from one company to another is known as open-book accounting (e.g., Seal et al. 1999; Kajüter and Kulmala 2005; Kumra et al., 2012). Particularly small companies are wary of data misuse and abuse conducted by their larger and more powerful partners, who could opportunistically monopolise also the benefits offered by the openness (Windolph and Möller, 2012). However, a certain level of transparency is a prerequisite for inter-organisational cost management (IOCM), which has been emphasised as an important tool in improving coordination and management in networked environments (e.g., Axelsson et al., 2002; Coad and Cullen, 2006; Fayard et al., 2012). We argue that companies are able to create tangible value by implementing open-book accounting as a part of inter organisational cost management in their business networks. At the same time, it is also important that the benefits are shared equitably, not necessarily equally, between the companies. Even though organisations are rather interdependent these days, the sharing of data and information is not often reality.

All things considered, we claim that networked companies should acknowledge, for the sake of mutual competitiveness, the significant value creation potential that is currently ‘hidden’ in the inter-organisational interface. Especially in long-term relationships, companies could, and should, pay attention to joint asset management besides the more evident forms of cost collaboration in purchasing and value chain operations. *The main objective of the paper* is, therefore, demonstrating the benefits of joint, inter-organisational asset management (IOAM) to companies in the spirit of open-book accounting. *Objective-wise*, value creation is exemplified from the operational perspective (physical asset-level maintenance) and strategic perspective (balance sheet-level asset positioning) in the industrial maintenance context. Our research questions can be phrased as follows...

- What is meant by the concept ‘IOAM’?
- How can value be created collaboratively with operational and strategic asset management?

Furthermore, as the methodology, a case study is used to find answers to our topical questions. The study is not, however, only retrospective as we also plan the future in an optimistic way via scenario creation, with simple mathematical modelling as the medium. Our case setting takes place in an industrial maintenance network that is comprised of a

maintenance customer that has decided to outsource the maintenance of its physical assets, and of a maintenance service provider that delivers the maintenance service for the mentioned customer. Even though an ideal network would also include an equipment provider that could be both the manufacturer of the physical assets and a service provider, we have simplified the network configuration slightly for practical reasons. Moreover, data collection has been conducted in two predominant streams. Firstly, in order to demonstrate the operational asset management of a company and its network, we have gathered production-related data and actual maintenance costs from years 2010 to 2013 from an industrial partner. Secondly, in order to emphasise the strategic asset management of a company and its network, we have studied the financial statements and other relevant balance sheet information of our case companies from a three-year period (2010 to 2012). Unlike in the case above, 2013 was excluded from the analysis because the data from that specific financial year was still unavailable at the time of data collection. Moreover, each future scenario is based on existing data.

2 Towards IOAM

As a concept, Håkansson and Ford (2002) describe a network as a structure where a number of nodes are related to each other by specific threads. When the definition is linked to the organisational context, the nodes represent individual business units, whether manufacturing or service companies, and their reciprocal relationships are the threads. As Håkansson and Snehota (2006) have phrased it, 'no business is an island'. Based on their argument and the above definition of a network, it can be argued that the industries around the world form a massive meta-network of interconnected and somewhat interdependent units. However, there are certain relational archetypes, i.e., distinct inter-organisational settings, which can be used to categorise and manage the complex network phenomenon in practice. Lind and Thrane (2010) have identified four typical sub-settings that are generally used to outline vertical networks, i.e., ones that consist of companies operating at different steps of a value chain. The first archetype, and by far the most common setting in the network literature, is a single dyadic relationship taking place between two legally independent companies. According to Lind and Thrane (2010), the other three settings are serial relationships in a chain (i.e., a company, a customer and a supplier), several counterparts in one direction (i.e., a company and several suppliers or customers), and multiple counterparts in two directions (i.e., a company and multiple suppliers and customers). Each one of the archetypes can be labelled as an inter-organisational relationship, but can they also be referred to as networks? In this paper, any structure that exceeds intra-organisational boundaries belongs to the network phenomenon, and thus a dyadic relationship is called a network as well.

As the perspective is in general clearly shifting from the traditional intra-organisational level towards the more complex inter-organisational level, the focus in both management and decision-making should follow accordingly. The blurring of organisational boundaries has created a need for inter-organisational performance measurement (e.g., Sahu et al., 2013) and IOCM, the main purpose of which is to achieve joint cost reductions and create additional value (e.g., Cooper and Slagmulder, 2004; Kulmala, 2004; Coad and Cullen, 2006; Agndal and Nilsson, 2009). According to Agndal

and Nilsson (2009), IOCM is very often described as a collection of methods and techniques which are neither designed nor targeted for mere inter-organisational purposes. They include for instance target costing, cost tables/disclosed cost data and activity-based costing (Axelsson et al., 2002), and they are typically employed in some way or another to improve dyadic inter-organisational coordination of purchasing and value chain operations in the present cost accounting and management literature. There are numerous empirical case studies where a company and its supplier(s) have implemented at least one IOCM technique in the above-mentioned context (e.g., Mouritsen et al., 2001; Kulmala et al., 2002; Agndal and Nilsson, 2008; Free, 2008; Suomala et al., 2010; Romano and Formentini, 2012; Kumra et al., 2012). The nature of such customer-supplier relationship, and the purchasing strategy of the customer in particular, can be either transactional or relational (Axelsson et al., 2002; Agndal and Nilsson, 2010). Particular features of transactional, classical purchasing are a low degree of commitment and focus on the company's own benefits, whereas a high degree of commitment and focus on joint benefits are emphasised in relational, modern purchasing. Therefore, the success of most IOCM methods and techniques rely more or less on companies' willingness to build and maintain long-term relationships patiently by incorporating relational aspects in their collaboration. As an addition to the current IOCM tools, we claim that networked companies should pay attention, especially in the long-term relationships, to IOAM. It can be seen to comprise operational and strategic levels, which both feature and require divergent management methods, models and tools for controlling the physical and non-physical, current and non-current assets of a network. IOAM is an integral part of the more extensive 'IOCM-umbrella'.

Coad and Cullen (2006) point out that information sharing is a central concept in IOCM. Openness and transparency in information is often called open-book accounting, otherwise OBA (e.g., Kulmala, 2002; Seal et al., 2004; Windolph and Möller, 2012). For instance, Kajüter and Kulmala (2005) describe open-book accounting both as a means for improving the cost efficiency of a supply chain and as a trust-building tool for networks. Mouritsen et al. (2001) even refer to OBA as a novel supply chain strategy that influences the flow of products and services. If the techniques of IOCM are mainly similar with the intra-organisational alternative, as argued above, the need for disclosing information from an organisation to another with 'open books' is representative solely for IOCM, and also its potential weakness. Kajüter and Kulmala (2005) highlight that cost data is usually one of the most sensitive pieces of information in companies, and revealing such data is problematic due to fear of misuse. Suppliers with a weaker negotiation status in relation to their larger customers might especially feel that OBA is implemented in order to apply pressure on profit margins, which further has a negative effect on supplier satisfaction (Windolph and Möller, 2012). Because information openness is often an initial requirement for any IOCM practice to take place between two collaborating companies, opportunistic behaviour should be avoided and the trust-building dimension of OBA underlined instead. Lack of information transparency is one of the biggest barriers that hinder efficient management of inter-organisational relationships and business networks. As IOAM is particularly suitable for relational, long-term collaboration and value creation through this coordination, the significance of openness and mutual trust should be highlighted.

3 Operational view to value creation in asset management

The international standard ISO 55000 (2014) outlines asset management as “coordinated activity of an organization to realize value from assets”. Further, according to the same standard, an asset can be defined as “item, thing or entity that has potential or actual value to an organization”, and thus the value of an asset can clearly be tangible or intangible, financial or non-financial. However, we concentrate here on asset management of tangible, physical assets and their tangible, economic value. Hastings (2010) has applied, based on the traditional balance sheet itemisation, a so-called accountant’s view to delineate a definition for physical assets. According to Hastings, they are physical items such as land, plant, buildings, machinery and vehicles, which are also typically known as fixed or non-current assets. When the content of this section is verbalised in terms of the above ISO 55000 definition, our ‘coordinated activity’ is maintenance management, our ‘organisation’ is a Finnish manufacturing company, our way to ‘realise value’ is improving long-term maintenance planning and decision-making, and finally our ‘asset’ is a hand-picked production machine. In summary, we approach the subject matter, IOAM, in this section from an operational, ‘grass roots’ perspective.

3.1 *How to improve maintenance planning and decision-making in a business network?*

There is a great number of models and divergent techniques that can be used to improve planning and decision-making in the industrial maintenance context. The life-cycle model (LCM), which has been created particularly for long-term maintenance management, is our alternative option. It can even be utilised by multiple companies at the network level. The LCM was presented for the first time in a paper of Kivimäki et al. (2013), where its basic structure had already taken shape, its fundamental operating logic had been fixed, and the first model version also tested in a real-life case setting. Kivimäki et al. (2013) describe the model as being suitable for item-level (i.e., asset-level) decision-making, monitoring realised costs and profits from the past and forecasting the future. Instead of forecasting something uncertain and unseen, we will rather emphasise the phrasing ‘planning the future’, as the realisation of any plausible future scenario is dependent on realistic organisational goal-setting and follow-up.

Despite the many merits of the first version, we returned to ‘the drawing board’ and improved the model further based on the feedback from our industrial partners in cooperation. An enhanced version, called ‘The LCM for maintenance service management’, was introduced by Sinkkonen et al. (2014). In this paper, the completed structure of the model and also its updated operating logic are illustrated explicitly, formula by formula. Although the model is designed to be suitable for varied industrial environments and conditions, we do not try to present a universal, turnkey-type solution for maintenance planning and decision-making. The LCM is a maintenance management approach and a tool for establishing tangible, economic value out of a company’s physical assets. However, incorporating the network perspective, which acknowledges a maintenance customer, a maintenance service provider and an equipment provider all together, makes it truly unique. Despite the organisational boundaries in question, world-class performance in operational asset management, such as industrial

maintenance, can be achieved only through systematic planning and coordination (Mishra, 2014).

The LCM is based on the present value method, which denotes that all asset-related cash flows, whether cost or profit items, are discounted (i.e., appreciated) annually to their present day values. Therefore, the main results of our model are formed from discounted values, and due to the adopted life-cycle perspective, especially on cumulative basis. There are two distinct key figures; *cumulative net present value* (*CNPV*) and *benefit-cost ratio* (*B/C-ratio*). As stated in (1), *CNPV* is comprised of the sum of discounted cumulative cost savings (CPV_S) and discounted cumulative maintenance-related profits (CPV_{MRPL}) reduced with discounted cumulative costs (CPV_C). The profits, or alternatively losses, in the CPV_{MRPL} are basically annual changes in maintenance customer's (a network context) or asset owner's (a company context) loss of production. Unlike the *B/C-ratio*, which is somewhat parallel to typical performance measurement metrics, the *CNPV* expresses a monetary net value for maintenance.

$$CNPV = CPV_S + CPV_{MRPL} - CPV_C \quad (1)$$

where

$CNPV$ cumulative net present value

CPV_S cumulative present value of cost savings

CPV_{MRPL} cumulative present value of maintenance-related profits (or losses)

CPV_C cumulative present value of costs.

Moreover, the three above-mentioned components of *CNPV* can be further reduced to smaller subcomponents. As shown in (2), the cumulative present value of costs (CPV_C), for example, is calculated in such a way that maintenance costs are first discounted year by year and then added up over the whole life-cycle. The other two, the CPV_S and CPV_{MRPL} , are naturally formulated in a similar way. At this point, it is not practical or reasonable to describe the logic of the LCM in closer detail. An extensive illustration about the structure of the model can be found in Appendix.

$$CPV_C = \sum_{n=1}^k \left(\frac{1}{(1+i)^n} \cdot C_{n,total} \right) \quad (2)$$

where

CPV_C cumulative present value of costs

$C_{n,total}$ annual maintenance costs.

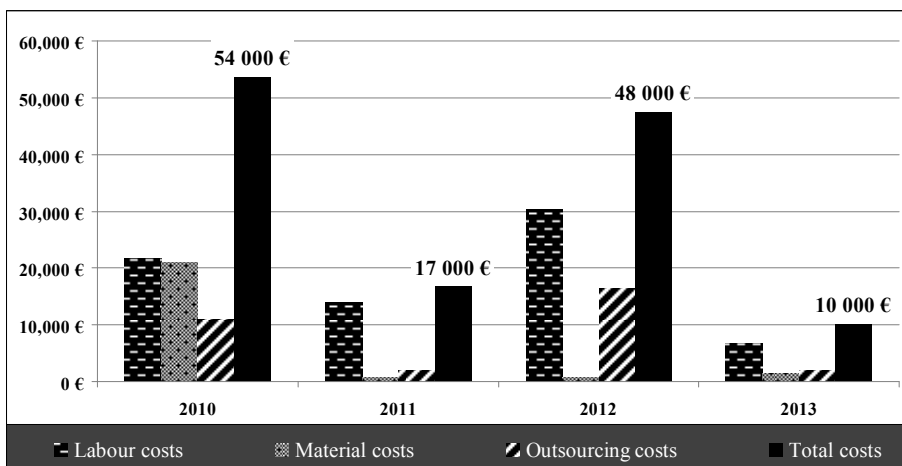
It is important to understand the characteristics of the *CNPV* because it is recognised as a synonym for created economic, life-cycle value in the model. As the *CNPV* is a net figure by nature, and is expressed in an unambiguous monetary unit (Euro), it symbolises the created economic value quite aptly. All things considered, and as an answer to the topic's question, we claim that maintenance planning and decision-making can be improved, in a network or a company, with our model by paying attention to the value of the *CNPV* over a given period of time.

3.2 Exemplifying the creation of economic value with long-term maintenance management

Our case company, Company A, is a Finnish manufacturing organisation of several distinct bulk products that have a variety of diverse industrial and other professional applications worldwide. We have chosen, in collaboration with Company A, to study both the past and planned maintenance of a certain piece of production machinery that is essential in the processing of their raw materials. Even though Company A has occasionally used external workforce in the past to maintain the above-mentioned machine, they have recently (approximately since 2010) outsourced its maintenance to one notably smaller local service provider, Company B. These two companies form a maintenance network, the asset-level maintenance costs and profits of which can be studied, allocated, planned and monitored with the LCM. In order to make things simpler, all references to Company A's production machine will be made as 'the asset' from now on.

A maintenance cost breakdown of a four-year time period (2010 to 2013) is presented in Figure 1, where the annual total costs are divided to internal labour, internal material, and external outsourcing, which comprise Company A's payments to Company B for provided maintenance services. As can be seen, there is substantial variation in annual cost levels, and besides that, the overall trend has been slightly downward as well. It seems that the years 2010 and 2012, as well as the years 2011 and 2013 have been maintenance-wise similar to each other. In 2010 and 2012, a number of larger and more expensive service operations have been conducted to the asset. Therefore, two conclusions that we can use as guidelines in planning future maintenance can be drawn. The level of maintenance total costs regarding the asset varies biennially, and it has a declining trend. In addition to the costs, we also require adjunct data and information related to the production and manufactured product to be able to determine a value for the CNPV. However, Company A was not willing to disclose any product-related data, i.e., *unit production costs* and *profit margin ratio*, so they had to be estimated. The former was evaluated to be around 50 € per ton, and the latter was set to 35%. Both are kept constant over our designated life-cycle.

Figure 1 Total and itemised maintenance costs of the asset from 2010 to 2013



Contrary to product-related data, the required production-related data was received, and some of the most crucial numbers are shown in Table 1. We use 6,240 hours per year as the value for theoretical *maximum operating time*, which means that Company A is capable of manufacturing the product five days a week and three shifts a day under ideal conditions. Therefore, the annual production quantity of 200,000 ton results in *average production speed* around 32 ton per a theoretical operating hour. These two figures are fixed over the life-cycle as well. Furthermore, *asset utilisation rate* and *total maintenance rate* are figures that portion Company A's annual operating time, e.g., the asset manufactured the product 73.5% of the time in 2010, and 9.6% of the time it was maintained. On the other hand, the *run-time maintenance rate* is not a portion of the maximum operating time, but rather a part of the *total maintenance rate*. In 2010, for instance, only 2.5% of all maintenance work to the asset was conducted during ongoing manufacturing. The *run-time maintenance rate* has a significant impact on the results, the *CNPV* in particular, as it does not increase loss of production.

Table 1 Production-related data regarding the asset from 2010 to 2013

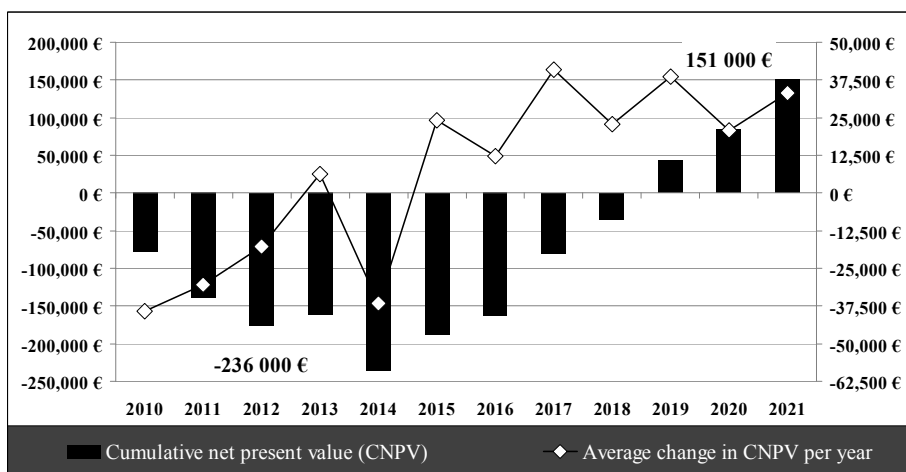
<i>Production-related information</i>	2010	2011	2012	2013
Theoretical maximum operating time	6,240 h/a	6,240 h/a	6,240 h/a	6,240 h/a
Average production speed	32 ton/h	32 ton/h	32 ton/h	32 ton/h
Asset utilisation rate (of max. op. time)	73.5%	75.9%	76.3%	77.8%
Total maintenance rate (of max. op. time)	9.6%	12.4%	10.7%	10.9%
Run-time maintenance rate (of total maint.)	2.5%	2.6%	10.3%	5.1%

So far, we have discussed past data that was received from Company A. In order to be able to quantify the economic value of the asset over its whole life-cycle, we need to plan the future by generating a realistic scenario, and for that, a worthy logic is required about the changes in the operations and maintenance of the asset. We present a 12-year life cycle (2010 to 2021), which includes five history years and seven planning years. Because the year 2014, which is considered here as a history year, was still under way when the data was acquisitioned, its values are based on average annual changes in the known data. From that point onwards, we have created a plan about how individual factors, such as *outsourcing costs*, *asset utilisation rate* or *total maintenance rate*, will vary in the future. For example, the last one is designed to drop 15% annually during the first two scenario years, and then this drop will decrease gradually first to 10% per year, and further to 5%, as there will be less and less room for additional intensifications. Moreover, our cost estimates have been established in such a way that the biennial cost variations and the declining overall trend are both properly considered. It should also be noted that Company B's increasing contribution in joint maintenance management is taken strongly into account.

Once the data had been collected and completed with our scenario approach, we were able to calculate the *CNPV* for the asset. As the *CNPV* is a cumulative figure, the model does not only define an end value for the life cycle, but a value for each year separately. The development of *CNPV* is illustrated in Figure 2, where 10% has been used as the interest rate for the discounting. In order to highlight the changes better, annual average is

presented on the right axis as well. As can be seen, the *CNPV* is heavily negative throughout the beginning of the life cycle, where relatively high levels of costs dominate over the smaller profit items, i.e., cost savings and gains in loss of production. Cumulatively observed, the lowest point is the year 2014, the value of which is approximately $-236,000$ €. This is a result of two factors. On one hand, the production losses in that specific year are slightly elevated due to a higher *total maintenance rate* in comparison to the life-cycle average, and on the other hand, there is also notable build-up in maintenance costs from the preceding year, affecting the cost savings category.

Figure 2 The development of the *CNPV*



After the trough in the *CNPV* is realised in the end of 2014, the figure starts to improve year by year gradually, reaching ultimately a positive life-cycle end value around 151,000 €. The result is expected, as we planned a maintenance scenario for the asset that emphasised both operational improvements and cost intensifications. It has to be stated, however, that the magnitude of the figure is surprising. Just over seven years, Company A could benefit more than 385,000 € through small, gradual changes in the maintenance of the asset. The scenario is admittedly a little optimistic, because it is based on the presumption that the entire production can be sold annually. This has an eminent, negative or positive, impact on the calculated production losses, depending on the situation at hand.

As both the *unit production costs* and the *profit margin ratio* were estimated, we did a two-variable sensitivity analysis to reduce any uncertainty that might be related to these two factors in the *CNPV*. Minor changes were simulated separately and simultaneously, and the influences on the life-cycle end value of the *CNPV* are illustrated in Figure 3. As can be noticed, our estimates seem to have sensitivity to some extent, as the difference between the worst and the best alternative is over 500,000 €. However, concurrent 30%, positive or negative, change in both factors is a lot of sensitivity, and thus the reality lies probably somewhere in between. The changes on the negative side are not very dramatic, which indicates that the scenario is rather conservative than overly optimistic.

Figure 3 Two-variable sensitivity analysis on the CNPV

		Profit margin ratio (%)						
		Change-%	- 30%, (24,5%)	- 20%, (28,0%)	- 10%, (31,5%)	0%, (35,0%)	+ 10%, (38,5%)	+ 20%, (42,0%)
Unit production costs (€/ton)	- 30%, (35€/ton)	-64 000 €	-34 000 €	-5 000 €	24 000 €	54 000 €	83 000 €	113 000 €
	- 20%, (40€/ton)	-34 000 €	-1 000 €	33 000 €	66 000 €	100 000 €	134 000 €	167 000 €
	- 10%, (45€/ton)	-5 000 €	33 000 €	71 000 €	108 000 €	146 000 €	184 000 €	222 000 €
	0%, (50€/ton)	24 000 €	66 000 €	108 000 €	151 000 €	193 000 €	235 000 €	277 000 €
	+ 10%, (55€/ton)	54 000 €	100 000 €	146 000 €	193 000 €	239 000 €	285 000 €	331 000 €
	+ 20%, (60€/ton)	83 000 €	134 000 €	184 000 €	235 000 €	285 000 €	335 000 €	386 000 €
	+ 30%, (65€/ton)	113 000 €	167 000 €	222 000 €	277 000 €	331 000 €	386 000 €	440 000 €

As a conclusion, it can be stated that companies are clearly able, when certain limitations are acknowledged, to realise considerable value from their physical production assets by improving maintenance planning and decision-making gradually in the long-term. Despite the fact that our example is presented solely from the perspective of a maintenance customer (Company A), service providers, such as Company B in this case, benefit from the collaboration as well. When joint actions are underlined in improving maintenance management, for instance the predictability of machine breakdowns and repairs evolves, which will reduce the service provider's costs and increase its profit margin. In order to 'balance the scales', the customer company could also distribute a certain portion of its economic value, e.g., through performance-related bonuses, as a sign of goodwill. As can be noticed, there is an immense number of different possibilities, the realism of which seem, however, to depend partly on the contractual circumstances between the companies as well. We are convinced that companies should focus increasingly on two things in operational, IOAM. Firstly, the emphasis in asset's maintenance management should be on longer time periods than previously, i.e., on life cycles. Secondly, all planning and decision-making regarding an important asset should be made together with network partners, which requires extensive inter-organisational openness and trust.

4 Strategic view to value creation in asset management

By concentrating on the strategic side, in this section, we move from the 'grass roots' to an 'eagle-eye' perspective to be able to study the subject matter, IOAM, on the top management level. Contrary to limiting the point of view to physical assets only, the scope of top management falls typically upon the entire organisation instead of a single asset, and thus a wide range of divergent industrial assets should be included. As remembered, the accountant's view by Hastings (2010) categorises different assets based on their balance sheet positioning. Physical assets, such as buildings and machinery, are referred to in the financial statement context as non-current assets. There are also faster moving items, i.e., current assets, on the balance sheet, which include cash, inventories

(materials, work in progress, finished goods, etc.) and accounts receivables. Therefore, strategic asset management comprises both the non-current and the current assets. Yet again, in terms of the ISO 55000 definition for asset management, our ‘coordinated activity’ is strategic management, our ‘organisation’ is a network of Company A, our way to ‘realise value’ is increasing profitability with flexible asset management, and finally our ‘asset’ incorporates a variety of different assets.

4.1 How to increase inter-organisational profitability with flexible asset management?

There are two generally accepted ways to delineate the profitability of an organisation. A company’s annual earnings can be proportioned either directly to its total sales or relatively to the capital invested. *Return on investment (ROI)* is a common option for determining a company’s relative profitability. It is typically defined in the area of financial statement analysis as the ratio between *earnings before interest and tax (EBIT)* and the capital employed, which includes both equity and liabilities with an interest. However, we have taken another approach to defining *ROI*, true with the asset management perspective, where the assets are highlighted instead of equity and liabilities, as shown in (3). This new type of formula, called the flexible asset management model (FAM), has been previously presented by Marttonen et al. (2013a, 2013b). So far, it has been used mainly in illustrating flexible working capital management under different conditions, but the FAM can be employed to manage ‘an asset portfolio’ of a network as Marttonen et al. (forthcoming) also demonstrate. While working capital is undeniably an important part of a company’s ‘asset portfolio’, the number of physical, fixed assets on the balance sheet can be controlled for strategic purposes, respectively. They have often a bigger impact on profitability as well.

$$ROI = \frac{EBITDA\% - \left(FA\% \cdot \frac{1}{B-1}\right)}{\frac{CCC}{365} + \frac{r}{365} + FA\%} \quad (3)$$

where

ROI return on investment

EBITDA% earnings before interest, tax, depreciation and amortisation/total sales

FA% fixed assets/total sales

B average depreciation period

CCC cash conversion cycle

r residual.

Similarly with the conventional *ROI* alternative, the company’s earnings in the FAM are located in the numerator, and its assets, equivalent to equity and liabilities, are located in the denominator. As a consequence of using the *cash conversion cycle (CCC)* in the equation to measure the employment of working capital, the earnings (*EBITDA%*) and the fixed assets (*FA%*) have to be divided by the total sales. The *CCC* is comprised of the

cycle times of inventories, accounts receivables and accounts payables. For example, the cycle time of inventories, i.e., the days that inventories are outstanding on average, is calculated in such a way that the amount of inventories is proportioned to total sales. The same analogy is suitable also for *residual* (r), which includes, by definition, the remainder of the company's working capital. Its components are the cycle times of other current assets and other current liabilities. All things considered, and as an answer to the topic's question, we claim that an organisation can improve the *ROI*, and thus its profitability, by managing its total assets, i.e., *FA%*, *CCC* and r , effectively and flexibly.

4.2 Exemplifying the creation of economic value by reorganising the assets on the network level

Our case network comprises Company A, which is a Finnish manufacturing organisation, and Company B, which provides the former with comprehensive maintenance services. In addition to their rather close operational collaboration in the field of industrial maintenance, Company A and Company B could, and should, pursue strategic joint benefits as well. We use the FAM to demonstrate how companies can create economic value with flexible, strategic asset management and act as a 'well-oiled unit' by adjusting the amount of their fixed assets and the *CCC*. Naturally, before making any further adjustments, we needed some data to be able to even determine the current values of *ROI*. Year-end financial statement information of Company A and Company B from the accounting periods 2010, 2011 and 2012 was used for the purpose. The information of year 2013 was not available yet at the time of data acquisition, and thus it has been excluded from the analysis.

Table 2 Current values of the components of the FAM model in the network

<i>Component:</i>	<i>Company A:</i>	<i>Company B:</i>	<i>Network:</i>
EBITDA%	10.0%	2.1%	9.8%
FA%	134.1%	4.1%	131.7%
B	24.5 d	4.0 d	24.4 d
CCC	59.9 d	70.3 d	130.2 d
r	-84.0 d	-12.5 d	-96.5 d
ROI	3.4%	3.6%	3.0%

The values for the different components of the FAM for the whole network and separately for each company are presented in Table 2. All figures of Company A and Company B have been calculated from the above-mentioned financial statement information as a three-year average in order to eliminate potential inconsistencies in the results, i.e., the effect of an exceptional year. Network-level numbers have been weighted proportionally, e.g., the *EBITDA%* of the network is the ratio between the total annual earnings of the two companies and their combined total sales. On the other hand, figures that illustrate cycle times on the network level, i.e., the *CCC* and r , are delineated simply by adding up the equivalent values of Company A and Company B. What should be said about the values then? Company A's *FA%* is one and a third times its annual total sales, which is an outstandingly high value. Moreover, the *CCC* can be reckoned fairly long in the case of both companies, which is also reflected in the unsatisfactory network-level

figure. Their collective working capital does not cycle even three times a year, and thus there is lots of ‘dead money’ tied in organisational structures.

In the following strategic asset management scenario, we do not emphasise the maximisation of the benefits of an individual company, such as Company A, which has prospectively power-wise a ‘dominating position’ in the collaboration, but instead our true goal is to create dividend, network-level value. The sharing of joint benefits could be based on the organisations’ informal agreements or even on written maintenance contracts. There are, however, some limitations. Firstly, we have assumed that the total sales and profit margins of Company A and Company B will remain constant, which denotes that their *EBITDA*%s stay unchanged as well. Secondly, the *residual* will be revised neither, because the accounting items included in the factor are most likely directly uncontrollable by the companies’ mutual decisions. That being said, all our flexible asset management techniques are directed on either fixed assets, total inventories, accounts receivables (of the maintenance service provider, otherwise Company B) or accounts payables (of the customer, otherwise Company A).

Encouraged by positive past experiences of maintenance cooperation, Company A has agreed, together with Company B, to start concentrating on strategic asset management, which they believe would increase the competitiveness of the network. As the profitability of the relatively small Company B has been unbearably low for years, Company A has decided to take the ownership of all Company B’s fixed assets and inventories. After all, those assets on its balance sheet have served the needs of Company A, which has for a long time been Company B’s biggest customer by far. Additionally, the new-found strategic joint focus will also lead to major intensifications in the assets. By getting rid of evident ‘asset overlap’, the required total amounts of fixed assets and inventories are reduced, which means that Company A will have now less assets than before despite the reorganisation. Even further, in order to optimise the utilisation of assets, the two companies have decided to alter the terms of payment in their mutual transactions in such a way that the length of Company B’s *CCC* will be shortened substantially.

Table 3 Adjusted values of the components of the FAM model in the network

<i>Component:</i>	<i>Company A:</i>	<i>Company B:</i>	<i>Network:</i>
EBITDA%	10.0%	2.1%	9.8%
FA%	127.5%	0.0%	125.1%
B	23.4 d	1.0 d	23.3 d
CCC	58.3 d	19.0 d	77.3 d
r	-84.0 d	-12.5 d	-96.5 d
ROI	3.5%	39.6%	3.5%

The impacts that our scenario has on the FAM and its components in the network of Company A and Company B are presented in Table 3. Company B’s *FA*% goes naturally to zero after its fixed assets are reorganised completely to the balance sheet of Company A, the *FA*% of which is respectively dropped by almost seven percentage points due to the intensifications. As Company B is extremely small compared to Company A, the transferred fixed assets have little to no effect on the network-level *FA*%, which mainly follows Company A’s figure. Furthermore, it can be immediately

noticed that our flexible asset management manoeuvres also reduces the cycle times of working capital. The *CCC* of the entire network drops by nearly 53 days, a difference that is largely caused by Company B's diminished number. This is a result of two separate arrangements. In its *CCC*, Company B gains approximately 31 days by giving up all the inventories, and another 20 days come from altering the terms of payment between the two companies. The new terms induce an approximately 40% decrease in the year-end figure of accounts receivables, which is realistic, given Company A's predominant position in Company B's clientele. The *CCC* of Company A is also slightly reduced due to the intensification of its overall inventories. However, the new terms of payment expedite Company A's cycle time of accounts payables, which unfortunately revokes partly the benefits that are received from fewer inventories.

At first, it seems profitability-wise that Company B is the ultimate winner in our flexible asset management scenario, as its *ROI* has impressively jumped by 36 percentage points. These results should not be, however, surprising after we have alleviated Company B's balance sheet by removing its fixed assets and inventories. Naturally, the new terms of payment between the two companies help as well. The overall gain, on the contrary, is more moderate, as there is a half percentage point raise in the network-level *ROI*, which equals effectively the created economic value. That being said, the value that is now mainly realised for Company B should be shared in reality more equitably in order to Company A to become interested in such an arrangement at all. For instance, Company B could return the favour by offering cheaper maintenance services to its loyal customer. Company A's profit margin, and thus its *EBITDA%* and *ROI*, would increase due to the lower cost level as a result.

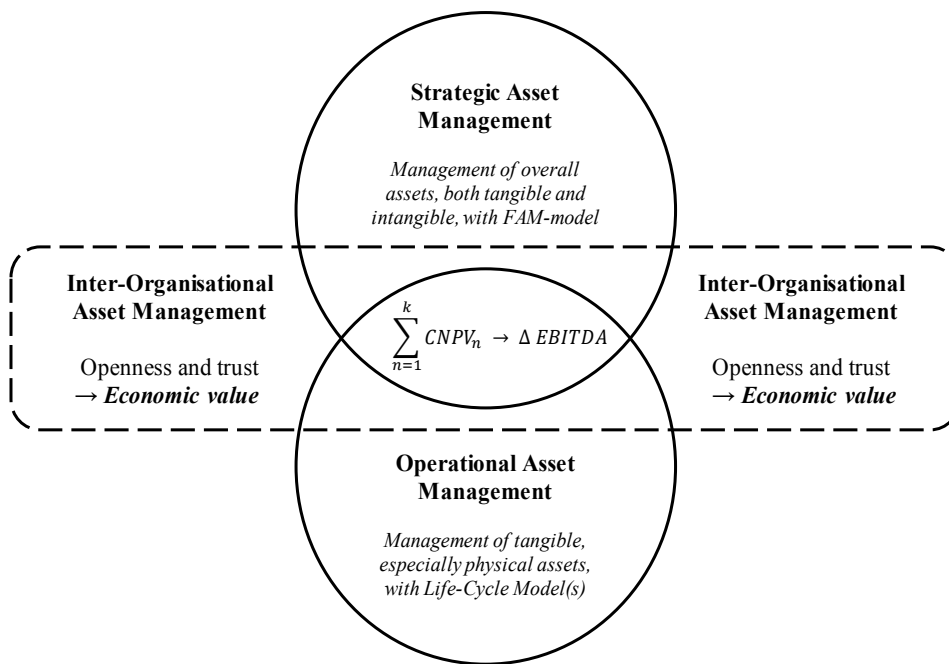
As a conclusion, it can be said that flexible asset management creates evidently strategic-level benefits for networked companies as a lighter asset structure equals higher profitability, i.e., economic value. Because we did not simulate any kind of growth in the companies' total sales or their profit margins by changing the numerator, the created value originates explicitly from a smaller amount of tied-up capital, which is released from both the fixed assets and the working capital. Therefore, the economic value that was established in our scenario should be perceived rather as proportional than absolute, as our actions did not have any impact on the financial performance of either Company A or Company B. Nevertheless, the elevated relative profitability of an organisation looks always better in the eyes of different stakeholders, such as investors, and the capital that was previously tied in the assets can also be invested somewhere else with higher rate of return expectations. However, an extensive reorganisation of assets between two legally independent companies may sometimes be problematic when there is a risk of a formation of a dominant market position, such as a monopoly. We claim that inter-organisational, strategic asset management is something that companies should be taking very seriously, especially if they are already collaborating on a long-term basis. 'Asset overlap' can be reduced by reorganising assets in a flexible way, which will improve the profitability of the network and the individual companies as well.

5 Discussion and conclusions

In today's world, no business is an island anymore, as companies are networking at an increasing pace and forming diverse inter-organisational relationships with each other. While a variety of formerly internal activities of a company, such as industrial

maintenance and even asset management, have become something that should be emphasised in collaboration, the day-to-day practices of the industry still feature many difficulties. Despite the fact that even the most well-established business networks collaborate on a rather shallow basis, we claim that there are lots of hidden, unrealised benefits (i.e., value) in extensive network coordination and management. It can be even stated that the challenge is mainly educational due to intra-organisational resistance, a threshold that we would like to crack.

Figure 4 Linking of the operational and the strategic view in IOAM



In this paper, we have discussed IOAM, which can be recognised as an integral part of IOCM, an approach the two main purposes of which are finding joint cost reductions and creating network-level value. IOAM is comprised of two complementary perspectives, operational asset management and strategic asset management. So far, we have exemplified how companies are able to create economic value collaboratively on the operational level with our LCM and on the strategic level with our FAM. However, the linkage between the two models is still somewhat ambiguous. As illustrated in Figure 4, operational asset management (i.e., the LCM) and strategic asset management (i.e., the FAM) are connected through *CNPV* and *EBITDA*. When an organisation, such as Company A, utilises the LCM in the long-term maintenance management of an asset, it will create a certain amount of economic value in the pursuit of a maximal *CNPV* figure throughout the life cycle of the asset. Sooner or later, the created value that comprises cost savings and gains in loss of production is realised in the financial statement as well. There are basically three factors that have an effect on *EBITDA*; selling more products, getting a better profit margin or alleviating the cost structure. As can be noticed, actually two out of the three can be achieved, separately or simultaneously, with our LCM. If a

company has implemented multiple LCMs in order to manage several critical production assets at the same time, then the sum of *CNPVs* leads to a change in *EBITDA*.

Two particularly important conclusions can be drawn from this paper. Firstly, we have demonstrated with two asset management models, the LCM and the FAM, that companies are able to create tangible, economic value together on the operational and the strategic level of asset management, especially when collaborating on a long-term basis. Our detailed introduction to the models and their hands-on utilisation provides lots of managerial insight and know-how. Secondly, the above-mentioned two dimensions, and thus also the two models, were integrated by introducing a novel concept called IOAM. By forming a linkage between our models as well as operational and strategic asset management in the wider context, IOAM can be seen as a comprehensive platform for both theoretical and practical purposes and further discussion. It also highlights the cause-and-effect relationship between operational decisions and strategic outcomes, which is a clear managerial implication as well. Even though the LCM and the FAM are just two examples of beneficial asset management tools, which can be seen as a limitation, they are still novel approaches in the field.

Lastly, future research directions are considered shortly. Evidently, our models still require additional testing in divergent industrial environments so that the results and the benefits of the models can be properly consolidated. Due to its nature as an operational model that incorporates a life-cycle perspective, the LCM should be implemented and tested in such a way that data is gathered for a longer period of time. This way the factors that influence the implementation process of an inter-organisational model could also be mapped in general. Additionally, we could study the linkage between operational and strategic asset management with our models by simulating their reciprocal behaviour in a real-life setting.

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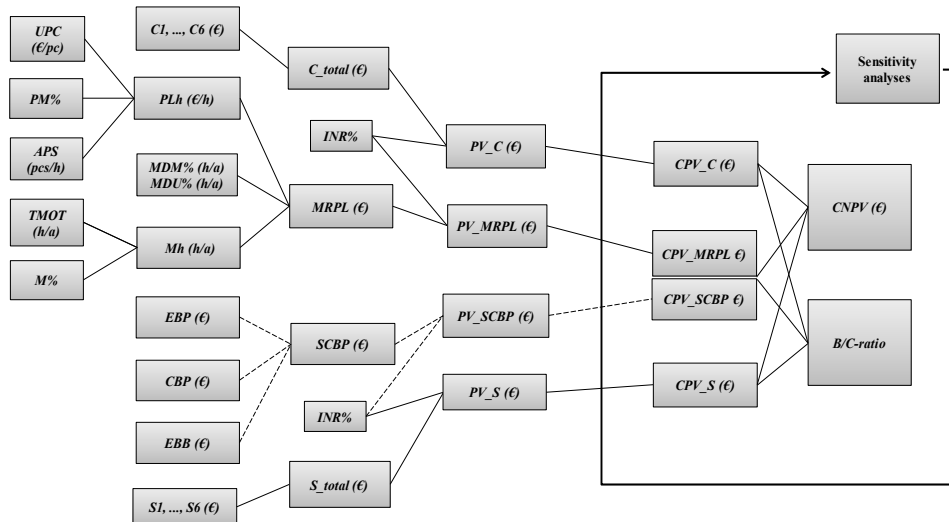
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Appendix

Figure A1 The structure and the logic of the LCM



- | | | | |
|-------------|--|---------------------------------|---|
| Notes: UPC | unit production costs | SCBP | service or equipment |
| PM% | profit margin ratio | provider's annual total profits | |
| APS | average production speed | INR% | discount rate/interest rate |
| PLh | profit losses caused by one hour stoppage in production | PV_C | present value of maintenance total costs |
| TMOT | theoretical maximum operating time | PV_MRPL | present value of maintenance-related profit or loss |
| M% | share of total maintenance (of max. operating time) | PV_SCBP | present value of service or equipment provider's total profits |
| Mh | annual maintenance hours in total | PV_S | present value of maintenance total cost savings |
| C1, ..., C6 | maintenance costs | CPV_C | cumulative present value of maintenance total costs |
| MDM% | share of maintenance performed during manufacturing (of total maint.) | CPV_MRPL | cumulative present value of maintenance-related total profits or losses |
| MDU% | share of maintenance performed during underutilisation (of total maint.) | CPV_SCBP | cumulative present value of service or equipment provider's total profits |
| EBP | equipment sales-based profits | CPV_S | cumulative present value of maintenance total cost savings |
| CBP | contract-based profits | CNPV | cumulative net present value |
| EBB | equipment-based bonuses | B/C | benefit-cost ratio. |
| S1, ..., S6 | maintenance cost savings | | |
| MRPL | maintenance-related profit or loss (annual change in loss of production) | | |

Source: Adapted from Sinkkonen et al. (2014)

Publication 3

Ylä-Kujala, A., Marttonen-Arola, S., Kärri, T. & Liyanage, J.P.

**From networks to ecosystems:
redefining inter-organizational transparency**

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From networks to ecosystems: redefining inter-organizational transparency

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Abstract — Servitization and digitalization are two forces currently restructuring the industrial landscape. The next step for manufacturers becoming service providers is to take advantage of the servitization potential of big data that is generated by smart connected assets enabled by Internet of Things (IoT) technologies. As the concept of interdependency is now applied to the animate (i.e. organizations populated by individuals) and the inanimate (i.e. smart connected assets as industry's installed base), business networks are shading into complex business ecosystems. In order to guarantee effective service provision, organizations should be willing to share the above-mentioned big data, although such disclosure has been repeatedly proven as problematic in the past. The aims of the paper are twofold; (1) to map and categorize the reasons for failed transparency (i.e. issues and barriers) by conducting a literature review, and (2) to understand through multiple case studies how IoT is able to support information disclosure.

Five types of issues and barriers are identified; (1) Asymmetrical power relations and opportunism, (2) Interpersonal relations and individuals' traits, (3) Poor commitment and inadequate relational support, (4) Insufficiency of data arising from methods/systems, and (5) Weak incentives and unresolved benefit sharing. The findings from the two case ecosystems indicate that IoT resolves each problem either directly or indirectly. As far as the theoretical implications are concerned, the paper provides a systematic listing of reasons for failed transparency and carries a suggestion that scientific discussion on inter-organizational relationships should focus on business ecosystems as the concept of business network is no longer congruent with the state-of-the-practice. The introduction of IoT plays a significant economic role in both case ecosystems, which should be of interest to managers and other practitioners.

Keywords — *inter-organizational relationships; business ecosystems; Internet of Things (IoT); big data; transparency; information disclosure; issues and barriers*

I. INTRODUCTION: NETWORKS AND ECOSYSTEMS

The role of services and service provision is rising across the industries. Machine and equipment manufacturers are becoming service providers by creating solutions and offerings to customers, which are comprised of conventional products and specialized services [1-5]. This kind of modus operandi where an organization transitions from selling products to providing advanced product-service hybrids is referred to as 'servitization' (see e.g. [6] for a recent literature review). Kowalkowski et al. [7] make a further distinction between servitization and 'service infusion' that are often applied interchangeably. According to them, service infusion is the process where the relative importance of services increases, while servitization is the revolutionary shift from a product-centric business model and logic to a service-centric one. Hence, servitization requires organizational and managerial philosophies that extend beyond the infusion approach.

Apart from the infusion of services, 'digitalization' is another factor that is changing industries and transforming competition by inducing another layer of complexity in the form of smart connected assets [8-9]. Smartness and connectivity are two qualities that are enabled by Internet of Things (IoT) technologies, e.g. Radio Frequency Identification (RFID), Near Field Communications (NFC), Wireless Sensor and Actuator Networks (WSAN), and data storage (e.g. cloud computing) and data analytics [10-12]. Recent bibliometric study of Mishra et al. [13] shows that the fascination towards the vision and applications of IoT is growing in the academia. Opresnik and Taisch [14] even suggest that services are slowly becoming a necessary, but insufficient condition for reaching lasting competitive advantage, i.e. services are commoditized. Based on this particular notion, they further argue that the next step in servitization is to capitalize on the big data that smart connected assets are generating. Novel information and communication technologies, including IoT, may therefore have a catalytic effect on industrial service provision [15].

According to Cenamor et al. [16], the creation of ‘platforms’ is a good way for manufacturers to leverage the value of digitalization and avoid the so-called servitization paradox, which means that increased revenues from service business do not translate to higher profits [17]. Gawer and Cusumano [18] define platforms as products, services or technologies that provide the foundation upon which outside organizations can develop their complementary products, services or technologies. In the IoT servitization context, platform is a combination of product-technology (i.e. smart connected asset) and services that are founded on the understanding of customer needs by collecting, storing and analyzing data from the assets on the field. In terms of Kowalkowski et al. [7], platforms are a move to a service-centric business model and logic that puts next generation, data-driven services in the center of the offering. It should be however acknowledged that original equipment manufacturers (OEM) do not have exclusivity on these kinds of services, as third-party providers may also tap into the potential.

Iansiti and Levien [19] argue that successful ‘business ecosystems’ are often founded on a platform strategy that not only enhances the performance of the keystone organization (e.g. OEM), but also that of ecosystem’s other inhabitants. Moore [20-21] is the pioneer who first drew the parallel between natural and social systems by discussing about the new ecology of competition and introducing the metaphor known as business ecosystem. He then outlined it as “the organism of the business world”, i.e. an economic community supported by a foundation of interacting organizations and individuals. As business ecosystems comprise a large number of stakeholders and even closest competitors, they can be perceived as forms of extended networks, a construct that is comparable with the understanding of business networks as extended enterprises. What is lacking from Moore’s seminal characterization is the idea of installed base (i.e. smart connected assets) as the third interacting species alongside organizations and individuals in modern business ecosystems. By referring to this installed base as a fleet, we define (business) ecosystem in this paper as follows...

Ecosystem = **Network** (of organizations /individuals)
+ **Fleet** (of smart connected assets)

The development of business ecosystems that revolve around the service-driven platforms causes unprecedented complexity to the industrial landscape. Instead of seeking to reduce complexity, Eloranta and Turunen [22] suggest that organizations should embrace the challenge of managing and orchestrating complex inter-organizational relationships either by connecting actors, sharing resources or integrating systems. Out of these logics, the most applicable to data-driven services is the sharing resources approach in which organizations are encouraged to establish deeper connections, build trust, and provide each other access to proprietary resources, including the vast amounts of data that originate from the fleet. This technical data dimension can be complemented with the exchange of economic big data that is available in the accounting and management information systems [23-24].

Simultaneously, it has to be also pointed out that such information disclosure has often been problematic in the context of traditional business networks [25]. Is it therefore possible that IoT – a new kind of mechanism forming interdependencies – has the capacity to foster transparency?

The aims of the paper are twofold; (1) to map and categorize the reasons (i.e. issues and barriers) for failed transparency, and (2) to understand how technological development (i.e. smart connected assets enabled by IoT) might resolve them. By building on the research aims, our research questions can be phrased as follows...

RQ1: *What are the issues and barriers that compromise inter-organizational information disclosure and thus the success of business networks?*

RQ2: *How IoT technologies support inter-organizational information disclosure and thus promote the transition to business ecosystems?*

In order to answer to the RQ1, a literature review was conducted by targeting two large scientific databases: ScienceDirect (Elsevier) and Emerald Insight. Authors’ prior experience with the topic governed the selection of the databases. Keywords including, e.g. ‘inter-organizational’, ‘inter-firm’, ‘relationship’, ‘partnership’, ‘network’ and ‘collaboration’, were combined with ‘information disclosure’, ‘information transparency’, ‘information sharing’ and ‘open-book accounting’ in order to look for matching research agenda. The search resulted in a large number of publications that were then screened for indications of issues and/or barriers, which are causing problems in the inter-organizational interface. We tried to include both qualitative and quantitative research in the literature review so that the overall picture of the situation would be more complete and compelling.

As shown in **Table I**, five categories of issues and barriers that have been reported to either hinder or even prevent the success of business networks were identified while mapping the above-mentioned databases. They are:

- I/B:1 (Asymmetrical power relations and opportunism)
- I/B:2 (Inter-personal relations and individuals’ traits)
- I/B:3 (Poor commitment and inadequate relational support)
- I/B:4 (Insufficiency of data arising from methods/systems)
- I/B:5 (Weak incentives and unresolved benefit sharing)

The five categories in the table are consequently also our definitive answer to the RQ1, i.e. “what are the issues and barriers that compromise inter-organizational information disclosure and thus the success of business networks?”

TABLE I. LITERATURE REVIEW: THE ISSUES AND BARRIERS

Author	Ref.	I/B:1	I/B:2	I/B:3	I/B:4	I/B:5
Seal et al. (1999)	[26]		X		X	X
McIvor (2001)	[27]	X	X	X	X	
Kulmala et al. (2002)	[28]				X	
Dekker (2003)	[29]	X				X
Kulmala (2004)	[30]				X	X
Seal et al. (2004)	[31]	X	X			
Kajüter & Kulmala (2005)	[32]	X	X	X	X	X
Free (2008)	[33]	X	X			
Paulraj et al. (2008)	[34]			X	X	
Agndal & Nilsson (2009)	[35]				X	
Suomala et al. (2010)	[36]	X	X		X	X
Agndal & Nilsson (2010)	[37]	X				X
Möller et al. (2011)	[38]			X		
Cheng (2011)	[39]	X				X
Kumra et al. (2012)	[40]	X		X		
Caglio & D'itillo (2012)	[41]			X		
Romano & Formentini (2012)	[42]	X				X
Fayard et al. (2012)	[43]				X	
Windolph & Möller (2012)	[44]	X				
Jakobsen (2012)	[45]		X			
Rajaguru & Matanda (2013)	[46]			X	X	
Alenius et al. (2015)	[47]	X				
In total		12X	7X	7X	10X	8X

In order to answer to the RQ2, case study method was chosen as the form of scientific inquiry. Two cases and thus ecosystems are discussed, i.e. Norwegian oil and gas and Finnish pulp and paper. The data collection relied on three sources of information: prior literature, two semi-structured interviews and organizational documents. As far as the interviews are concerned, the discussed topics retained the nature of inter-organizational relationships, the extent of data/ information disclosure, the implementation of ecosystem-level tools, methods and systems (incl. IoT), and the state of data quality and access. The following two chapters (II and III) provide full case descriptions of both ecosystems, while case comparison is presented in conclusions and discussion (IV).

II. ECOSYSTEM I: TECHNOLOGY AS AN INTEGRATOR

In the first case example, we take an industry-wide glance to IoT technologies. The benefits of IoT are discussed in the context of the ecosystem (i.e. the Norwegian oil and gas).

A. A transition from conventional to integrated operations

As a response to declining competitiveness, oil and gas producers supported by the Norwegian government decided to initiate the industry's third efficiency leap program in 2003-2004, where organizations would gradually switch to an Integrated Operations (IO) -model [48-50]. Whereas the two previous efficiency leaps had focused mainly on developing better drilling and production techniques, the ambition behind the third is to integrate onshore and offshore operations with

novel information and communication technologies across traditional organizational boundaries. The concept of IO is comprised of eOperations [48-49] and eMaintenance [50] approaches combined with smart connected assets, the intelligence of which stems from IoT, e.g. sensor technologies and wireless data transfer. The first IO phase (2003 – 2011) focused on bridging the gap between onshore and offshore operations. Since then, more emphasis has been put towards improving inter-organizational collaboration, which is also the main objective of the second IO phase (2006 – 2018). [51] Because of the IO, the industry has undergone a major restructuring that has brought the producers, service providers, and support and supply organizations closer together [48].

B. The wide spectrum of technological solutions and benefits

So that the IO could be successful, the industry needed a neural network that is capable of integrating organizations' onshore and offshore operations. Since 1998, the oil and gas companies have had an industry-wide information system, Secure Oil Information Link (SOIL), at their disposal [48-49]. SOIL is a closed system that is not only reliable, but also extremely secure due to access control. Fiber-optic cables on the Norwegian seabed complemented with radio and satellite communication guarantee a large data bandwidth for its users. A variety of applications are run within the SOIL including RigCamp (i.e. a standardized way to transfer data, e.g. files and audio/video) and SOIL Directory (i.e. a database solution that facilitates the search of services and competencies among SOIL member organizations and their employees) [48].

The existence of SOIL enables the adoption of novel technologies, as there is an easy way to transfer data from offshore to onshore and vice versa. Technological solutions that are utilized to gather data from offshore platforms and other sites include sensors and actuators, automation and remote control, CCTV-monitoring, VisiWear-devices and wireless data transfer [48-50]. An important role in the industry's data-driven decision-making is played by onshore support centers (OSC) that control drilling activities and operations and maintenance. Decision-making in OSCs is supported by another set of technologies, including virtual conferencing facilities, SMART Boards, online diagnostics and prognostics, and 3D visualization/simulation tools [48-50]. OSCs are filled with expertise as engineers, geologists and analysts collaborate intra- and inter-organizationally. It is not unprecedented that personnel from two organizations (e.g. producer and service provider) are located in the same OSC.

As far as the benefits of the IO are concerned, OSC- prototype center introduced by one of the largest oil and gas producers in 2003 is a success story worth mentioning. Cumulative cost savings from its first two years of operation were up to USD 22 million that were realized by reducing direct man-hours and offshore-onshore transportations [48]. The payback period of the initial USD 5.5 million investment to the OSC-prototype was only seven months. In the larger scale, the savings potential of IO is even more substantial. Some have suggested that the operating costs are going to decrease by 30 percent, while the recovery efficiency of deposits increases by 10 percent [49]. In monetary terms, the industry-wide savings potential is around USD 30 billion [51].

C. Trusting culture as the foundation for transparency

We wanted to untangle the reasons behind Norway's success by interviewing the Integrated Operations Advisor (IOA) of an oil and gas exploration and production company that operates on the Norwegian continental shelf.

Would you state that you typically pursue closer and longer relationships, i.e. exchange beyond simple transactions, with key suppliers/customers?

IOA: "Yes, definitely. It is an integral part of the Norwegian working culture. We pursue long-term relationships especially with the largest suppliers. Contracts are, at least, five years long with extensions of two or three years. We have even embedded offices with couple of our key suppliers."

How are benefits shared between you and key suppliers/customers?

IOA: "Everything depends on the contracts that we have. They are based on risk-reward considerations, which means that we pay for performance. These types of contracts have recently become very common in the industry."

Do you disclose data/information with your key suppliers/customers?

IOA: "Yes, we are very transparent. I think that the transparency stems from the working culture that I mentioned. Even so, we are still ahead of most Norwegian companies in this matter. Contractors, for example, have access to our IT-systems, but there are non-disclosure agreements (NDA) in place."

What type of data (e.g. economic, technical etc.) do you usually disclose?

IOA: "Well, I would say that mostly technical data that is available via SAP. We do not disclose cost information as such, but people are aware of these things as we work so closely together. However, macro-level economic data, such as budgets, are shown directly to partners in our meetings."

What is the direction of exchange and the boundaries to openness?

IOA: "We are very transparent as I said, but everything depends on the language in the contracts. We are often more open towards exchange of information than service companies that we work with. Contracts define the boundaries as well. We have certain three-way relationships."

What are the actual tools, methods and/or systems that are used specifically to disclose information with your key suppliers/customers?

IOA: "We have lots of them on several organizational levels. Microsoft toolbox is common, although we try to avoid Excel-spreadsheets. We arrange video conferences especially with our suppliers, and data is moved around using the industry standards, which are important. We also have custom-made tools that are specifically designed for inter-organizational collaboration."

What are the most important and promising IoT technologies?

IOA: "We are constantly working on sensor technologies and automation as we would like to reduce human impact in order to avoid mistakes. We also have on-going projects around artificial intelligence and robotics as well as new communication and collaboration systems. However, sensors are the main thing for us; we want new sensors, more sensors, wireless sensors, and smart sensors that can communicate. I would also like to see advanced analytics that looks for correlations in data and makes predictions."

What is the role of fleet asset management, i.e. managing multiple assets instead of an individual asset?

IOA: "Our approach is quite asset-centric, but there is variation depending on the organizational level. The big picture is not currently integrated, as the upper management does not have fleet-specific information in their decision-making views. Situation is getting better though."

Do you think that data/information quality is adequate for decision-making, i.e. enough for utilizing those tools, methods and systems?

IOA: "There are certain issues in quality, but significant improvements have been made. We have been working with a big name from another industry, where they have a lot more elaborate sensors than we do. Measure what you want to manage as they say, we are not entirely there yet."

Do you always have full access to the data that your assets generate?

IOA: "Unfortunately, we do not. There are multiple systems and databases, which are not entirely integrated to each other. We are constantly

working on big data solutions to solve these problems. We have data coming from drilling sites that is pre-processed by our suppliers before we get our hands on it. We are now looking to re-process that data retrospectively."

III. ECOSYSTEM II: REINVENTING MAINTENANCE

In the second case example, we take a relationship-specific glance to IoT technologies. The benefits of IoT are discussed in the context of the ecosystem (i.e. the Finnish pulp and paper).

A. The critical role of calender rolls in papermaking

Production process on a paper machine (incl. finishing treatments) is typically comprised of multiple phases, such as forming, pressing, drying, slitting and reeling. Depending on the paper type, finishing can also contain coating, surface sizing and calendering. [52] Due to its series-connected nature where production phases follow each other in a sequence, papermaking is very sensitive to unexpected malfunctions. Calendering, which improves paper surface properties (e.g. smoothness and gloss), adjusts paper thickness and levels the paper caliber profile [52], is maintenance-wise an interesting process phase as calender rolls wear out relatively quickly.

As paper web is led through a series of nips of rolls in the calendering, the total quantity of potentially malfunctioning rolls is considerable. There are also various roll positions, of which some are more prone to errors than others. To detach and replace a defective roll, production has to be stopped, which causes production losses. Our focus in this example is specifically on a case machine that produces SC-paper that is an uncoated and calendered grade of paper used widely in magazines, catalogues and brochures. Calender rolls are nowadays saturated with sensors that generate lots of data, which can be used to reduce unexpected stoppages and production losses by improving the uptimes of calender rolls.

B. Sensor-based roll maintenance: the savings potential

The entire Ecosystem II is naturally larger, but we have limited the scope to two case organizations in this study. Company A is a paper producer and the owner of the case machine, whereas Company B is a maintenance service provider and the OEM of the case machine. They have set recently in motion a joint big data project that focuses on utilizing sensor data in the maintenance of calender rolls. Within the limits of the project, Company B has an unlimited access to the production data of Company A in order to develop maintenance practices. On behalf of both companies, we have estimated the savings potential. This is illustrated in **Table II**, where the baseline situation is checked against a scenario that incorporates sensor-based improvements.

The calendering phase on the case machine is comprised of three coated rolls in difficult positions, five coated rolls in normal positions, and six thermorolls. The difference between a difficult position and a normal position lies in the uptime that can be five times longer in the latter. As the basis of the calculations in the scenario, we have estimated that – by analyzing patterns in the production data – uptimes can be increased by a week in difficult positions (i.e. from three to four weeks) and by four weeks in normal positions (i.e. from

sixteen to twenty weeks). As thermorolls are highly durable, their uptimes cannot be influenced with data analysis. Malfunctioning rolls are detached, serviced and eventually recoated after a few rounds of service (approx. five rounds to coated rolls and eight rounds to thermorolls). When the uptimes are improved (diff. / norm.), the number of calender rolls that have to be serviced and coated annually diminishes.

TABLE II. ROLL MAINTENANCE: BASELINE VS. SCENARIO

	Baseline	Scenario
Cost of downtime:		
Difficult roll positions	10 500 000 €/a	5 440 000 €/a
Normal roll positions	3 210 000 €/a	1 940 000 €/a
Thermoroll positions	1 170 000 €/a	1 170 000 €/a
Annual costs	14 880 000 €/a	8 550 000 €/a
Cost of roll service:		
Serviceable rolls (average)	63.2 pc/a	48.7 pc/a
Costs per service	30 000 €/pc	30 000 €/pc
Annual costs	1 900 000 €/a	1 460 000 €/a
Cost of roll coating:		
Coatable rolls (average)	8.1 pc/a	6.3 pc/a
Costs per coating	120 000 €/pc	120 000 €/pc
Annual costs	970 000 €/a	750 000 €/a
Total costs:	17 750 000 €/a	10 760 000 €/a
Change in €	-	- 6 990 000 €/a
Change in %	-	- 39,4 %

Minute adjustments in the uptimes of calender rolls have massive overall ramifications as the total costs plummet up to 39 percent from the baseline. The majority of this figure follows from the decreased cost of downtime especially in difficult roll positions. In monetary terms, the whole savings potential (~EUR 7 million) is multiple percentages of the worth of annual production of Company A. It should be acknowledged that in reality the situation is never quite as drastic because there are complementary production units to the case machine and the paper demand fluctuates as well.

C. Towards improvements with a partnership arrangement

To be able to compare the two ecosystems, we decided to interview the Director of Operations (DOO) of Company A with an identical frame of questions than in Ecosystem I.

Would you state that you typically pursue closer and longer relationships, i.e. exchange beyond simple transactions, with key suppliers/customers?

DOO: "Well, it really depends on the extent of our mutual business. With Company B, for example, we have a partnership agreement, which means that we are fully committed to joint business development. However, these kind of agreements are quite rare and lately in a decreasing manner."

How are benefits shared between you and key suppliers/customers?

DOO: "We set objectives, but benefit sharing has not been defined."

Do you disclose data/information with your key suppliers/customers?

DOO: "Not typically, no. We have sporadic relationships where small amounts of transparency take place. In this regard, the collaboration with Company B is currently rather unique in our relationship portfolio."

What type of data (e.g. economic, technical etc.) do you usually disclose?

DOO: "I would say that Company B is getting strictly technical data at this point of the project. Of course, there are things, such as spare part prices, which have to be openly discussed due to the fact that they provide basically all-inclusive maintenance at our plant."

What is the direction of exchange and the boundaries to openness?

DOO: "Within the limits of the on-going big data project, we send large amounts of process and sensor data to Company B, where it is analyzed and refined to models. Data is disclosed unilaterally, but in return, we receive models that are utilized to improve our operations and maintenance. Boundaries are always dyadic, as we do not have three-way relationships."

What are the actual tools, methods and/or systems that are used specifically to disclose information with your key suppliers/customers?

DOO: "As far as the relationship with Company B is concerned, we had a working committee discussing about this subject in the beginning of the big data project. I am not an expert on information systems, but I have understood that it is a crude set-up. Data goes from our sensors to a server, which is the location from where we sent updated data packages daily to Company B."

What are the most important and promising IoT technologies?

DOO: "As we have currently invested in the development of data-driven roll maintenance, sensor technologies are important to us. In this respect, we cannot forget control and automation systems either. Our laboratory instruments are also connected. If we think about the full potential, we should concentrate on the analyzers that are pre-processing the data in the field."

What is the role of fleet asset management, i.e. managing multiple assets instead of an individual asset?

DOO: "I would say that each paper machine is so unique that it is difficult to make reasonable comparisons. Nowadays technology also evolves fast and investments in new machines are made every ten years or so, which means that different machine generations are a factor. I think that a fleet approach makes more sense on the roll level, although we do not employ the terminology."

Do you think that data/information quality is adequate for decision-making, i.e. enough for utilizing those tools, methods and systems?

DOO: "It remains to be seen. As the big data project started only a few months ago, we are still in the beginning stages. Whether the quality is enough or not, we do not really know yet. I think that there is, however, a decent possibility that some new indicators on roll condition are still required."

Do you always have full access to the data that your assets generate?

DOO: "We have a pretty good access to the sensor data, but the difficulty lies in the variety of data forms. We have time-based data, event-based data and so on. It is challenging to combine different forms of data in order to be able to calculate cause-and-effect relationships for instance."

IV. CONCLUSIONS AND DISCUSSION

Table III summarizes the discussion on the ecosystems. Although both cases are referred to as ecosystems, they are different relative to the ecosystem characteristics presented in the table. Ecosystem I is a well-established setting, where companies build long-term exchange relationships, disclose data/information based on benefit sharing agreements, have systematic tools, methods and systems as the means of disclosure, and utilize IoT on daily basis. In comparison, Ecosystem II is still emerging. Companies A and B are learning inter-organizational transparency and ways to take advantage of sensor technologies, which establishes a premise for a long-lasting relationship in the future. As far as the dimensions of disclosure (i.e. type, direction and boundaries) are concerned, the ecosystems are surprisingly similar as mostly technical data/information is disclosed bilaterally in a dyadic fashion. Only exception is found from Ecosystem I, where occasional three-way relationships take place as well.

TABLE III. A COMPARISON BETWEEN THE CASES

Ecosystem characteristics based on the interviews	Ecosystem I	Ecosystem II
Long-term relationships	Yes, esp. with key partners	No, the case is an exception
Benefit sharing arrangements	Risk-reward contracts	No sharing arrangements
Disclosure of data/information	Yes, but still NDA protected	Yes, roll data as a pilot case
Disclosure: the type (e.g. technical)	Technical data, also budgets	Mostly technical data at this point
Disclosure: the direction/boundaries	Bilateral/ even triadic	Bilateral/ strictly dyadic
Systematic disclosure tools etc.	A large variety, e.g. custom-made	Packages sent from a server
The utilization of IoT technologies	Yes, sensors and even robotics	Yes, currently piloting sensors
Fleet asset management perspective	No, but improving for upper mgmt.	No, but potential on the roll level
The quality of data/information	Getting better, but requires work	Pilot ongoing, still unknown
Access to asset data/information	Limited due to complexities	As it stands, good to roll data

In the beginning of this paper, we defined ecosystem as a combination of network and fleet. Based on the interviews however, fleet perspective is hardly recognized by the practitioners. We assume that this stems rather from a terminological disparity between academic and managerial outlooks than a sentiment that the collection of data is somehow irrelevant beyond the asset level. The access to data/information plays an important role in forwarding fleet-centric thinking in both ecosystems. The fixed nature of the IoT application in Ecosystem II provides a good access to required data, while the situation in Ecosystem I is more complex due to a large number of technological solutions. Good data/information quality should also ensure that a more integrated fleet asset management is a future possibility.

We should address the RQ2, i.e. “how IoT technologies support inter-organizational information disclosure and thus promote the transition to business ecosystems?” Based on the cases, IoT can outweigh the issues and barriers directly and/or indirectly depending on the category. Direct influence occurs in I/B:3 (Poor commitment and inadequate relational support) and I/B:4 (Insufficiency of data arising from methods/systems). Regarding the former, technological joint initiatives, i.e. SOIL (Ecosystem I) and the big data project (Ecosystem II), are signals of commitment. Customers in particular are often responsible for laying the foundations that promote trust in their suppliers. By establishing SOIL as an industry-wide system, oil and gas producers and other stakeholders have achieved a culture of trust that has transformed into commitment. IoT advances also relational support in Ecosystem I. OSCs, where experts work side by side, are the pinnacle of collaborative, data-driven decision-making. Feedback is another type of relational support, an example of which are the models that Company B devises based

on the production data that it receives directly from Company A.

In the case of the latter category (i.e. I/B:4), the link between the problem (i.e. insufficient data), and IoT as the solution is even more evident. Smart connected assets in conjunction with information systems are able to overcome issues and barriers related to data quality/access. Even though the poor state of (cost) accounting systems is recognized as the predominant reason for data inadequacy in the literature, it did not emerge in this particular study, likely because the information exchanges were mostly technical. Joint IoT, however, improves shared technical compatibility between organizations. The informant from Ecosystem I brought up standardization as an enabler of information disclosure. The basis of standards are contracts that also determine the guidelines for benefit sharing. Therefore, IoT may have an indirect effect on I/B:5 (Weak incentives and unresolved benefit sharing). Some of the companies in Ecosystem I also pay for performance, the measurement of which has become easier with technology. The contractual extensions can be seen as incentives for suppliers to perform better.

IoT has indirect influences in the remaining categories: I/B:1 (Asymmetrical power relations and opportunism) and I/B:2 (Inter-personal relations and individuals' traits). As individuals may act as gatekeepers of data/information, organizations are able to dodge problems by removing the human variable from the equation with technology. Reducing the impact of humans is a central development theme in Ecosystem I, where organizations seek to automatize parts of their decision-making processes. As calendar roll maintenance is a labor-intensive task, the big data project (Ecosystem II) is evidently built around similar objective. The scarcity of partnership agreements in the ecosystem is an indicator that calendar rolls as the pilot case has facilitated the inter-organizational relationship between Companies A and B. The role that IoT plays in decreasing asymmetrical power and related opportunism (i.e. I/B:1) is more ambiguous. We can only speculate that the likelihood of opportunism should be decreased when organizations are fully committed to the development of joint technologies. The more powerful counterpart, often the customer, does not have to create a conflict that might have guaranteed disclosure in the past.

The paper carries two implications to the current theoretical knowledge: (1) a systematic listing of the reasons for failed transparency (i.e. issues and barriers) and (2) a suggestion that the concept “business ecosystem” should be increasingly emphasized in the scientific discussion as “business network” is no longer congruent with the state-of-the-practice. The managerial implications are twofold as well: (1) case-based evidence shows how IoT may support inter-organizational transparency, and (2) the economic significance of IoT applications is demonstrated from two complementary perspectives, i.e. industry and relationship. As the exploratory nature of the study imposes its limitations, the findings are preliminary. Further research could focus on the prerequisites that have to be reconciled (e.g. the role of fleet) before the transition from networks to ecosystems is absolute. Further case studies would also benefit from a longitudinal design.

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Publication 4

Ylä-Kujala, A., Marttonen-Arola, S., Sinkkonen, T. & Kärrä, T.

**Implementation of inter-organisational mediums:
synthesising framework as a design exemplar**

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Implementation of inter-organisational mediums: synthesising framework as a design exemplar

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Abstract: The field of management research has an utilisation problem. A considerable avenue in which the translation from theory to practice has been only partial is the management control of inter-organisational relationships. In this particular stream of management (accounting) research, open-book accounting (OBA) is a key concept. Based on the OBA literature, our ambition is to develop an implementation framework for inter-organisational mediums (IFFIM). The first part of the framework, IFFIM_1: the relational view is concerned with the multidimensional nature of inter-organisational relationships by illustrating relational complexities through the OBA dimensions. The second part of the framework, IFFIM_2: the process view is an outlook to the stepwise implementation process, where the factors that influence OBA implementation have been integrated to the phases of the so-called enterprise system experience cycle. Unlike most contemporary research, our work is based on the idea of 'design science', the aim of which is to develop general knowledge to support the design of solutions to field problems. IFFIM is a design exemplar to practitioners, i.e., a guideline to follow in the design of interventions.

Keywords: inter-organisational relationships; inter-organisational mediums; open-book accounting; OBA; implementation framework; implementation; framework; design science; design exemplar.

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1 Introduction

The field of management research has an utilisation problem. Despite that the academia has generated a vast and impressive body of scientific knowledge over decades; the impact of research on day-to-day managerial practices is poor at best. The disconnection between theory and practice is often known as ‘the rigor-relevance gap’, where ‘rigor’ refers to the academic credibility of research and ‘relevance’ to its practical applicability (e.g., Rynes et al., 2001; Starkey and Madan, 2001; Weick, 2001; Van de Ven and Johnson, 2006; Shapiro et al., 2007; Kieser and Leiner, 2009; Starkey et al., 2009; Banks et al., 2016). According to Van de Ven and Johnson (2006), the gap can be explained with three types of arguments

- a transfer of scientific knowledge to practice is flawed
- b theory and practice are distinct forms of knowledge
- c production of practical scientific knowledge is challenging for the academia.

In explanation (a), the knowledge is – as Shapiro et al. (2007) phrase it – ‘lost in translation’, i.e., managers fail to adopt research findings because they are not directly applicable to practice. Explanation (b) implies that the gap is unbridgeable, as scientist and managers inhabit different social systems and thus the relevance of rigorous research is, well, irrelevant (see e.g., Kieser and Leiner, 2009). Those in favour of explanation (c)

question the established mode of science, where the knowledge is – as Shapiro et al. (2007) phrase it – ‘lost before translation’, i.e., the research findings are unimportant to practitioners.

In their ‘point-counterpoint debate’ with Kieser and Leiner (2009), Starkey et al. (2009) argue that practical relevance should be reimagined. Rather than being a separate entity, relevance could be interpreted as a condition of rigor, i.e., management researchers should investigate topics that are of interest to managers without abandoning the scientific approach to inquiry. In order to achieve this, management research has to become a ‘design science’ (Starkey et al., 2009). Van Aken (2004, 2005) distinguishes design science from explanatory science, the latter being congruent with the established mode of science in management research, including both quantitative and qualitative methodologies. The divider between the two approaches is the nature of the research products. Whereas explanatory sciences commonly seek to describe, explain, predict and thus understand observable phenomena, the objective of design sciences is to generate knowledge that can be used in designing solutions to actual problems. Unlike explanatory sciences that deal with pure knowledge problems, design sciences thus endeavour to improve the human condition (Van Aken and Romme, 2009). The desideratum to see management research as a design science stems from critique to explanation (b), while accepting explanation (c) as well. Assuming that scholars insist on segregating rigor from relevance, it is understandable that most findings are ‘lost before translation’ as a consequence.

According to Van Aken (2004), design science has two missions

- 1 to develop knowledge for the design of artefacts (i.e., to solve construction problems)
- 2 to develop knowledge for the design of interventions that enhance the performance of existing artefacts (i.e., to solve improvement problems).

The characteristics of ‘knowledge’ and ‘problem’ are essential. Design sciences are concerned particularly with developing ‘general knowledge’ to support the design of solutions to ‘field problems’, hence ‘specific’ – as in ‘specific knowledge’ and ‘specific field problems’ – remains as the domain of practitioners (Van Aken, 2004, 2005; Van Aken and Romme, 2009). General knowledge can be expressed in the form of ‘a technological rule’ that follows the logic of ‘if you want to achieve Y in situation Z, then perform action X’, or as a ‘design exemplar’, where the last part of the rule is framed more nebulously ‘... then perform something like action X’ [Van Aken (2005), p.23]. Each design exemplar provides a general solution for a type of a field problem, of which the practitioner creates a specific variant for a specific situation. Flexibility in comparison to technological rules makes design exemplars as appropriate research products in management research. Scholars simply cannot give managers straightforward instructions plausibly, as organisational problems are typically indeterminate by nature, and the solution is case-specific and reliant on the heuristic processes of each practitioner.

Apart from original design science research, design exemplars may arise also from the empirical findings of explanatory science (Romme, 2003; Van Aken, 2004, 2005; Van Aken and Romme, 2009). For instance, Romme (2003) states that preliminary design exemplars can be grounded in ‘science’ that also functions as a source of ill-defined areas to which the ‘design’ mode can effectively contribute. From the perspective of the rigor-relevance dilemma, design science therefore accepts also explanation (a). The argument that valuable scientific knowledge is frequently ‘lost in

translation' is the premise of this paper, applying to management research in general and management accounting research in particular. A considerable avenue where the translation from theory to practice has been only partial is the management control of inter-organisational relationships. Open-book accounting (OBA), which stands for information transparency in the inter-organisational interface is a key concept in the above-mentioned stream of research (e.g., Mouritsen et al., 2001; Kajüter and Kulmala, 2005; Agndal and Nilsson, 2010; Windolph and Möller, 2012). Regardless of recurring empirical studies, it remains unclear how OBA should be implemented. A common denominator for successful implementations in a number of studies seems to be the utilisation of 'an inter-organisational medium'. By inter-organisational mediums, we refer collectively to various (accounting) techniques (see e.g., Cooper and Slagmulder, 2004), decision-making tools (see e.g., Kajüter and Kulmala, 2005), collaborative methods (see e.g., Kumra et al., 2012), and information/accounting/management control systems (see e.g., Pernot and Roodhooft, 2014).

In the crossroads of management (accounting) research and design science, both

- 1 construction problems
- 2 improvement problems exist (see Van Aken, 2004, 2005).

In this particular paper, however, our ambition is (2) to develop knowledge for the design of interventions that enhance the performance of existing artefacts, i.e., to solve improvement problems. In the abstract, the term 'artefact' is typically employed in reference to man-made objects, tangible and intangible alike. The artefact that we seek to improve is the management control of inter-organisational relationships by developing an OBA-based framework from the existing literature that managers can use as a design exemplar when they want to implement an inter-organisational medium (i.e., a technique, tool, method or system) successfully. Therefore, our research questions can be framed as follows:

- RQ1 Which theoretical perspectives are central in the implementation of inter-organisational mediums?
- RQ2 What kind of a framework, i.e., a design exemplar to managers, can be built from the theory?

Van Aken (2004, 2005) emphasises that technological rules, and consequently also design exemplars, need to be field-tested, i.e., experimented in the intended context of application, and grounded, i.e., the generative mechanisms of the solution untangled, resulting in certain outcomes in specific variants of the intended context. As far as the field testing of design exemplars is concerned, Van Aken (2004) suggests that there should be two phases; α -testing (by the researchers themselves) and β -testing (by a third party to counteract unrecognised defenses that may blind the researchers to flaws and limitations). The grounding of design exemplars will eventually occur through several rounds of α -testing and β -testing. In addition to the framework, the findings of initial α -testing are also presented in the paper.

In order to get a practitioner's opinion on the framework, we conducted a small-scale survey among students participating in a continuing education program at our university. The program is targeted specifically to engineers and managers employed by energy and environmental technology companies in Finland. The size of these organisations varied from local small and medium-sized enterprises to significantly larger international

players. The participants of the program, and thus the respondents of the survey, were experienced professionals with an up-to-date view to inter-organisational relationships within the above-mentioned industries. Their job titles included, e.g., facility planner, development engineer, service engineer, project manager, area manager, invoicing and shipping coordinator, and spare parts purchaser. The total number of respondents was 27.

The above kind of α -testing has two particular functions. Firstly, it reveals certain underlying realities that may have an effect on the realisation of information transparency in the current organisational landscape. Secondly, it demonstrates how the framework enables collaborating companies to make more informed managerial decisions when they create a specific variant of the general design exemplar.

2 OBA: an inter-organisational phenomenon

When the focus of management control is taken from the intra-organisational domain to the inter-organisational one, disclosure of potentially sensitive information becomes emphasised. Within the management (accounting) research tradition, such transparency that exceeds organisational boundaries is known as 'OBA' (e.g., Carr and Ng, 1995; Seal et al., 1999; Mouritsen et al., 2001; Kajüter and Kulmala, 2005; Agndal and Nilsson, 2010; Windolph and Möller, 2012; Alenius et al., 2015). Some authors refer to the phenomenon also as 'open-book costing' (McIvor, 2001; Humphreys et al., 2003), 'open-book negotiation' (Lamming, 1996; Lamming et al., 2005), 'open-books policy' (Agndal and Nilsson, 2008; Kumra et al., 2012), or 'open-books' (Axelsson et al., 2002; Agndal and Nilsson, 2009).

Despite the somewhat inconsistent nature of OBA terminology, its purpose is rather unambiguous. Kulmala (2002) states that OBA is employed

- 1 to reveal cost structures to another company as a sign of commitment
- 2 to strengthen the competitive position
- 3 to learn about other companies' operations
- 4 to improve cost efficiency in a supply chain jointly.

The establishment of trust is typically recognised as a key issue in OBA (e.g., Mouritsen et al., 2001; Kajüter and Kulmala, 2005; Free, 2008). According to Kajüter and Kulmala (2005) in particular, trust should be seen both as a prerequisite and a consequence of OBA. They refer to Tomkins (2001), who argues that information disclosure can either warrant trust to an inter-organisational relationship (i.e., trust as a prerequisite), or make collaborative mastering of events possible in a later, more mature stage of the relationship (i.e., trust as a consequence).

In relation to OBA, we should also discuss 'inter-organisational cost management' (IOCM), which was first introduced by Cooper and Yoshikawa (1994), who observed boundary-spanning cost management practices in a Japanese supply chain. As concepts, IOCM and OBA are clearly aligned with each other. Coad and Cullen (2006), for instance, state that information sharing is central to the concept of IOCM, the purpose of which is, with cooperative efforts by members of separate organisations, to modify cost structures and create value for its participants. Before anything else, IOCM is an umbrella term that encompasses various (accounting) techniques, such as 'target costing' (e.g.,

Carr and Ng, 1995; Caglio and Ditillo, 2012), ‘value engineering/analysis’ (e.g., Cooper and Slagmulder, 2004; Agndal and Nilsson, 2009), ‘activity-based costing’ (e.g., Dekker and Van Goor, 2000; Suomala et al., 2010), ‘value chain analysis’ (e.g., Dekker, 2003; Coad and Cullen, 2006), and ‘OBA’. Unlike the other techniques that are mostly suitable for a type of situations and problems, OBA should be seen more as a ‘platform’ that enables IOCM. Thus, the element of inter-organisational transparency is an integral part of IOCM, although some of these techniques may be employed also without disclosing any information.

OBA is not just another management (accounting) fad, but also a distinctive stream of research that contributes arguably to the wider networking discussion, which should be of interest to the IJNVO audience. By looking through the past volumes and issues of IJNVO, we found certain commonalities between OBA and IJNVO research topics. Organisational context can be seen as the first commonality. Novel approaches, such as OBA, are prerequisites to the management of new organisational forms. In this regard, both supply chain relationships (e.g., Coleman, 2010; Hammervoll and Toften, 2010; Mazzawi and Alawamleh, 2013) and virtual organisations (e.g., Alves and Rabelo, 2013; De Mattos and Laurindo, 2015) have been observed by IJNVO scholars in the past. The second commonality relates to the transparency of information that is – as described above – central to OBA and IOCM as phenomena. Other types of knowledge and information sharing practices have been considered in a number of IJNVO publications (e.g., Lopez and Eldridge, 2010; Feng and Yue, 2011; Shamsuzzoha et al., 2012; Paiola et al., 2013). Transparency often requires trust, which is the third commonality. Yasir et al. (2014), for instance, have studied the role of trust in the development of virtual organisations. The last commonality is the need for partner selection and related criteria (Zarvic et al., 2010), which is also essential in OBA implementation.

2.1 The nature of OBA: three distinct dimensions

Windolph and Möller (2012) argue that OBA consists of three distinct dimensions

- 1 the degree and quality of disclosure
- 2 the direction of information exchange
- 3 the boundaries to openness.

Similarly to Windolph and Möller (2012), also Agndal and Nilsson (2010) have found three OBA dimensions. Their dimensions are

- a the nature of data and accounting data disclosure practices
- b the uses of disclosed accounting data
- c the conditions of OBA.

Of these dimensions, (a) seems to incorporate dimensions (1), (2) and (3). Even though the categorisation of Agndal and Nilsson (2010) is evidently more extensive, the perception of Windolph and Möller (2012) is favoured in this paper for two explicit reasons. First, application, i.e., dimension (b), does not have to be acknowledged in the framework as it stems directly from the medium in question. Moreover, the conditions, i.e., dimension (c), are redundant to other elements in the framework (see Section 2.2/3.2).

The type of information and its level of detail are covered in the first dimension, the degree and quality of disclosure. Despite the term ‘accounting’ in the name of the concept, different types of information are disclosed within the OBA practice. In addition to costs, cost structures and other types of accounting data, companies have been reported to exchange, e.g., sales forecasts (Mouritsen et al., 2001), technical knowledge and development support (Kajüter and Kulmala, 2005), levels and measures for target profitability (Suomala et al., 2010), materials and manufacturing data (Caglio and Ditillo, 2012), and feedback, including benchmarks and suggestions (Kumra et al., 2012). As far as quality is concerned, information can range from unspecific (e.g., estimates/predictions) to specific (e.g., data from internal information systems), depending on the decision-making situation and thus the application of OBA.

Disclosure takes often place in a dyadic inter-organisational relationship, i.e., between two independent companies. Within such a relationship, the second dimension, the direction of information exchange is either bilateral or unilateral (Windolph and Möller, 2012). Bilateral, two-way disclosure stands for companies’ reciprocal willingness to exchange information in a relationship, whereas unilateral, one-way disclosure denotes that only one company reveals information to the other. Most studies on OBA to date have described empirical settings where suppliers disclose information to customers in a unilateral fashion (e.g., Carr and Ng, 1995; McIvor, 2001; Kulmala, 2004; Agndal and Nilsson, 2010; Kumra et al., 2012). Despite the fact that such one-sided transparency may lead to customers’ opportunistic behaviour, as repeatedly highlighted (e.g., McIvor, 2001; Free, 2008; Suomala et al., 2010; Windolph and Möller, 2012), unilateral disclosure remains as the predominant OBA approach in customer-supplier relationships.

According to Windolph and Möller (2012), there are two ways to draw the boundaries to openness. Information can be exchanged either in a dyadic inter-organisational relationship or within a more extensive network of companies. While also other types of dyadic inter-organisational relationships naturally exist, customer-supplier dyads seem to prevail in the literature (e.g., Mouritsen et al., 2001; Dekker, 2003; Kulmala, 2004; Agndal and Nilsson, 2008, 2009, 2010; Möller et al., 2011; Kumra et al., 2012; Romano and Formentini, 2012). Only a handful of authors have reported on more extensive, network-wide disclosure practices (e.g., Cooper and Slagmulder, 2004; Kajüter and Kulmala, 2005; Coad and Cullen, 2006; Alenius et al., 2015). As ‘network-wide disclosure’ is conceptually somewhat ambiguous, it should be clarified that here it refers to situations where information is disclosed beyond a dyadic relationship.

2.2 Factors that influence OBA implementation

Arising from their findings from multiple case studies, Kajüter and Kulmala (2005) have recognised three categories of factors that may have an impact on the implementation of OBA

- 1 exogenous factors
- 2 endogenous factors
- 3 network-specific factors.

To begin with, the degree of competition and economic trend are included in the exogenous factors. As the role of such factors is ambiguous and mediating at best, we

have disregarded the exogenous factors from the framework because companies are unable to control systematically the environment in which they operate.

According to Kajüter and Kulmala (2005), the endogenous factors incorporate organisational size, cost accounting systems, competitive policy, and relational commitment. Even though Kajüter and Kulmala (2005) distinguish policy from commitment, we would argue, however, that they are both included in the concept of 'purchasing strategy' that Agndal and Nilsson (2010) have previously discussed in the context of OBA. As far as divergent purchasing strategy alternatives are concerned, Agndal and Nilsson (2010) disassociate the transactional approach from the relational one. The transactional purchasing strategy relies on arm's length procurement, whereas long-term commitment, collaboration and mutual benefits are emphasised in the relational alternative. The choice is not, by any means, binary. Axelsson et al. (2002) state that the two purchasing approaches are complementary, which means that companies apply different strategies to different relationships simultaneously. A strategic disparity is a sign of differing ambitions, which may become an issue from the implementation standpoint.

Organisational size influences OBA implementation through several mechanisms. Many characteristics, such as organisational structure, company policies and organisational culture are linked directly to the size of an organisation. Kajüter and Kulmala (2005) also mention that larger companies are often able to commit more development resources towards the adoption of new methods and systems than their smaller counterparts. Thus the problematic nature of organisational size arises from the differences in size between collaborating companies rather than 'largeness' or 'smallness' per se. Organisational size is also related to cost accounting systems, which are considerably more sophisticated in larger companies. A poor state of companies' cost accounting systems has been reported to impede or even prevent OBA (e.g., Seal et al., 1999; Kulmala et al., 2002; Kajüter and Kulmala, 2005; Agndal and Nilsson, 2009; Suomala et al., 2010). While only the role of cost accounting systems is recognised by Kajüter and Kulmala (2005), we would emphasise information systems in general. The linkage between information disclosure and various types of information systems has been studied by a number of authors (e.g., Humphreys et al., 2001; Vélez et al., 2008; Fayard et al., 2012; Pernot and Roodhooft, 2014). We think that this is an important perspective and addition, as the degree of disclosure in OBA is not limited to cost information alone.

According to Kajüter and Kulmala (2005), the network-specific factors comprise the type of network, the type of product, the network infrastructure, and the social nature of network relationships. The type of network is defined by two particular elements; structure and maturity. Kajüter and Kulmala (2005) claim that especially hierarchical, mature relationships provide opportunities for cost savings and other improvements, which is the reason why OBA functions better in these relationships in comparison to project-based, non-hierarchical networks. The type of product is closely related to the type of network. To date, OBA has been observed mainly in hierarchical manufacturing supply chains and networks, including, but not limited to, automotive industry (Möller et al., 2011), food industry (Alenius et al., 2015), electronics industry (Seal et al., 2004), kitchen fittings industry (Romano and Formentini, 2012), construction industry (Kumra et al., 2012), and fashion industry (Caglio and Ditillo, 2012).

Network infrastructure, which is an assemblage of inter-organisational mediums (i.e., techniques, tools, methods and systems), contributes significantly to the success of OBA.

In addition to the (accounting) techniques and systems (information/accounting/management control) that have been discussed above, tangible examples of network infrastructure are also decision-making tools (e.g., Ylä-Kujala et al., 2016 – inter-organisational asset management mediated by two managerial models) and collaborative methods (e.g., Kumra et al., 2012 – cross-functional meetings between customer and supplier as a part of joint development of the manufacturing process). Lastly, the social nature of network relationships deals largely with the importance of trust (Kajüter and Kulmala, 2005). Even though OBA can be occasionally coerced due to asymmetrical balance of power, trusting behaviour is likely to warrant better results in the long run, especially when transparency is extended beyond dyadic inter-organisational relationships.

3 Implementation framework for inter-organisational mediums (IFFIM)

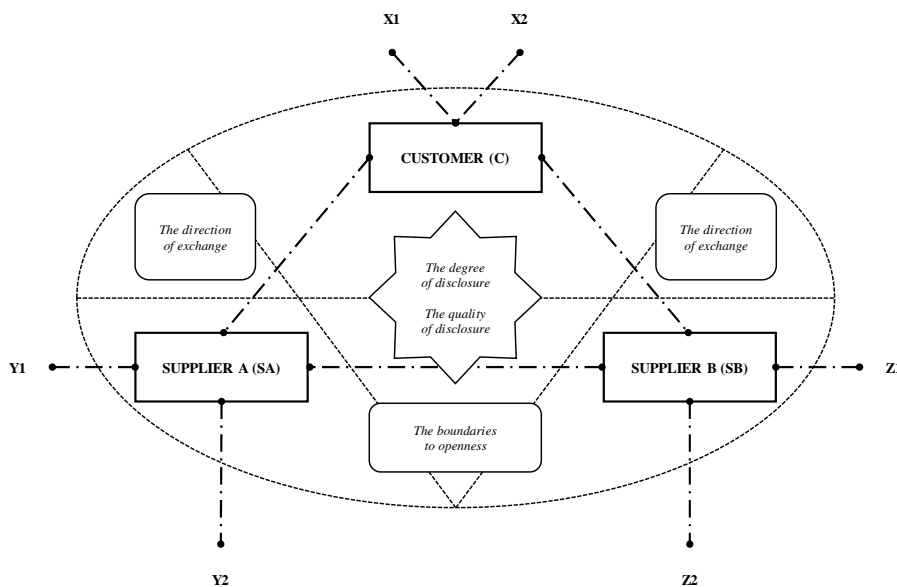
In the beginning of this paper, we stated that our main objective is to improve boundary-spanning management control by developing an OBA-based IFFIM. In the spirit of design science, that particular framework should be seen as a design exemplar, i.e., an instrument for practitioners to design situation-appropriate interventions. By building upon the theoretical perspectives discussed in the preceding section, we have created a bipartite framework called ‘IFFIM’. The first part of the framework (i.e., IFFIM_1) is concerned with the multidimensional nature of inter-organisational relationships in networked environments, which is the reason why IFFIM_1 is here also referred to as ‘the relational view’ (see Figure 1). IFFIM_1 illustrates relational complexities visually through the OBA dimensions (Windolph and Möller, 2012). The function of IFFIM_1 is to facilitate managerial decision-making in a given network in relation to the degree and quality of disclosure, the direction of information exchange, and the boundaries to openness.

The second part of the framework (i.e., IFFIM_2) is an outlook to the stepwise process of implementing an inter-organisational medium, and is therefore here referred to as ‘the process view’ (see Figure 2). The classification of implementation phases in IFFIM_2 is based on the ‘enterprise system experience cycle’ of Markus and Tanis (2000), the phases of which have been later modified by Nah et al. (2001). The enterprise system experience cycle contains four chronologically consecutive phases; the chartering phase, the project phase, the shakedown phase, and the onward and upward phase. By integrating the factors that influence OBA implementation (Kajüter and Kulmala, 2005) to the phases of enterprise system experience cycle, we have established a manner of representation where each factor is considered separately in each phase of the implementation. The function of IFFIM_2 is to increase managerial awareness in a given network in relation to the endogenous factors and the network-specific factors that may hinder, or occasionally even prevent, an implementation to be a success. As can be seen, the exogenous factors have been demarcated outside of IFFIM_2 as justified above (see Section 2.2).

3.1 IFFIM₁: the relational view

IFFIM₁ as shown in Figure 1 is a demonstration of the interplay between the OBA dimensions in the simplest imaginable form of a network, i.e., a triad that is comprised of three dyadic relationships; customer – supplier A (CSA), customer – supplier B (CSB), and supplier A – supplier B (SASB). As far as the degree and quality of disclosure is concerned, it has been placed to the core of IFFIM₁ because the other dimensions are more or less insignificant without it. While the significance of the direction and boundaries would be weakened by incongruous (i.e., wrong degree) or inadequate information (i.e., flawed quality), the absence of disclosure would make them completely irrelevant.

Figure 1 IFFIM₁: the relational view

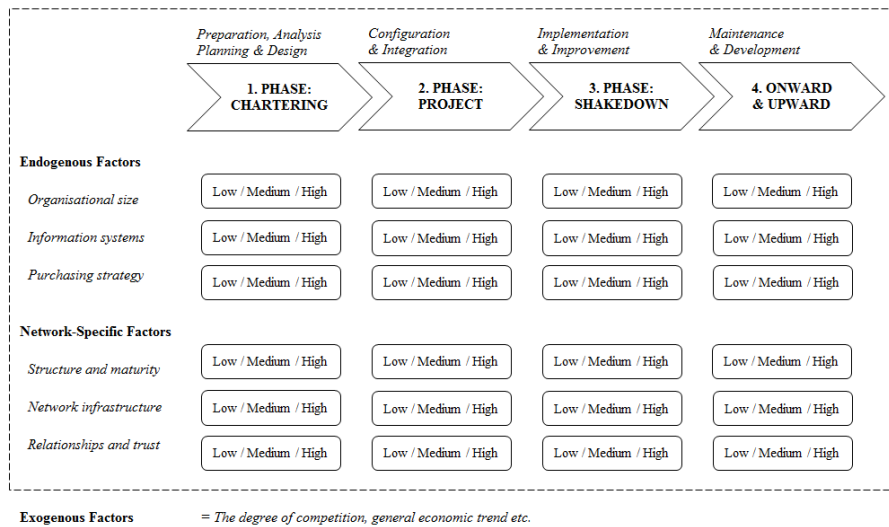


The stronger dashed lines that interconnect companies are a representation of the direction of information exchange. The nature of exchange (unilateral vs. bilateral disclosure) delineates how these lines are presented visually. If we take the relationship CSA as an example, it can play out basically in one of the following ways; unilateral disclosure from SA to C, unilateral disclosure from C to SA, or alternatively the companies engage in bilateral disclosure. As each dyad in the network can be analysed separately, the directions of information exchange may vary from one relationship to another. Moreover, the lighter dashed lines that both surround and segregate the companies illustrate the boundaries to openness. In the exemplary network triad, there are effectively four boundaries. The left-hand diagonal, for instance, segregates SA from the relationship CSB. The circular borderline, on the other hand, sets restrictions to disclosure in relation to external actors (e.g., end customers and second-tier suppliers). Several boundaries can be placed simultaneously, but each is another constraint to transparency.

3.2 IFFIM_2: the process view

As can be seen in Figure 2, the endogenous factors and the network-specific factors in IFFIM_2 consist of three factors each. Organisational size, information systems and purchasing strategy are included in the endogenous factors, whereas structure and maturity, network infrastructure, and relationships and trust are subsumed into the network-specific factors. The impact of each factor to the stepwise implementation process is assessed in our example on a tripartite scale (ranging from low to high) that each manager can assimilate to suit the specific needs of his/hers practical situation.

Figure 2 IFFIM_2: the process view



It should also be underlined that the right configuration of implementation phases depends heavily on the medium. By conjoining techniques to tools and methods to systems, we have created a category, the entities of which are similar relative to their inter-organisational nature, but not commensurably relative to the extent of their application. A simple decision-making tool, for instance, does not necessarily require a full-scale implementation process to be operable in the inter-organisational interface, but an information system probably does. As far as the exogenous factors are concerned, their potential influence on the process should always be taken into account, although external circumstances cannot be revised, e.g., in times of recession, the implementation of a new medium might prove to be challenging.

4 The framework: as seen by practitioners

The engineers and managers who participated in our survey completed a form that comprised three types of questions; open-ended questions, multiple choice questions, and rating scale questions. The inquiry on the degree and quality of disclosure was based on two open-ended questions, in which the respondents defined the types of information that

they/their company would be willing to disclose and what quality-related challenges such transparency might pose. Multiple choice questions were utilised in addressing the direction of information exchange and the boundaries to openness. In our approach, we laid down a set of conceivable options for how information disclosure might occur in each relationship (i.e., in CSA, CSB and SASB) from which the respondents disassociated the feasible alternatives from the unthinkable. Lastly, the potency of each factor in the endogenous factors and the network-specific factors on the stepwise implementation process was evaluated by the respondents with a rating scale (low/medium/high), and completed phase by phase.

4.1 *The OBA dimensions: what kind of preconditions are imposed to transparency?*

The practitioners' opinions on the degree and quality of disclosure are shown in Table 1. Due to the nature of open-ended questions, there was lots of variation in the responses. After the contents of each survey form were analysed in detail, we were able to categorise the types of information that companies are willing and unwilling to disclose. Our content analysis also revealed certain challenges that stem from the quality of information in general and information systems in particular.

Table 1 As seen by practitioners: the degree and quality of disclosure

<i>Degree</i>	<i>R</i>	<i>N</i>	<i>R%</i>
Willing to disclose...			
1 General (product) specifications and technical documentation	10	27	37%
2 Best practices, assessments, and short-term plans and estimates	10	27	37%
3 Publicly accessible information (e.g., annual reports, references, etc.)	7	27	26%
4 Track records on suppliers/sub-contractors/in-service equipment	6	27	22%
5 Economic information (e.g., annual budgets, limited cost data, etc.)	4	27	15%
Unwilling to disclose...			
1 Information about pricing (e.g., cost structures, profit margins, etc.)	19	27	70%
2 Trade secrets (e.g., R&D innovations, proprietary technologies, etc.)	12	27	44%
3 Detailed product, service, equipment and/or process specifications	8	27	30%
4 Long-term strategies and scenarios (e.g., outsourcing decisions, etc.)	4	27	15%
5 Other types of sensitive information (e.g., contractual terms, HR, etc.)	4	27	15%
<i>Quality</i>	<i>R</i>	<i>N</i>	<i>R%</i>
Challenges in quality and information systems...			
1 Information systems are inadequate (e.g., poor quality, availability, etc.)	10	27	37%
2 Definition disparities and other inter-organisational challenges	10	27	37%
3 The question of information timeliness and obsolescence	8	27	30%
4 Differences in information systems and software (i.e., compatibility)	5	27	19%
5 Incompetent users and/or limited access to required information	4	27	15%

Note: R = The number of responses per category.

Regarding the degree of disclosure, the respondents seemed to be rather conservative. The pricing of products/services including cost structures and profit margins was seen as the most sensitive piece of information. Only four respondents out of 27 were of the opinion that economic information could be occasionally disclosed. Strangely, the willingness to disclose publicly accessible and mostly obligatory information, such as annual reports, was mentioned in several responses. From the perspective of information quality, the poor state of information systems was highlighted together with inter-organisational disparities. The question of timeliness and obsolescence was perceived important as well.

The perspectives on the direction of information exchange and the boundaries to openness are shown in Table 2. In the case of CSA/CSB, the majority of respondents found all directions feasible, but bilateral disclosure in particular had a nearly unanimous support. As far as SASB was concerned, most respondents were of the opinion that unilateral disclosure is unthinkable. The support for bilateral disclosure was also decreased in comparison to CSA/CSB. The explanation for the difference of opinion between the two situations arises probably from a perceived asymmetry in bargaining power. As the inquiry did not rule in the type of information, unilateral disclosure from C to SA/SB may therefore also contain non-sensitive information that C feeds to its suppliers in order to control them.

Table 2 As seen by practitioners: the direction of exchange and boundaries to openness

<i>DIRECTION</i>	<i>F</i>	<i>U</i>	<i>N</i>	<i>F%</i>	<i>BOUNDARIES</i>	<i>F</i>	<i>U</i>	<i>N</i>	<i>F%</i>
Customer \leftrightarrow supplier A/B	18	9	27	67%	Customer – supplier A/B	18	9	27	67%
Bilateral disclosure \leftrightarrow	26	1	27	96%	Supplier A – supplier B	9	18	27	33%
Supplier A \leftrightarrow supplier B	7	20	27	26%	Network/supply chain	21	6	27	78%
Bilateral disclosure \leftrightarrow	18	9	27	67%	Vacillating boundaries	4	23	27	15%

Note: F = Feasible, U = Unthinkable, N = Sample size, F% = Feasibility percentage.

As can be noticed, two boundary configurations were found particularly feasible by the practitioners. The majority of the respondents favoured network-wide disclosure, which would require that information disclosure takes place in all relationships (i.e., CSA, CSB and SASB). Many would draw a boundary between the suppliers, which is also consistent with the above-mentioned power asymmetry explanation. By eliminating the exchange of information between SA and SB, C is able to dictate the degree and quality of disclosure in the entire network. It has to be pointed out that the reality and ideals were mixed in the findings to some extent. On one hand, there was support for network-wide and bilateral disclosure, but on the other hand, the respondents were entangled to a world view, where transparency is constrained by bargaining power asymmetries. Bilateral disclosure between SA and SB is only feasible when C is included in the arrangement, i.e., a set boundary to openness subsumes the entire network.

4.2 Stepwise OBA implementation: how is the significance of each factor experienced?

The practitioners' outlook on the importance of the endogenous factors and the network-specific factors in relation to the stepwise implementation process are shown in Table 3. According to the respondents, information systems that stand out especially from the

project and shakedown phases is the most significant endogenous factor. In the project phase, collaborating companies concentrate on integrating the medium into the existing systems, and eventually in the shakedown phase, it will become a functioning piece in the companies' systemic puzzle. Dissimilarities in the information systems thus weaken this process as, e.g., availability and quality of information differ from one company to another.

Table 3 As seen by practitioners: factors that influence OBA implementation

	1	2	3	N	AVG.		1	2	3	N	AVG.	
1	<i>Phase: chartering</i>					2	<i>Phase: project</i>					
	Endogenous factors						Endogenous factors					
	Organisational size	7	9	11	27	2.15	Organisational size	8	9	10	27	2.07
	Information systems	5	13	9	27	2.15	Information systems	2	15	10	27	2.30
	Purchasing strategy	4	11	12	27	2.30	Purchasing strategy	6	12	9	27	2.11
	Network-specific factors						Network-specific factors					
	Structure and maturity	6	12	9	27	2.11	Structure and maturity	5	12	10	27	2.19
	Network infrastructure	5	13	9	27	2.15	Network infrastructure	1	15	11	27	2.37
	Relationships and trust	2	5	20	27	2.67	Relationships and trust	1	4	22	27	2.78
		1	2	3	N	AVG.		1	2	3	N	AVG.
3	<i>Phase: shakedown</i>					4	<i>Onward and upward</i>					
	Endogenous factors						Endogenous factors					
	Organisational size	7	11	9	27	2.07	Organisational size	7	13	7	27	2.00
	Information systems	1	12	14	27	2.48	Information systems	4	15	8	27	2.15
	Purchasing strategy	8	14	5	27	1.89	Purchasing strategy	5	15	7	27	2.07
	Network-specific factors						Network-specific factors					
	Structure and maturity	4	13	10	27	2.22	Structure and maturity	9	8	10	27	2.04
	Network infrastructure	3	7	17	27	2.52	Network infrastructure	5	11	11	27	2.22
	Relationships and trust	2	5	20	27	2.67	Relationships and trust	2	4	21	27	2.70

Note: 1 = Low influence, 2 = Medium influence, 3 = High influence, N = Sample size, AVG. = Average influence.

As far as organisational size is concerned, the effect of size differences seems to decrease gradually through the implementation process. Granted that, e.g., colliding organisational cultures or a resource imbalance may play a certain role in the beginning; the respondents were of the opinion that organisational size is the least significant endogenous factor. In fact, only purchasing strategy was perceived more important than information systems at

any stage of the process. It is, however, logical that companies' aims and expectations should be aligned at the outset. A large disconnection in the purchasing approaches would likely undermine the entire process from the chartering phase onwards.

The single most influential factor in the study, both endogenous and network-specific factors included, is relationships and trust. It has been frequently argued in the literature that trust is both a prerequisite and a consequence of continued relational engagement. The respondents seemed to agree with this particular perspective. The importance of structure and maturity, on the other hand, increases towards the onward and upward, which is not surprising, as an established hierarchy coupled with mature interaction reasserts collaboration. Still, the respondents were of the opinion that structure and maturity is the least significant network-specific factor. Similarly to information systems, network infrastructure is highlighted in the project and shakedown phases, but achieves consistently somewhat higher averages in comparison. It appears that a prior network infrastructure between the collaborating companies is regarded even more important than a decent state of information systems. The process of implementing new additions to the infrastructure is therefore facilitated by the current assemblage of mediums.

5 Discussion and conclusions

In the beginning of the paper, we argued at length that there is an utilisation problem in management research, which is often referred to as the rigor-relevance gap. As a potential way to bridge the gap between scientific rigor and practical relevance, we suggested that more studies in the field should be based on an alternative mode of research known as 'design science'. Design science is concerned with developing general knowledge to support the design of solutions, i.e., the design of artefacts and interventions, to field problems. Depending on the nature of the problem, general knowledge can be expressed either in the form of a 'technological rule' or a 'design exemplar'. While technological rules are applied to the letter like 'recipes' to achieve certain outcomes, design exemplars are more like guidelines that practitioners can follow in the design of a solution variant for a specific situation.

In order to increase the relevance of management research in general and management accounting research in particular, we developed an IFFIM that can be employed as a design exemplar in the design of boundary-spanning managerial interventions. Theoretically, the framework is founded on the concept of OBA, the success of which can be dependent on the deployment of inter-organisational mediums (i.e., techniques, tools, methods and systems). According to Van Aken (2004, 2005), an integral part of the design science process are field testing (α -testing + β -testing) and grounding of design exemplars. The empirical findings discussed in this paper represent one phase of α -testing that has two functions.

The first function of α -testing was to reveal certain underlying realities that may have an effect on the realisation of transparency in the current organisational landscape. Based on the survey, there are multiple pitfalls. As far as the degree and quality of disclosure are concerned, both the respondents' conservativeness towards disclosing costs and other economic information, as well as the poor state of information systems are potential issues. The disparity between ideals and the reality is important to recognise as well. If collaborating companies agree that the direction of information exchange is bilateral in

all relationships and the boundaries to openness subsume all companies involved in the above-mentioned relationships, then these preconditions should also be carried through. The lack of consensus among the respondents showed that inter-organisational discourse is critical to success.

The second function of α -testing was to demonstrate how practitioners are able to make more informed managerial decisions with the framework, i.e., to provide a 'proof-of-concept'. Let us imagine that the respondents of the survey are representatives of C, SA and SB. These companies are currently in the middle of collaborative negotiations, the purpose of which is to increase integration between them through the implementation of an inter-organisational information system. After the responses to IFFIM_1 are revealed to the managers of these companies, they agree that information disclosure should always be bilateral in the network, but also limited to the following relationships; CSA, CSB and SASB. A key requirement in the new system is the transparency of cost structures, which has been causing uneasiness in suppliers' representatives, who feel that their cost information is poor in comparison to C. Once the issue has been identified with the framework, the situation can be resolved collaboratively. The management is also keen to analyse the responses to IFFIM_2. The importance of relationships and trust among the respondents motivated them to establish a new tradition that is comprised of weekly network meetings and monthly team-building events. A closer look is also taken on the compatibility of information systems when the implementation proceeds to the project and shakedown phases.

The α -testing discussed above is still very much preliminary. As suggested by Denyer et al. (2008), further testing of the framework could follow the so-called CIMO-logic (i.e., context, intervention, mechanisms and outcome). Two design-wise comparable interventions will likely result in slightly different outcomes depending on the specific context of application and the mechanisms that the intervention triggers in that specific context. Thus IFFIM has to be tested more extensively (α -testing + β -testing) before we can convincingly state that

“If you want to increase information transparency in a company network by implementing an inter-organisational medium (context), use IFFIM (intervention) to raise awareness of pitfalls, identify what influences the stepwise implementation process and develop a sense of solidarity (mechanisms), the result of which is a successful implementation (outcome).”

Managerial implications aside, our IFFIM contributes also to the theoretical discussion. In this paper, we have determined a new taxonomy, 'inter-organisational medium' that stands for (accounting) techniques, decision-making tools, collaborative methods and information/accounting/management control systems in the inter-organisational interface. By synthesising some of the existing literature on OBA, we have also formed an understanding on what kind of dimensions (relational) and factors (processual) are important to the implementation of such mediums. Overall, we think that the design science approach should receive more attention in the field of management (accounting) research.

In addition to further testing and grounding of the design exemplar, the influence of external factors on the implementation of mediums should also be mapped. Even though companies are unable to change the environmental conditions directly, it would still be beneficial to know when and how external factors, such as fierce competition between suppliers, or macroeconomic conditions like recession, may compromise all the attempts

to increasing inter-organisational transparency. Knowledge about these factors would most likely support organisations in making decisions that are more informed. To summarise and conclude, the next research steps could include:

- 1 conducting further α -testing of the framework so that the IFFIM could be finalised
- 2 proceeding to β -testing and thus grounding the design exemplar by conducting multiple case studies and following, e.g., the CIMO-logic
- 3 examining the influence of external factors to organisations' willingness to implement mediums that require OBA.

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